DOES AGRICULTURAL EMPLOYMENT BENEFIT FROM EU SUPPORT?

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(preliminary draft, please do not quote without permission)

Abstract:

Studies dealing with the impact of public support on employment have given varying results, depending on the estimation process, sample and type of subsidy. In this paper, we investigate the impact of support from the Common Agricultural Policy and Objective 5 funds on agricultural employment levels and changes across 109 European regions. We use a spatial econometric approach to consider the fact that employment dynamics in one region also depend on the dynamics of its neighbors. Our conclusions indicate that subsidies on crop output negatively impact agricultural employment levels and changes. Subsidies on animal production have no impact and objective 5 structural funds only support the average share of agriculture on regional employment. Measures that support the level of productivity and benefit several regions at the same time (because spatial dependence is highly significant) appear much better employment-enhancing factors. This raises interesting issues for the new member countries where this sector still uses a great share of the labor force.

Keywords: Agriculture, employment, EU support, spatial econometrics

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Section 1- Introduction

The share of agricultural employment in total employment is decreasing in almost all regions in Europe. At the same time, in some of these regions, there are no other activities which can fill this employment gap. This especially holds for lagging regions with a homogenous economic structure. In these regions, problems related to unemployment, poverty and a lagging economy because of negative demographic developments could increase. But also in more prosperous countries, a decrease in agricultural employment can lead to local problems and the need to find new economic carriers in rural areas.

EU policies, concerning rural areas and the agricultural sector changed considerably over the last 30 years. After the Second World War, it was thought important to increase the output of the agricultural sector to ensure the availability of enough food to avoid the shortages experienced in many countries. Emphasis was put on the modernization of the agricultural sector and the restructuring of rural areas. Although, officially, the Common Agricultural Policy (CAP) in its early stage also took into account the structural improvement of rural areas, in real terms all subsidies were linked to output or production levels in the same way all over Europe. According to Pezzini (2000), it would be better if agricultural policy takes into account the diversity of regions. If, for example, productivity gains in agriculture tend to reduce the sector's capacity to create jobs, viable rural communities should be assured by comprehensive area-targeted programs instead of by traditional agricultural production-linked payments. On the contrary, in regions where, for example, aging populations and geographic conditions restrict the speed of conversion to non-agricultural jobs, block grants for area-targeted programs will result in monetary support to farmers if there are no clear alternatives. In addition, area related programs in remote, declining rural regions distort trade to a minimal extent because these regions participate only marginally in the global economy. However, this is different in the case of agricultural policies linked to production which raise output in more productive rural regions and which tend to support the most efficient farmers. As argued by Thomson and Roberts (2004), the CAP was not developed with territorial cohesion (especially concerning employment issues) in mind, nor was it one of the aims over the years. They even conclude from their analysis that besides the uneven

effects of the CAP across the EU-15, it also runs counter to cohesion objectives: larger farms in better accessible areas receive most support. In general, these farms are located in north-western Europe. This resulted in the closure of many small farms, often located in the southern part of Europe, and thus to a decrease in (agricultural) employment in these areas.

In addition to CAP funding, rural areas have been benefiting from objective 5 funds (5a and 5b). Objective 5 a was devoted to support modernization and restructuring in the fishery sector, while objective 5b was targeted to developing rural areas at risk (high unemployment, low income, low population density). They represented a bit less than 5% of the structural funds budget.

In this paper we try to answer the question as to whether agricultural employment benefits form EU support. Although, the CAP and objective 5 funds are not directly targeted at supporting employment in the agricultural sector, it would be at least a positive side-effect of the great amounts of subsidies involved. Nevertheless, we expect a negative effect of the CAP on agricultural employment due to an uneven distribution of the subsidies.

Employment in Agriculture

A basic characteristic of economic development seems to be the long-term shift of (economic) activities from agriculture to industry and services. In agrarian societies, with few trading opportunities (often in the less developed regions), most resources are used for the production of food. In more developing regions, the industrial sector can grow, using agricultural inputs. This often leads to a fall of the agricultural share in Gross Domestic Product (GDP), but to its growth in absolute terms (Bresciani *et al*., 2004).ref

From an economic point of view, the agricultural sector has lost its important position in most developed countries. The contribution of the agricultural sector to GDP varies between 7.0 per cent in 2001 in Greece and 0.9 per cent in the United Kingdom (United Nations, 2003). Nevertheless, income from agricultural activity is growing, but at a rate below that of the other sectors. Between 1983 and 1996, agricultural GVA per

agricultural job increased at an average annual rate of 4%, as a combined result of a sharp increase in GVA and a reduction in the number of agricultural jobs.

In addition, a wide variance appears in the percentage of agricultural employment, as shown in table 1. In Greece, Ireland and Portugal, more than 10% of total employment in 1995 belonged to the agricultural sector. However, only in Portugal this percentage increased in 2001.

When looking at some non-EU15 countries, the percentages are significantly higher, with even 68% in Albania in 1995. But also in these countries, except in Albania, the share of employment in agriculture decreased. At the same time, in almost all countries, also the share of employment in the industrial sectors declined and the share in services increased.

Table 1: Change of percentages in employment in agriculture, industry and services between 1995 and 2001 in several countries (United Nations, 2003).

	Percentage of total employment in:					
	agriculture		industry		services	
	1995	2001	1995	2001	1995	2001
European Union:						
Austria	7	6	32	30	61	64
Belgium	3	2	28	26	69	72
Denmark	4	3	27	25	68	71
Finland	8	6	27	27	64	67
France	5	4	27	25	69	71
Germany	3	3	36	32	61	65
Greece	20	16	23	23	56	61
Ireland	12	7	28	29	60	64
Italy	7	5	34	32	60	63
Luxembourg	4	2	25	21	70	77
Netherlands	4	3	23	21	74	76
Portugal	12	13	32	35	56	53
Spain	9	6	30	31	61	62
Sweden	3	2	26	24	71	74
United Kingdom	2	1	27	25	70	74
Other Europe:						
Albania	68	72	10	6	21	21
Bulgaria	12	10	36	33	51	58
Croatia	…	16	…	30	…	54
Czech Republic	7	5	42	40	52	55
Poland	23	19	32	31	45	50
North America:						
Canada	4	3	22	23	74	74
United States	3	2	23	22	74	76

Of course, we have to keep in mind that the characteristics of the agricultural sector differs very much between these countries. In the Netherlands and Denmark, the agricultural sector is almost similar to an industrial sector with the environmental factors nearly totally adapted to production; whereas in Poland and Portugal, still a significant group of peasants exists. Nevertheless, it is a well-known fact that, overall, the level of agricultural employment is decreasing in Europe. But, even though farmers are a minority group in the countryside, they are still the main managers of the land, and agricultural work largely determines the degree of attractiveness of these regions, particularly where the landscape is concerned (Barthelemy and Vidal, 1999).

The Common Agricultural Policy (CAP)

Especially after the Second World War, when many countries in Europe were short of provisions, it seemed very important to modernize the agricultural sector and to produce as many products as possible. At first, European integration did not intend to consider a European agricultural market because of great national policy differences. But because in many countries (especially France and the Netherlands) the sector was important for the national economy and the industry sector would be integrated as well, agriculture needed to be integrated too. Therefore they developed a Common Agricultural Policy, the CAP. It started in 1957 with the treaty of Rome and the objectives were to increase productivity, improve the living standard of farmers, stabilise the market and assure the availability of enough food. Some years later (1962) the CAP became operational. Its principles were:

- One market: free trade in agricultural products;
- Community preference: a preference for products from the EU (by discouraging imports);
- Financial solidarity regarding the CAP, all members have to pay.

Therefore, the CAP protected the producers in two ways. Firstly, it guaranteed fixed prices, establishing a price threshold (intervention prices) below which the EU becomes the buyer, takes the product out of the market and stores it. Thus, prices were kept high

and stable. Secondly, the CAP imposed levies on cheaper imports and granted export "refunds" to allow surpluses to be traded competitively on the world market.

As a result, almost 50% of the EU budget was devoted to the CAP: €40 billions in 2001, i.e. €280 per ha of agricultural land. However, this varied per country as it was linked to productivity (e.g. €700 per ha in the Netherlands, €175 per ha in Spain/Portugal). But, after some years (in the mid-1980s), the policy of self-sufficiency resulted in excessive surpluses in the form of beef and butter mountains and milk and wine lakes. And there were more complaints. First of all, because the support was related to production quantities, especially the large farms were funded. Next to that, the CAP favoured the output of products which were mostly produced in Central and Northern Europe (cereals and beef). The top 20% of producers received 80% of CAP funds and many farms in the Southern countries were even too small to be qualified for payments at all. Often these small farms had to close, leading to a decrease in agricultural employment. Secondly, when production increased too much, budgetary problems arose; the EU received less income from imports levies and had to pay more for the intervention and storage (€3 billion a year). Furthermore, the consumer had to pay a far too high price for its food. This affected especially the poorer consumers as food purchases take a larger share of their (small) budgets. Furthermore, it leaded to higher labour costs and thus to a decrease in jobs. Finally, the CAP also had a negative effect on the world market. Because of the big surpluses (from intervention) the EU 'dumped' products on the world market below cost price. This depressed the world price of food. All this had to result in changing agricultural regimes: from a main focus on production of food and fibre, to a focus on a multitude of functions with an emphasis on food quality and environmental conservation.

In 1992, the MacSharry Plan started a shift from support and control of prices to direct payments to farmers. Important points were the reduction in prices for cereals and beef, compensatory payments to farmers if they set land aside and a compensation for early retirement. Seven years later, in 1999, Agenda 2000 was published. New focus points were set: Agriculture should be competitive and gradually able to face world competition; in order to have stable farm incomes a diversification of income sources is needed; and production should be environmentally friendly. Still, the CAP payments were, to a small extent, linked to production. Finally, in 2003, the Midterm review broke

the link between intervention and production. Farm subsidies are now linked to rural and environmental conservation and are often directly paid to landowners, which eventually could lead to an increase in agriculture related jobs.

From all this, it becomes clear that employment in the agricultural sector is not an issue in the CAP. But as the main focus shifted from production-supports to income-supports one could expect an increase in employment, especially because now a larger share of the subsidies should reach smaller farms in southern Europe instead of large modern farms.

This paper is organized as follows: in section 2 we start by describing the potential linkages between the various explanatory variables we use and agricultural employment. We also perform an exploratory analysis of the level and evolution of agricultural employment. This last one is defined in two different ways. First we consider agriculture as a share of regional employment and second the share of each region in European agricultural employment. These notions are quite different. The first one is influenced by the dynamics of employment in other sectors of the same region, as will be shown by the index of inequality in the productive structure that we develop. The second definition reflects the weight of each region in total EU agriculture. This last one allows us to control for sector specific effects, and thus measure how region-specific effects can affect agricultural employment. Section 3 describes the spatial econometric tools that we use to perform our estimation and presents the results. The underlying idea is that the dynamics of regional employment are determined, to some extent, by the ones of their neighbors. While this technique has been applied recently to different aspects of economic development, only Franzese and Hays (2005) used it on regional employment dynamics. Finally, section 5 provides some concluding remarks.

Section 2- Data and exploratory analysis

Our study covers the 1989-2003 period. This is the period over which regional development expenditures and support to the agricultural sectors have been developed, mostly under the reforms of the Delors I and Delors II packages. Details on the origin of the variables we use are as follows:

For the dependent variable, we use changes in the share of agriculture in total employment over 1989-2003. These data come from the regional database of Cambridge Econometrics. The conditioning variables are listed below:

- Average objective 5 funds support (over 1989-1999) per worker in the agricultural sector in 1995 prices. This objective has been integrated in objective 2 funds after the reform that marked the beginning of the Agenda 2000 programming period. While keeping its initial goal of restructuring the agricultural sector, objective 5a was also devoted to support modernization and restructuring in the fishery sector after 1993. Objective 5b was targeted to developing rural areas at risk. Those were defined according to the following criteria: a) high share of employment in the agricultural sector, b) low level of agricultural income and c) low population density or tendency to depopulation. Around 33 millions people directly benefited from this objective. It represented 4.9% of structural funds. These data come from the publications of the Commission. The data over 1989-1993 are from "*Community structural interventions*", *Statistical report n°3 and 4*, (July and Dec. 1992) and for 1994-1999, from *The 11th annual report on the structural funds*. These data are the average of total payments over 1994-1999 plus the commitments taken during this period, but that have not been paid yet. The lack of more recent data leads us to assume that structural funds commitments and expenditures are strongly correlated. We are aware that this may create some problems, as considerable lags between the commitments and actual expenditure often take place. In addition, we have data on Community project total cost. This last variable includes investment efforts taking the form of additional funds by the region itself. This variable is assumed to have a positive impact on employment in agricultural areas.

- As it is very difficult to find figures about the total support costs of the various components of the CAP (see also Thomson and Roberts, 2004), we use the average subsidies in crops and animals (over 1993-2001) divided by the number of workers in the agricultural sector. Those data come from the Eurostat-Regio database. For some regions, Eurostat does not provide information, therefore we multiplied the national amounts of subsidies by share in area of cereals or number of animals (cattle) in the concerning region. These two previous variables are assumed to affect agricultural employment in a negative way.

- The average of weekly hours worked per employee in agriculture as opposed to all the sectors (over 1989-2003). These data come from Cambridge Econometrics.
- The average remuneration per employee in the agricultural sector as opposed to all the sectors (over 1989-2003). These data also come from Cambridge Econometrics. For these two last variables, it is expected that a lower number of hours worked in other sector and/or a higher remuneration in other sectors may convince farmers to move to other sectors.
- The average productivity per worker in the agricultural sector over the same period. These data are also from Cambridge Econometrics. Productivity is assumed to have a negative impact on employment.
- The average share of holders who are more than 65 years old (over 1990-2000). These data are from Regio database. This variable is assumed to act negatively on employment because youngsters tend to be more attracted by urban life than their parents were at their age.
- The average area of each region devoted to agriculture (over 1989-2003). The impact of these data which come from Regio database is not very clear. Indeed, with the progresses in mechanization and technologies, each single farmer is able to take care of much more land than what is used to be before. On the other hand, EU regulations oblige farmers to freeze part of their land for some time.
- Mean elevation above sea level (in meters) and mean annual sunshine radiation (in KWh/m²). These data come from USGS (1999) and Palz and Greif (1995) respectively.
- Accessibility by road. These data come from Fuerst *et al*. (2000). Accessibility is a necessary component for agricultural production to reach its final consumers. Its impact on agricultural employment is not clear.

Our sample is made of 109 regions that cover the former EU12 countries. These regions are either at the NUTS 1 or NUTS 2 level: Belgium (3 regions), Denmark (1 region), Germany (10 regions, Berlin and the nine former East German regions are excluded due to historical reasons), Greece (13 regions), Spain (16 regions, as we exclude the remote islands: Las Palmas, Santa Cruz de Tenerife Canary Islands and Ceuta y Mellila), France

(22 regions), Ireland (2 regions), Italy (20 regions), Netherlands (4 regions), Portugal (5 regions, the Azores and Madeira are excluded because of their geographical distance), Luxembourg (1 region), United Kingdom (12 regions). Choosing NUTS 1 regions for some countries (the northern ones: UK, the Netherlands, Belgium and Germany) and NUTS 2 regions for others allows to reduce the variance across regional areas. This is an important point when dealing with the agricultural sector where the level of output and employment often depends on the size of the area devoted to it, much more than any other economic sector. In addition, NUTS 2 regions are not used as governmental units in the UK, they are merely statistical inventions of the EU Commission and the UK government. Finally, data on remuneration per worker were only available at the NUTS 1 level in Germany.

Figure 1 below represents the share of agriculture in regional employment in 1989. While it is not surprising to see that share being greater in the southern regions, some German regions and Denmark display a relatively high share also.

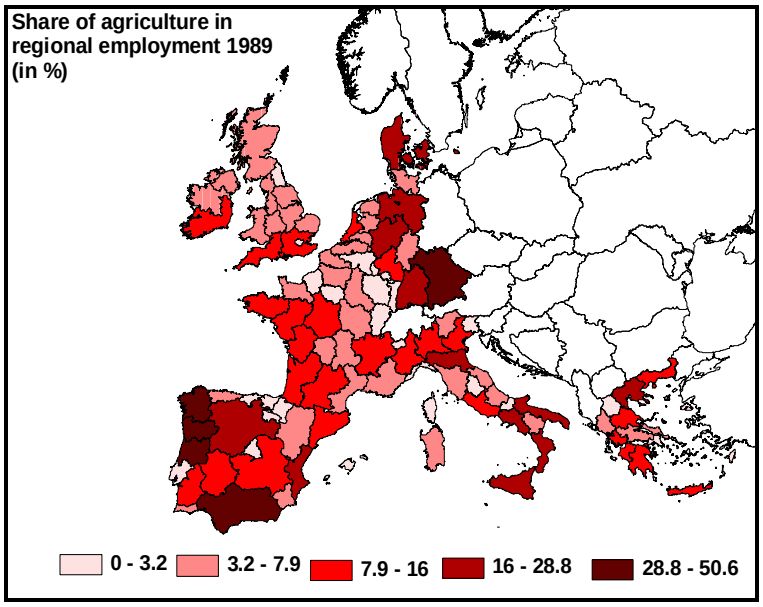


Figure 1: Share of agriculture in regional employment in 1989

Figure 2 indicates how the share of agriculture in regional employment has decreased over the 1989-2003 period in all the regions except Zuid in the Netherlands. The regions the most affected by a decrease are Brussels, three Spanish regions (Communidad Valenciana, Pais Vasco, Algarve) and Lisbon in Portugal.

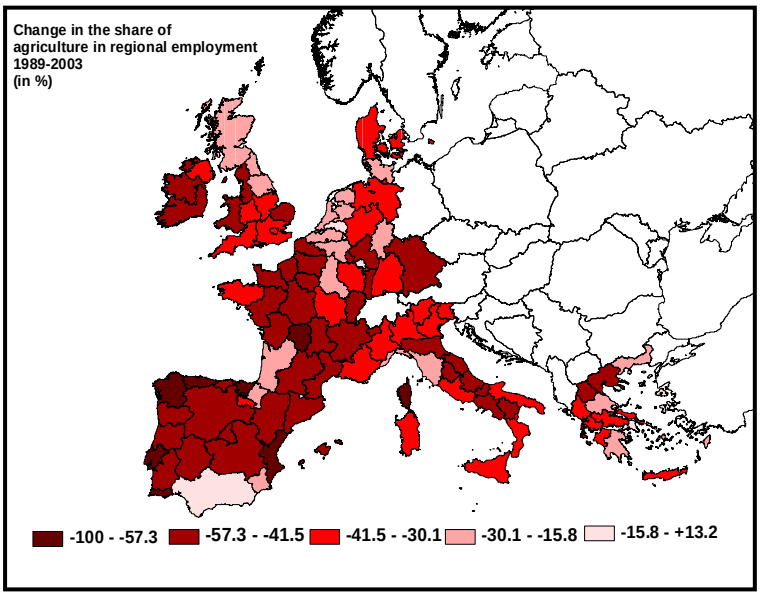


Figure 2: Change in the share of agriculture in regional employment 1989-2003

According to Bont, and van Berkum (2004) the number of workers in the EU-15 agricultural sector decreased on average with 2% a year in the 1990-2002 period. The smallest decrease took place in the Netherlands (only -0.5%), the largest ones in Ireland and Portugal (around 5%) A possible explanation for this development could be the intensification of activities. In the Netherlands, where compared to other countries a larger number of workers are found per farm, the production process already is very intensive. Obviously, this does not hold for most farms in Ireland or Portugal.

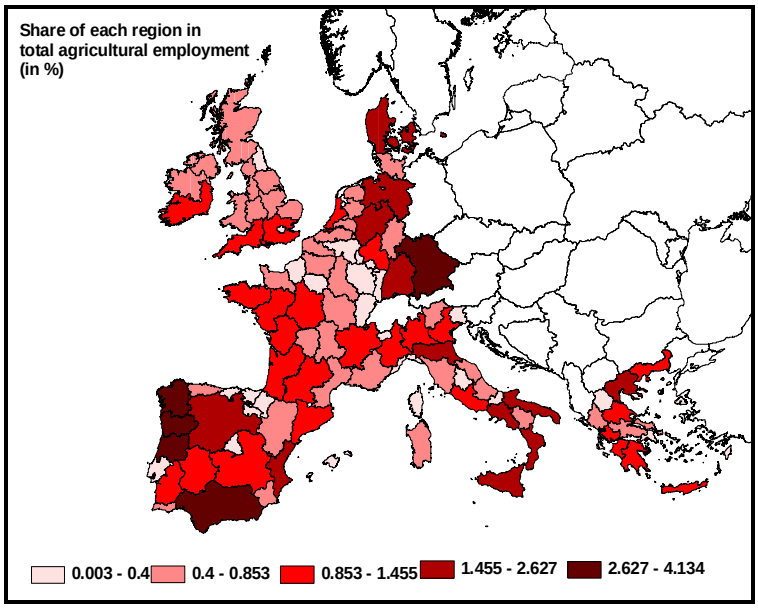


Figure 3: Share of each region in agricultural employment in 1989

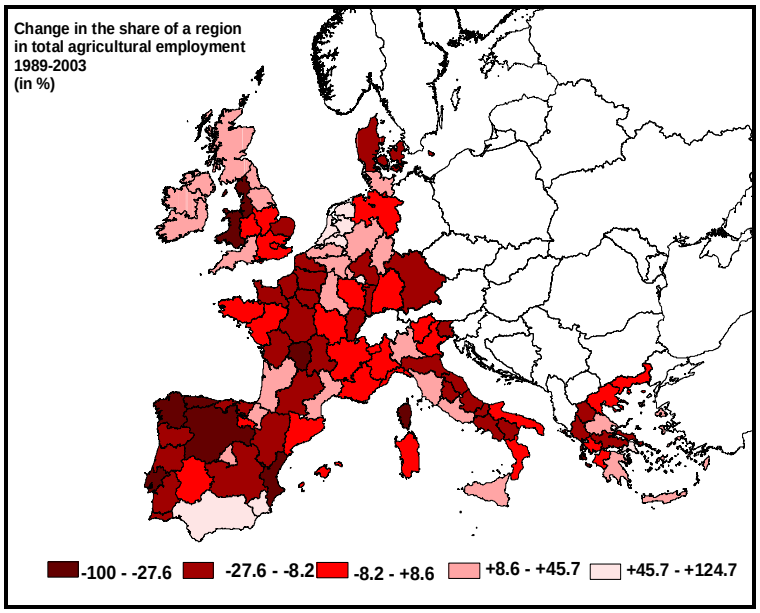


Figure 4: Change in the share of a region in agricultural employment 1989-2003

In order to verify whether the changes noted above are due to intrinsic characteristics of the agricultural sector, we also display the distribution of the share (and its evolution) of each region in total agricultural employment. Those are figures 3 and 4. Among the ten regions that have had an increasing weight in the EU agriculture, we count the four Dutch regions, a few Southern regions (Attiki, Notio Aigaio, Andalucia, Murcia) and surprisingly two Northern regions (Saarland in Germany and Dublin in Ireland). On the opposite of the spectrum, only two of the ten regions that lost most of their weight in the EU agriculture are Northern regions (Wales in the UK and Brussels in Belgium).

While figure 3 displays a distribution which is very much alike the one in figure 1, figure 4 clearly indicates that many regions across the EU have increased their role in the European agricultural sector. Those are regions that displayed a decrease in the share of agriculture in employment in figure 2. The difference in the outcomes of figure 2 and 4 may be due to two reasons:

a) in these regions, the share of other sectors has increased faster than the share of agriculture.
b) in these regions, the share of agriculture in employment has decreased less rapidly than in the rest of the regions.

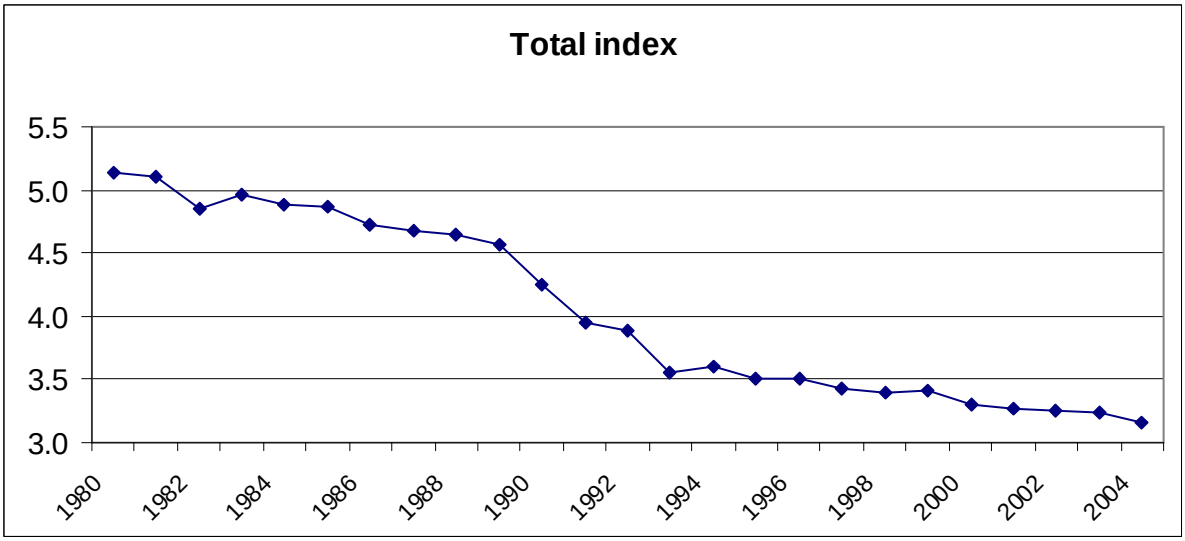
However, it is important to note that these regions are not necessarily the ones that display a high level of employment in agriculture at the initial period. Those are the regions we want to focus on since they are the most concerned by the impact of support to agriculture either under the form of Objective 5 funds or agricultural subsidies. For these regions, the results of figures 1 to 4 indicate they have lost more employment in agriculture than other regions.

In order to examine this outcome more closely, we introduce an index of inequality in employment structure based on the one of Cuadrado-Roura *et al*. (1999) as follows:

$$I = \sum_{i=1}^{109} \left[\begin{array}{l} (WA_{it} - WA_t)^2 + (WEM_{it} - WEM_t)^2 + (WC_{it} - WC_t)^2 + \\ (WMS_{it} - WMS_t)^2 + (WNMS_{it} - WNMS_t)^2 \end{array} \right] \quad (1)$$

where $WA_{it}, WEM_{it}, WC_{it}, WMS_{it}, WNMS_{it}$ denote, respectively, the weight of agriculture, energy and manufacturing, construction, market services and non-market services in total employment in region *i* at time *t*; and $WA_t, WEM_t, WC_t, WNMS_t WMS_t$ are the corresponding sectoral weights at the EU level. The value of this index would be zero if the productive structures were the same across all the regions.

Figure 5: Total index of inequality in productive structure



This index is represented in figure 5 above and shows that, in terms of employment, the productive structure of the European regions has become more uniform over time. Employment data are the only ones of the above mentioned to be available from 1980 (except for Flevoland where they start in 1986). This index can be divided into the sum of inequalities in productive structure by sector as follows:

$$IDA = \sum_{i=1}^{109} \left(WA_{it} - WA_t \right)^2 \quad (2)$$

$$IDEM = \sum_{i=1}^{109} \left(WEM_{it} - WEM_t \right)^2 \quad (3)$$

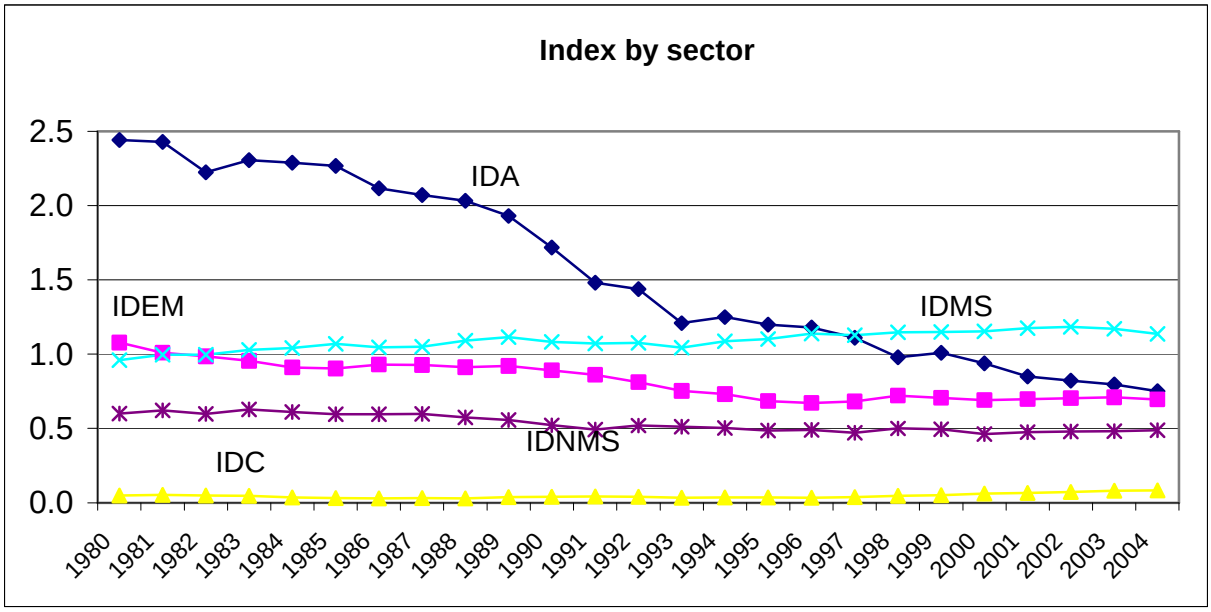
$$IDC = \sum_{i=1}^{109} \left(WC_{it} - WC_t \right)^2 \quad (4)$$

$$IDMS = \sum_{i=1}^{109} \left(WMS_{it} - WMS_{t} \right)^2 \quad (5)$$

$$IDNMS = \sum_{i=1}^{109} \left(WNMS_{it} - WNMS_{t} \right)^2 \quad (6)$$

These indices are represented in figure 6 below. It shows that the reason for the greater homogeneity in productive structures comes mainly from a harmonization of agricultural structures among regions. It is not due to an increase in the weight of agriculture in employment in the initially low agricultural regions. On the contrary, it comes from a transfer of resources from agriculture towards other productive sectors with a higher average productivity that has been more marked in the initially highly agricultural regions than in the low agricultural ones. While focusing on 48 NUTS 3 Spanish regions, Dall'erba (2005) reaches the same conclusion.

Figure 6: Index of inequality in productive structure by sector



In this respect, the share of agriculture in total employment in the ten initially most agricultural regions has decreased by 36% over the period while it has decreased by 30% in the ten initially least agricultural regions. In order to estimate the extent to which these changes are due to the variables we described above, the next section describes the spatial econometric techniques we use and discuss the results.

Section 3- Estimation process and results

The last decade has seen an increasing number of studies using a spatial approach to tackle econometric estimations of problems considering spatial interaction and spatial structure. In the European case, spatial econometrics has been used to estimate how spatial interactions are due to regional growth spillovers (see, for instance, the studies by Le Gallo and Dall'erba, 2006; Le Gallo *et al*., 2003; Fingleton, 1999, 2000, 2001), technology, knowledge and R&D externalities (Lopez-Bazo *et al*., 2004, Parent and Riou, 2005; Bode, 2004), public investments from the EU budget devoted to cohesion (Dall'erba and Le Gallo, 2003, 2004) and the agricultural support (Bivand and Brunstad, 2003). More recently, Franzese and Hays (2005) have applied spatial econometrics to the study of employment spillovers and labor market policies within the EU. To our knowledge, this is the only study using a spatial econometric approach on regional employment data. They conclude that EU spending in labor policies suffer a free rider problem and thus recommend domestic policy-makers to lower the spending in proportion to how much their neighbors spend on such policies.

The specification of the weights matrix is the sensitive point of spatial econometric modeling, since all the estimation results rely on it. We follow the standards of the spatial econometric community by basing the weights on pure geographical distance, as its exogeneity is unambiguous (Anselin and Bera, 1998; Anselin, 1996). However, we also respect the point of view of economists, such as Bodson and Peeters (1975), Aten (1997) or Los and Timmer (2002)**,** who find more attractive to base these weights on the channels of communication between regions, such as roads and railways. As a result, our estimations will also be performed with weights representing travel time by road between the most populated town of a region to the one of other regions[1]. We adopt the travel time instead of the distance by road because the existence of islands (Balearic Islands) forces us to include the time spent to load and unload trucks on boats. This information would not have appeared if we would have considered the distance by road only. Both distance

[1] Information on the most populated town come from www.citypopulation.de/Europe.html. Data on travel time come from the web site of Michelin (www.viamichelin.com).

and time-based matrices are defined on the great circle distribution between regional centroids (resp. most populated town), as follows:

$$\begin{cases} w_{ij}^*(k) = 0 \text{ if } i = j, \forall k \\ w_{ij}^*(k) = 1/d_{ij}^2 \text{ if } d_{ij} \le D(k) \quad \text{and} \quad w_{ij} = w_{ij}^* / \sum_j w_{ij}^* \quad \text{for } k = 1,\ldots 3 \\ w_{ij}^*(k) = 0 \text{ if } d_{ij} > D(k) \end{cases} \tag{7}$$

where w_{ij}^* is an element of the unstandardized weight matrix; w_{ij} is an element of the standardized weight matrix; d_{ij} is the great circle distance (or time) between centroids of region *i* and *j*; $D(1) = Q1$, $D(2) = Me$ and $D(3) = Q3$, $Q1$, Me and $Q3$ are respectively the lower quartile, the median and the upper quartile of the great circle distance (or time) distribution. $D(k)$ is the cutoff parameter for $k = 1,...3$ above which interactions are assumed negligible. We use the inverse of the squared distance (time), in order to reflect a gravity function. Each matrix is row standardized so that it is the relative and not absolute distance (time) which matters[2]. Because of the European geography, we cannot consider simple contiguity matrices, otherwise the weights matrix would include rows and columns with only zeros for the islands. Since unconnected observations are eliminated from the results of spatial autocorrelation statistics, this would change the sample size and the interpretation of statistical inference.

The weight matrices will allow us to detect and include the relevant spatial effects in the estimation of the impact of structural funds. These spatial effects take the form of spatial autocorrelation and/or spatial heterogeneity. The first one refers to the coincidence of attribute similarity and locational similarity (Anselin 1988, 2001). In our case, spatial autocorrelation means that rich regions tend to be geographically clustered as well as poor regions. The second spatial effect means that economic behaviors are not stable over space. It can be linked to the concept of convergence clubs, characterized by the possibility of multiple, locally stable, steady state equilibria (Durlauf and Johnson 1995).

[2] For comparison purposes, weight matrices based on the number of nearest neighbors are also generated.

In order to detect the appropriate form of spatial autocorrelation, we use the classical "specific to general" specification search approach outlined in Anselin and Florax (1995) using tests described in Anselin *et al.* (1996). Indeed, in the absence of a formal theory, this strategy provides ways to discriminate between a spatial lag and a spatial error model. More specifically, they suggest Lagrange Multiplier (LM) tests (resp. LMERR and LMLAG) and their robust versions (resp. R-LMERR and R-LMLAG). The decision rule used to choose the most appropriate specification is as follows: if LMLAG (resp. LMERR) is more significant than LMERR (resp. LMLAG) and R-LMLAG (resp. R-LMERR) is significant whereas R-LMERR (resp. R-LMLAG) is not, then the most appropriate model is the spatial autoregressive model (resp. the spatial error model). This rule is applied to the basic model which is similar to the model below but does not include spatial error autocorrelation. The results based on OLS estimation are not displayed here for space limitation. They show a significant Moran's *I*, indicating the significant presence of spatial autocorrelation. Following the decision rule described above, it appears that the spatial lag model is the most appropriate specification for all weight matrices. This model can be described as follows:

$$AGR = \alpha + \beta_1 SF5 + \beta_2 subsA + \beta_3 subsC + \beta_4 h + \beta_5 w + \beta_6 pty + \beta_7 age + \beta_8 area + \beta_9 sun + \beta_{10} elev + \beta_{11} accroad + \varepsilon$$

$$\text{with } \varepsilon = \lambda W\varepsilon + u \qquad \text{and } u \sim N(0, \sigma_u^2 I) \tag{1}$$

where all the above data are in log form. *AGR* represents 1) the evolution of the share of agriculture in regional employment over 1989-2003 (column 1 of table 1 below), 2) the average share of agriculture in employment over the period (column 2), 3) the evolution of the regional share in EU agriculture employment over the period (column 3), 4) the average of the regional share in EU agriculture employment (column 4). *SF5* are structural funds objective 5[3], *subsA* are subsidies in animal output, *subsC* are subsidies in crops, *h* is the average hours worked in agriculture as opposed to all the sectors, *w* is the same for remuneration, *pty* is the average productivity per worker in agriculture over

[3] For structural funds, we used the following formula : ln(SF+1) in order not to eliminate regions that do not receive any funds. The same formula is used for the variable "age" because in some regions the share of elderly (over 65) is null.

1989-2003, *age* is the share of 65 years old and plus holders[3], *area* is the share of regional area devoted to agriculture, *sun* is the annual sunshine radiation, *elevation* is the mean elevation above sea level, *accroad* is an index of accessibility by road.

λ is a coefficient indicating the extent of spatial correlation between the residuals. The results of the estimation by Maximum Likelihood are displayed in columns 1 to 4 of table 1 below. We note that two of the explanatory variables are significant for all the specifications below. Those are the level of subsidies in crop and the spatial error autocorrelation term. Subsidies have a negative impact on agricultural employment level and change, except in column 1, but the significance level is lower (10% vs. 2% at most for the others). The spatial error term is highly significant and positive for all the specifications. This means that changes/levels of agriculture employments are spatially and positively dependant on the changes/levels of the same variable in their neighboring regions. Note that these results are similar whatever the spatial weight matrix or transportation time by road matrix we use.

Looking at the other explanatory variables, structural funds have a positive and significant impact on the share of agriculture in regional employment only. This may be due to the fact that objective 5 funds are targeted to this sector but not directly to employment. They mostly finance infrastructures and machineries in this sector. Animal subsidy is not significant for any of our specifications, may be because they are supporting agricultural output first. But, subsidies in crops act negatively related to the share of agriculture in total regional employment and in the EU agricultural employment. Perhaps, in this kind of production process it is easier to change labor for capital .

The number of hours worked is significant in specification 2 only and acts negatively. As a result, when the number of hours worked in agriculture relatively to all the other sectors increases, workers leave the agricultural sector for other sectors. Remuneration does not seem to be a sufficient factor to make them stay in this sector. Indeed, remuneration (in agriculture relative to all the sectors) only acts significantly in the regional share of agricultural employment. It represents the fact that some regions pay relatively well in this sector compared to other regions, therefore increasing remuneration will increase the presence of some regions in EU agricultural employment. Later on, this

point will need to be developed in order to formally reflect this presence of spatial heterogeneity.

Contrary to our first intuition, productivity acts significantly and positively on our dependent variables (except in column 1). It means that productivity does not come from a reduction in the labor force but from a combination of factors that have increased the output level. Those factors could be better infrastructures, better machineries, better climatic conditions…

The high presence of 65 years old and plus holders in the region acts positively only on the regional share in EU agricultural employment. This indicates that this variable is specific to the agricultural sector only. The regions with a high presence of elderly holders have a greater presence in the EU agricultural employment. This may represent the fact that youngsters prefer to leave the country-side to settle in cities.

The size of agricultural area compared to total regional size acts positively in specification 2 only. Devoting more land to agriculture would therefore act on the level of relative employment in agriculture, not on its evolution or on the weight of one region in EU employment. This is because in every region the land is divided between the territory devoted to agriculture and one devoted to other activities (other sectors).

The two variables we used to represent the climatic and geographic characteristics of each region are not significant (or at a level slightly greater than 10%). This is eventually because those variables impact the output level not the employment per se.

Finally, accessibility by road has a negative impact on our dependent variables (except in specification 1). This may be due to the fact that transportation infrastructures have eliminated the protection from which country-side regions benefited by reducing distance (transportation time and costs) between regions. As a result, agricultural production in each region does not compete on the local market only anymore, but on the whole EU market. In addition, greater accessibility may have facilitated the move of workers from agriculture to other sectors, usually located in cities.

Table 2. ML Estimation results with spatial error dependence and weight matrix $D(1)$

	Share of agriculture in regional employment		Share of a region in EU agricultural employment	
	Change	Average level	Change	Average level
	1	2	3	4
Constant	0.097 (0.921)	-0.445 (0.890)	**-15.867 (0.000)**	**-15.867 (0.000)**
Structural funds	-0.003 (0.589)	**0.044 (0.013)**	$-0.052.10^{-5}$ (0.961)	$-0.052.10^{-5}$ (0.961)
Subsidy animal	-0.031 (0.155)	-0.021 (0.778)	-0.021 (0.635)	-0.021 (0.635)
Subsidy crop	0.022 (0.100)	**-0.108 (0.021)**	**-0.086 (0.002)**	**-0.086 (0.002)**
Hours worked	0.047 (0.912)	**-2.900 (0.032)**	0.694 (0.404)	0.694 (0.404)
Remuneration	0.019 (0.626)	-0.085 (0.518)	**0.207 (0.008)**	**0.207 (0.008)**
Productivity	-0.009 (0.828)	**0.362 (0.010)**	**0.790 (0.000)**	**0.790 (0.000)**
Age(65+)	-0.317 (0.359)	-0.379 (0.741)	**1.655 (0.016)**	**1.655 (0.016)**
Area	-0.024 (0.602)	**0.673 (0.000)**	0.035 (0.721)	0.035 (0.721)
Sun	-0.146 (0.538)	**1.229 (0.100)**	0.194 (0.671)	0.194 (0.671)
Elevation	-0.026 (0.263)	0.116 (0.130)	0.073 (0.114)	0.073 (0.114)
Accessibility by road	-0.005 (0.881)	**-0.535 (0.000)**	**-0.125 (0.087)**	**-0.125 (0.087)**
Spatial error lag	**0.473 (0.000)**	**0.274 (0.079)**	**0.359 (0.014)**	**0.359 (0.014)**
LIK	25.778	-108.846	-51.565	-51.565
AIC	-27.556	241.693	127.131	127.131
SC	4.739	273.989	159.427	159.427
Sq. Corr.	0.163	0.693	0.878	0.878

Notes: Significance level into brackets. *Sq. Corr.* is the squared correlation between predicted values and actual values. *LIK* is value of the maximum likelihood function. *AIC* is the Akaike information criterion. *SC* is the Schwarz information criterion.

Section 4-Conclusion

This article has examined the role of several variables in explaining the level and the evolution of agricultural employment across 109 European regions. We use three variables to represent EU support to agriculture, namely objective 5 structural funds, subsidies related to crops and subsidies related to animal output. While the first one and

third one do not display a significant impact (except on the share of agriculture in regional employment in the case of structural funds), the crops related subsidies clearly act negatively on agricultural employment. This may be due to the fact that these factors are targeted to support infrastructures or the agricultural output per se, not necessarily the employment in this sector. Our results indicate that if this is the final goal of the agricultural policy, then policies promoting productivity and paying attention to the presence of spillover effects across regions would be way more efficient. The differences between the specifications we used in this paper indicate that we need to control for particularities in the agricultural sector (i.e. results in columns 1 and 2 are clearly different from those in columns 3 and 4). This is a point we need to stress in further research. In addition, we want to pay attention to the eventual presence of spatial heterogeneity, eventually due to differences in climate, in infrastructures or simply in the weight of agriculture in the economy of a club of regions.

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