The Inequality of Farmland Size in Western Europe

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Abstract

In this paper, we seek to identify spatial clusters of farmland size inequality across Western Europe and to discuss the implications for the future of agriculture and agricultural policy reform in the region. We utilise Eurostat data to estimate the degree of inequality in farmland size at the NUTS (Nomenclature of Territorial Units for Statistics) 2 level. We utilise geographical information systems software to illustrate the spatial distribution of farm size inequality and conduct exploratory spatial data analysis techniques to identify spatial dependence between neighbouring NUTS 2 regions. The findings show that there are clusters of low inequality in the countries of Northern Europe and clusters with high inequality in much of Southern Europe. The highlands of Scotland are a notable exception to the general trend in Northern Europe. The variation in farmland size is a key determinant in the distribution of farm income. In combination with high farmland prices and sparse land rental opportunities, a highly unequal farm size distribution can militate against the progress of new-entrant farmers and small farmers wishing to expand their production and increase their farm incomes. A highly unequal farm size distribution can therefore grant an elevated importance to land inheritance as a determinant of relative economic success at the farm level.

Keywords Farm Size, Inequality, Western Europe, Spatial Autocorrelation

JEL code C21, D31, 013, Q12, Q15, R58

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1 INTRODUCTION

Distributional issues are gaining a prominent position within agricultural economics, particularly in relation to farm income inequality. Numerous recent studies have focussed on this topic, including Allanson (2006); Moreddu (2011) and Sinabell et al. (2013). In addition to a number of other well-established factors, the distribution of farm income is highly influenced by the distribution of farm size (Eastwood et al., 2010; Severini and Tantari, 2015). In this paper, we utilise exploratory spatial data analysis techniques to examine the spatial distribution of farm size inequality across some of the countries of Western Europe. The research identifies significant spatial dependence between neighbouring regions in terms of the typical farm size and the inequality of farm size. We outline some of the implications for the future of agriculture in Western Europe.

For some time farm size has interested agricultural economists, particularly in terms of the relationship farm size has with farm-level efficiency and productivity. Deolalikar (1981); Feder (1985) and Bhalla and Roy (1988) have examined the relationship for developing countries, while more recently Mugera et al. (2011) and Bojnec and Latruffe (2013) have examined the relationship in developed countries. The literature on farm size is increasingly concerned with distributional issues notably in the work of Olper (2007) and Roberts and Key (2008). The policy debate regarding farm size inequality is particularly intense in Eastern Europe, where financial investors have engaged in large-scale land deals, leading to concerns about further increases in land concentration with an associated detrimental impact on farming communities (Kay et al., 2015; Van Der Ploeg et al., 2015).

In addition, the presence of large farms can affect the national policy position with regard to reform of the CAP payments system. This problem can be exemplified by the recent negotiations regarding the proposed reforms to the CAP for the financial period 2014 to 2020. Sahrbacher et al. (2015) explain that the inequality of direct payments provided contentious debate during the negotiations between EU member states including the issue of 'capping' payments for the largest farm recipients i.e. limiting the absolute amount of payments that could accrue to a particular recipient. Sahrbacher et al explain that the main opposition to the 'capping' of direct payments emerged from those countries where large farms dominate the agricultural sector.

Bureau and Mahé (2015) report that ten member states, many with a high proportion of large farms, did not apply a real capping but instead imposed the minimum flat rate reduction of five per cent on basic payments above the threshold of €150,000.

This research is primarily concerned with the current spatial heterogeneity of farm size inequalities across Western Europe rather than their evolution over time. The evolution of farm size is the subject of numerous studies focusing on the potential relationship between farm growth and the initial farm size i.e. testing the validity of Gibrat's Law which hypothesises no significant relationship between these two variables (Gibrat 1931). Piet et al (2012) report that most empirical studies find a statistically significant relationship between farm growth and farm size thereby rejecting Gibrat's Law. In the case of Canada (Shapiro et. al., 1987), the tendency is towards a uniform farm size. Other studies find that farm size has tended towards a more unequal bimodal distribution in the case of Hungary (Rizov and Mathijs 2003) and in the case of Israel (Dolev and Kimhi 2010).

The evolution of farm size and its distribution is closely connected with structural change in agriculture. Piet et al (2012) argue that the degree of farm size inequality can represent a measure of structural change, as it encompasses both exit-entry decisions and the expansion-contraction decisions in farming activity. Piet et al examined the evolution of farm size inequality in France between 1970 and 2007 and found that policy measures significantly affected farm size inequality, with the activity of the SAFER (Sociétés d'Aménagement Foncier et d'Établissement Rural) having an important role in containing farm size inequality. The Common Agricultural Policy (CAP), in the form of the direct payments system and the milk quota system, also contained the extent of the inequality of farm size.

In the United States, Miljkovic (2005) analysed the distribution of farm size for each state utilising 'product sales' for the definition of farm size. Miljkovic identified a rise in farm size inequality between 1987 and 1997 for the United States. Miljkovic discovered a high degree of spatial heterogeneity in farm size inequality with relatively low inequality in the mid-western and northern great plain states[1] and relatively high inequality in a number of southern and western states[2] in addition to

[1] Illinois, Iowa, Wisconsin, Minnesota, North Dakota, South Dakota, and Montana
[2] Florida, Alabama, South Carolina, Mississippi, Texas, New Mexico, Arizona, Colorado, California, and Oregon

the non-continental states of Hawaii and Alaska. Miljkovic (2005) that grain farming regions have a lower degree of farm size inequality relative to regions with a high concentration of livestock, fruit and vegetable production. This is a result that is also evident from the French study by Piet et al. (2012).

Severini and Tantari (2015) examined both the distribution of agricultural land and the distribution of direct payments across the European Union and found a high degree of spatial heterogeneity in the concentration of direct payments across EU member states. This research identified particularly high inequality in direct payments for Spain, Italy and a number of Eastern European countries, while the inequality appeared to be lowest in the case of Ireland, Luxembourg and Finland. Severini and Tantari attributed much of this spatial heterogeneity to variations in the distribution of agricultural land. In this paper, we expand upon the research of (Severini and Tantari) by applying spatial analysis techniques to assess the variability of farm size inequality at a more spatially disaggregated level and testing for spatial dependence between neighbouring NUTS 2 regions.

This study adds to the recent body of literature which applies spatial analysis techniques to assess economic issues in European agriculture. For instance, Ezcurra et al (2008) have analysed the spatial disparities in agricultural productivity across Europe, finding positive spatial dependence and significant differences between Northern and Southern Europe. Ezcurra et al. (2011) further identified six types of region within Europe according to the gross value added and employment profiles. Renwick et al (2013) examined the potential impact of further trade liberalisation and the abolition of the Pillar 1 payments on land-use across the EU. Giannakis and Bruggeman (2015) examined the highly variable economic performance of European agriculture finding that the odds to attain high economic performance are almost 9 times higher for countries with a highly trained farming population than for countries with poor farm training.

In the next section of this paper, we provide a description of the data. In section 3, we discuss the methodology used to develop the model. This is followed with two sections of results. In the first results section, we illustrate the spatial pattern of inequality. In the second results section, we illustrate the results with respect to the exploratory spatial data analysis techniques and the identification of spatial dependence between neighbouring regions. We follow this with a comparison of statistics on farm size inequality and statistics on farmland sales and rental activity. The final section of the paper provides conclusions.

2 DATA

The main data source is based on the 2010 round of the World Programme for the Census of Agriculture. This data provides information on the number of farm holders and the total number of hectares, defined as utilisable agricultural area (UAA), according to a range of size classes in each country. The data are available for all 28 European Union countries and the EEA (European Economic Area) countries but we have decided, for reasons of feasibility, to concentrate the analysis on 13 western European countries.[3] The data are available at both a national level and at the NUTS 2 level and we concentrate most of the analysis at the NUTS 2 level with a total of 169 NUTS 2 regions included in the study.[4]

In Table 1, we show that there are wide disparities in the average farm size between countries examined. The United Kingdom has the largest average farm size with approximately 92 hectares. Denmark, Luxembourg, France and Germany also have a relatively high average farm sizes. Italy has the lowest average farm size of the countries under study and is also notable for having the highest number of farm holders. Austria, Switzerland and Portugal also have a relatively low average farm size, while Ireland, Spain, Belgium and the Netherlands have an average farm size which is close to the middle of the distribution. Some of the disparities in average farm size for the countries under study may reflect differences in farming systems and climatic conditions between countries and regions. The small farm size in Italy and Portugal is partly due to the presence of small-scale fruit, vegetable and horticultural producers. However, the average farm size in Italy and Portugal is smaller across most systems relative to the other EU-15 countries. We cannot therefore attribute the relatively small farm size in Italy and Portugal exclusively to the mix of farming systems or the form of land use. Other characteristics or institutions are relevant in

[3] Switzerland is the only non-European Union country included in the analysis.
[4] For Germany, the data is provided at the NUTS 1 level.

determining the substantial differences in farm size between some Mediterranean countries and most of the other EU-15 member states.

Table 1: Farm Size in 13 Western European Countries

Country	Total Number of Holders (000)	Total UAA (000 Ha.)	Mean Farm Size (Ha.)
United Kingdom	182.7	16.9	92.4
Denmark	40.5	2.6	65.3
Luxembourg	2.2	0.1	59.9
Germany	297.7	16.7	56.1
France	506.6	27.8	55.0
Ireland	139.8	5.0	35.7
Belgium	41.9	1.4	32.4
Netherlands	70.6	1.9	26.5
Spain	967.3	23.8	24.6
Austria	149.1	2.9	19.3
Switzerland	57.7	1.0	18.2
Portugal	303.9	3.7	12.1
Italy	1615.6	12.9	8.0

Source: Eurostat (2015)

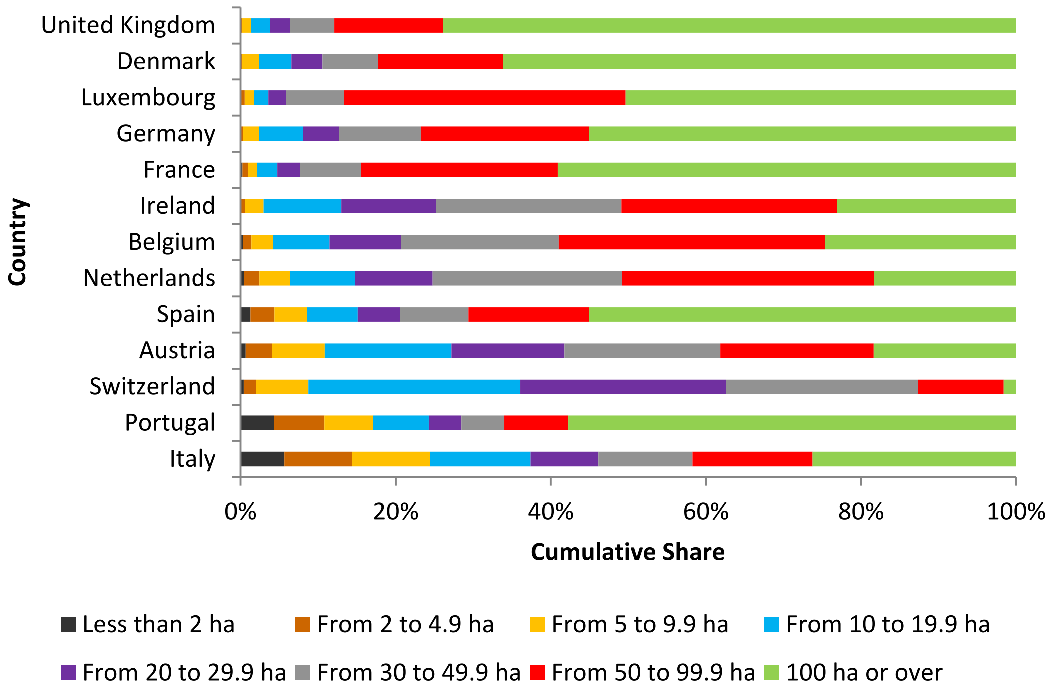
Table 2: Mean Farm Size by Farm System in 13 Western European Countries

Country	Fruits/ Hortic ulture (Ha.)	Cereal/ Field Crops (Ha.)	Specialist Dairy (Ha.)	Cattle (Ha.)	Sheep (Ha.)	Pigs and Poultry (Ha.)	Other (Ha.)
United Kingdom	24.3	126.8	103.3	60.9	82.8	31.3	92.0
Denmark	26.1	56.7	135.0	27.3	14.3	137.3	63.0
Luxembourg	5.0	33.7	95.5	76.9	26.5	59.5	73.8
Germany	8.9	70.8	63.2	39.9	23.9	53.0	87.8
France	14.1	75.4	78.5	68.0	32.6	35.3	64.2
Ireland	15.3	59.4	55.4	28.9	30.4	24.8	51.5
Belgium	9.5	34.2	45.7	34.7	9.2	17.9	44.1
Netherlands	9.7	37.9	46.6	17.5	8.9	11.5	37.5
Spain	8.6	48.4	22.6	45.3	47.6	20.5	29.8
Austria	8.1	26.7	21.0	17.3	8.4	24.6	20.3
Switzerland	7.8	17.4	21.1	18.9	8.4	11.2	22.5
Portugal	5.2	19.4	18.3	50.8	27.4	7.6	7.9
Italy	3.1	12.8	26.6	27.1	25.7	20.4	9.0

Source: Eurostat (2015)

Figure 1, illustrates the share of total UAA in each country according to each of the eight size classes. One can see that Ireland has a similar distributional pattern to Belgium and the Netherlands, while France and Germany are also quite similar to each other. The farm size inequalities can however, differ substantially between these countries, as the proportion of the total number of farm holders within each size class varies. In the United Kingdom, the proportion of agricultural land in the largest size class (100 Hectares and over) exceeds 70 per cent, while the proportion is less than two per cent in Switzerland. The data includes the number of farm holders in each size class, which will prove useful in estimating the degree of farm size inequality for each country and region.

Figure 1: UAA Decomposed by Farm Size Class in 13Western European Countries



Source: Eurostat (2015)

3 METHODS

The methodology for this research consists of two main components. The first component involves the estimation of farm size inequality with grouped data. The second component involves the estimation of spatial dependence or spatial autocorrelation between neighbouring regions. For the estimation of farm size inequality, we rely on the work of Abounoori and McCloughan (2003) who have modified the Gini coefficient formula of Milanovic (1994) in the following:

$$G = C \sum_{k=1}^{k} w_k \left(1 - \frac{\bar{y}_k}{\bar{y}}\right) \quad (1)$$

Where G refers to the estimated Gini coefficient of farm size, C = $\frac{2}{n}(n+1)$ and w_k represents the weight for each size class of farmers. The term $\bar{y}_k$ refers to the average farm size for the particular size class. The term $\bar{y}$ refers to the average farm size for the population of farmers as a whole.

The general term for the group weights is the following:

$$w_k = \frac{1}{2}\left\{\sum_{k=k}^{k} n_k \left(\sum_{k=k}^{k} n_k + 1\right) - \sum_{k=k+1}^{k} n_k \left(\sum_{k=k+1}^{k} n_k + 1\right)\right\} \quad (2)$$

where the weight for the size class group of farmers with the largest farm size is the following:

$$w_k = \frac{n_k(n_k+1)}{2} \quad (3)$$

For the penultimate group, the relevant weight is

$$w_{k-1} = \frac{(n_{k-1} + n_k)(n_{k-1} + n_k + 1)}{2} - w_k \quad (4)$$

for the third last group

$$w_{k-2} = \frac{(n_{k-2} + n_{k-1} + n_k)(n_{k-2} + n_{k-1} + n_k + 1)}{2} - w_{k-1} - w_k \quad (5)$$

and so on back to w_1.

To identify the presence of spatial dependence in farm size inequality for Western Europe as a whole, we calculated the Moran's I global test which can be expressed in the following:

$$I = \frac{n \sum_{i=1}^{n} \sum_{i=1}^{n} w_{ij} (y_i - \bar{y})(y_j - \bar{y})}{S_o \sum_{i=1}^{n} (y_i - \bar{y})^2} \quad (6)$$

Where I is a measure of spatial autocorrelation, y_i denotes the farm size inequality in region i while $\bar{y}$ is the sample average. The weights w_{ij} are calculated based on the square of the inverse euclidean distance between the centroids of each region. This ensures that more weight is attached to neighbouring regions relative to regions further away from region i. The sum of weights w_{ij} equals S_o. A significant and positive value for Moran's I indicates the presence of positive spatial autocorrelation, while a significant and negative value indicates the presence of spatial association dissimilar values (Ezcurra et al 2008).

A limitation of the Moran's I global test is that it refers to the overall spatial dependence for the geographical area under study as a whole, in this case Western Europe. This test fails to detect clusters of regions with either high or low farm size inequality to exist. As in the case of Ezcurra et al (2008), we therefore apply the local Moran's I test in the following:

$$I_i = \frac{n(y_i - \bar{y})}{\sum_{i=1}^{n} (y_i - \bar{y})^2} \sum_{j \in J_i} w_{ij} \left(y_j - \bar{y}\right) \quad (7)$$

where J_i refers to the set of neighbouring regions of i. As in the case of (Anselin 1995), we provide significance level results based on the assumption that the local Moran's I follows a normal asymptotic distribution and we also provide results without this assumption by following Anselins randomization process based on the empirical distribution of farm size inequalities. Under the assumption of normality, we assume that all regions are neighbouring regions with the weights varying for each neighbouring region. Under Anselins randomization process, neighbouring regions are defined as regions where the distance between centroids is within 500 kilometres. This essentially means that zero weight is attached to regions j located far away from region i.

In addition to the Gini coefficient of farm size inequality, this study includes estimates of median farm size which is sometimes employed as an alternative measure of farm size concentration. The Census data of farm size is based on size class groups and therefore does not directly provide the median farm size but it is possible to estimate the median farm size based on the size class information. This firstly involves identifying the size class containing the median farmer i.e. the 50th percentile of the distribution and applying the following formula:

$$\widetilde{\mathrm{X}} = \mathrm{LL} + \mathrm{w} * \frac{n/_2 - \mathrm{F}}{f} \qquad (8)$$

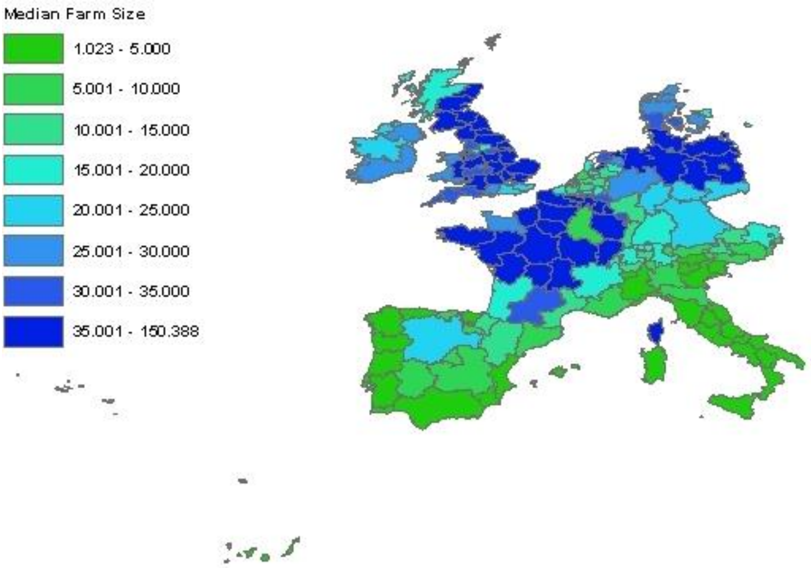
Where $\widetilde{\mathrm{X}}$ is the estimated median value, LL represents the lower limit for the median size class and w represents the width of the size class. For example, in the case of the interval for the category of five to ten hectares, the width of the interval w equals 5. n represents the total sample size, F represents the cumulative distribution of farms up to the lower limit (LL) of the median size class and f represents the number of cases in the interval containing the median farm.

4.1 Results 1

In this section, we present results showing the extent of the farm size inequality in each of the NUTS 2 regions. These initial results do not address the question of spatial dependence in a formal test, but do provide some initial indicators regarding the farm size inequality that exists across Western Europe. In Figure 2, we show the median farm size for each region and the Gini coefficient of farm inequality in Figure 3.

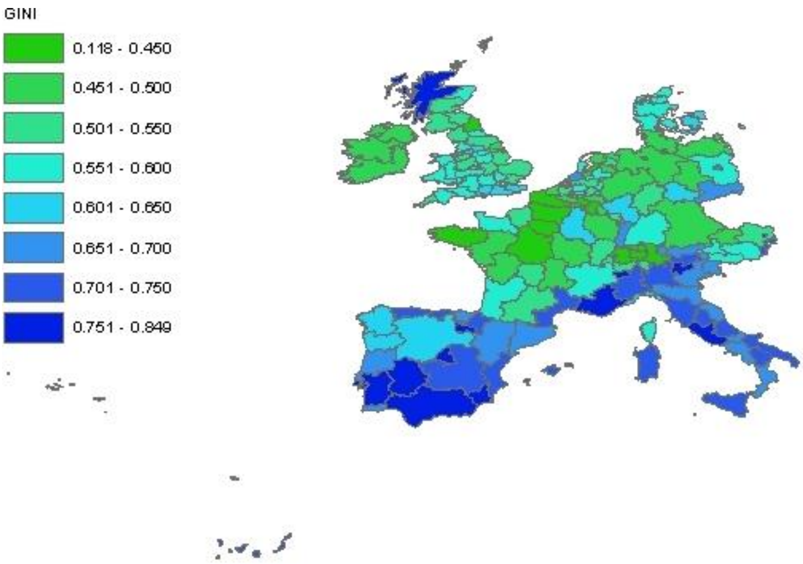
From Figure 2, it appears that there is a good deal of variability in the median farm size among the countries considered. For most of the Mediterranean area, the median farm size is below ten hectares, whereas the median farm size is above 40 hectares in many parts of the United Kingdom, Northern France and Northern parts of Germany. To some extent, the median farm size can be an indicator of land concentration, with larger median farm size indicating greater concentration. In that respect, the degree of land concentration, appears greater in Northern Europe relative to Southern Europe.

Figure 2: Median Farm Size [UAA Hectares] by Region in Western Europe



However, the Gini coefficient of farm size inequality tends to give a better picture of the inequalities in farm size within the farming sector, as it reflects the differences in the share of land being farmed across the full distribution of the farmer population. In Figure 3, we show that the Gini coefficient of farm size inequality is greatest in the Southern Mediterranean countries. Northern France, Switzerland, Ireland and Northern Ireland appear to have the lowest levels of farm size inequality. These results correspond closely to the findings of (Severini and Tantari, 2015).

Figure 3: Gini Coefficient for Farm Size Inequality by Region in Western Europe



In addition, we identify some within-country variability in farm size inequality, notably in the United Kingdom. The south and south-western parts of England appear to have higher inequalities than other parts of England and the United Kingdom generally. There is a noticeable difference between the farm size inequality in the Highlands of Scotland and the neighbouring regions, suggesting that the Highlands may be an outlier. A number of academic studies have addressed the issue of land inequalities in the Highlands of Scotland (MacMillan, 2000; Hoffman, 2013). The Scottish Government has recently set up a permanent Land Reform Commission whose objectives include "to make provision about engaging communities in decisions relating to land" and "to enable certain persons to buy land to further sustainable development" (Scottish Parliament, 2015).

4.2 RESULTS 2

Applying Exploratory Spatial Data Analysis techniques (Anselin, 1998) allows us to gain a deeper understanding of the characteristics of the distribution under consideration, and to formally test for the presence of different patterns of spatial association and spatial heterogeneity. In Table 3, we show the result for the Global Moran's I test for the Western Europe region as a whole in relation to farm size inequality. The result shows that there is significant and positive spatial autocorrelation, thus confirming the patterns observed in Figure 3. It can be concluded that spatially adjacent regions have a tendency to display similar levels of farm size inequality. This result is similar to the finding of Ezcurra et al. (2008) in relation to agricultural productivity.

Table 3: Global Moran's I Test

Region	Global Morans I	P-Value
Western Europe	0.120	0.000***

The local Moran's I test gives a better picture of the spatial dependence at a more disaggregated level than the global test. In Figure 4, we therefore show the results for the local Moran's I test for each of the 169 regions in relation to median farm size. In

Figure 5, we show the local Moran's I test results in relation to farm size inequality under the Anselin random permutation approach.

It is clear from Figures 4 and Figure 5 that some significant geographic clusters can be detected, both in terms of median farm size and the inequality of farm size. In terms of median farm size, Figure 4 shows that a cluster of high farm size covers much of the United Kingdom, including the north and east of England and much of Scotland. Northern France also has a cluster of relatively high farm size, while most of Italy and some southern parts of Spain provide examples of geographic clusters with low median farm size. To some degree, the low median farm size in Italy can be attributed to the importance of the fruit, vineyards and olives sectors and it is evident from Table 2 that farm size is typically lower for these product sectors.

Figure 4: Local Moran's I Results for Median Farm Size in each Region

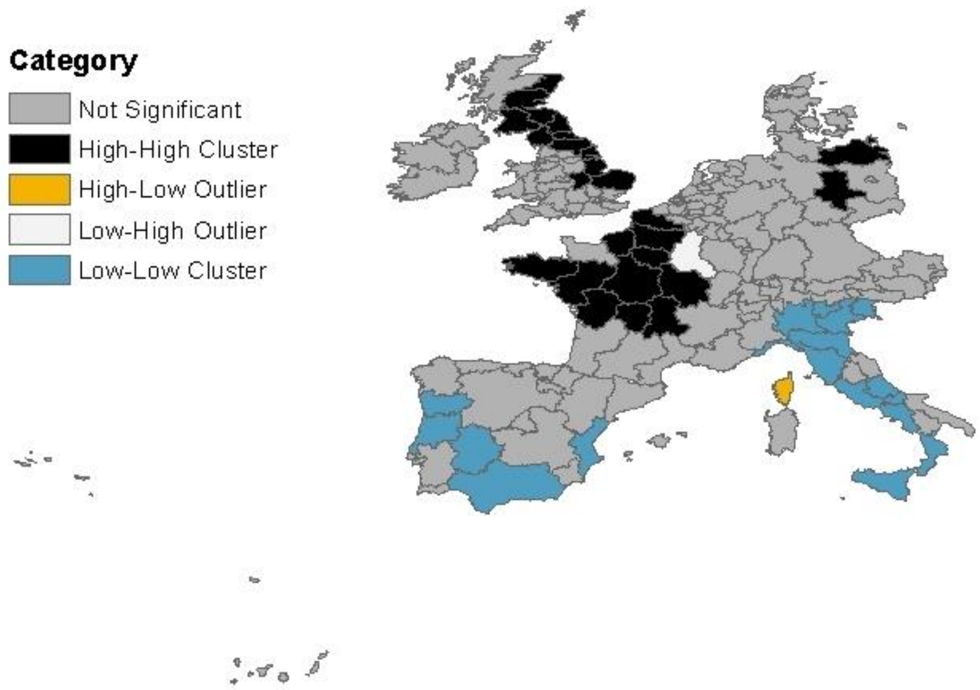
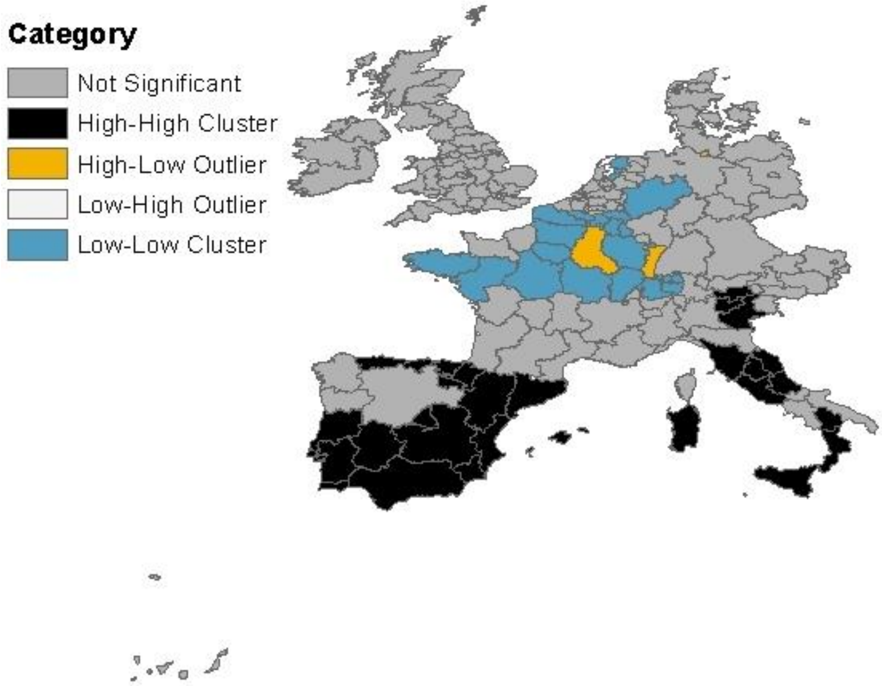


Figure 5 illustrates that the model detects clusters of relatively low and high inequality of farmland size. In contrast to Figure 4, it appears that there are no significant clusters of farmland size inequality in the United Kingdom. The Highlands of Scotland do not appear as an outlier, despite the apparently high inequality relative to the surrounding areas. However, if we apply the alternative normalization approach, the model detects the Highlands of Scotland as an outlier and this is shown in Figure

6.[5] Northern France, Southern Belgium, the Nordrhein-Westfalen region in Germany and Luxembourg appears to be one single cluster of low farm size inequality. The identification of this cross-country spatial dependence is new to the literature on farm size inequality in Europe. In the case of France, the patterns are quite close to those identified in (Piet et al., 2012) although their study was carried out at a more disaggregated level.

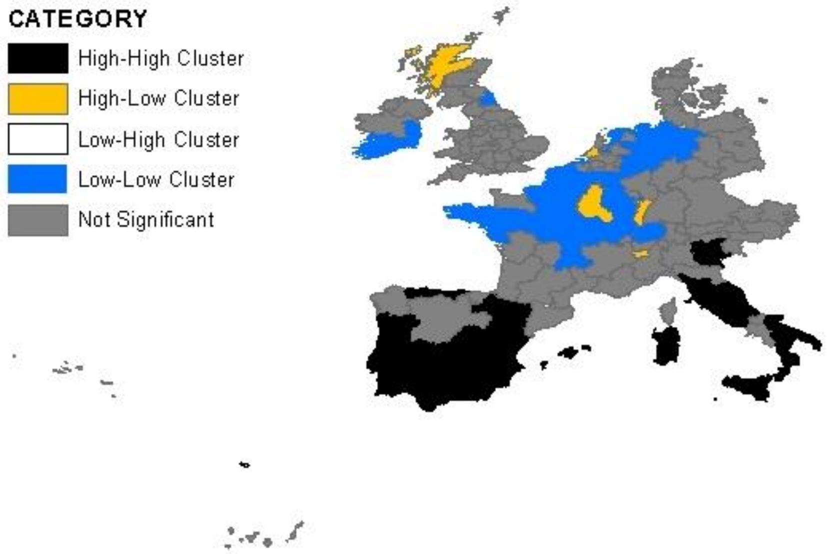
In Figure 5, the main outliers appear to be the two French regions of Alsace and Champagne-Ardenne, both located in the eastern part of France. These are areas with a relatively high farm size inequality adjacent to areas of low farm size inequality. This may be attributable to the heterogeneous nature of farming in these regions (See Piet et al., 2012) for further discussion.

Figure 5: Local Moran's I Results for Inequality in each Region [Anselin Method]



[5] The normalization approach is generally found to be a less severe test than the Anselins permutation approach but the latter is generally advisable where significant global spatial dependence is present, as appears to be the case in this study.

Figure 6: Local Morans I Results for Inequality [Normal Distribution Method][6]



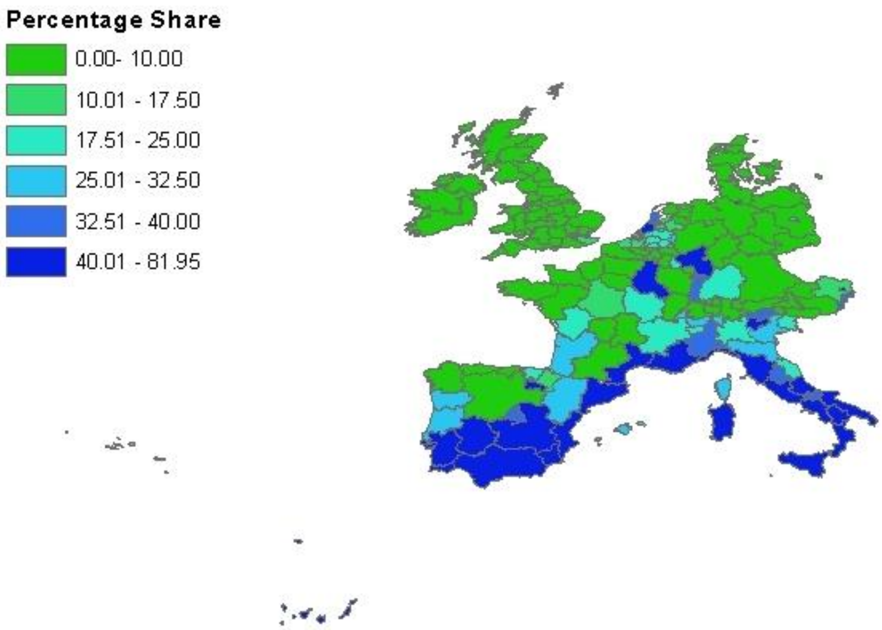
In Figure 7, we show the share of UAA in horticultural, fruit or vegetable production and the contrast between Northern and Southern Europe is quite striking. The Mediterranean countries have a relatively high concentration in horticultural, fruit or vegetable production in comparison with Northern European countries. Table 2 showed that these farming systems have a much lower farm size relative to other sectors. The coexistence of horticultural, fruit or vegetable production alongside livestock or grain production could therefore contribute to high farm size inequalities at the local or regional level. From a comparison with figure 3, the Mediterranean areas have a relatively high inequality and a high share in the horticultural, fruit or vegetable production systems. We find however, that this does not explain a large share of the differences in inequality between countries. We find that excluding the horticultural, fruit or vegetable production area and the associated farm holders from the analysis will lead to a small reduction in the measured inequality in Spain and Italy but a large gap remains between these Mediterranean countries and the Northern European countries in terms of the extent of farm size inequalities.

In the appendix, we also show the share of UAA in Specialist Cereal/General Field Crop Production. Previous research has shown that areas with a high concentration in

[6] In the appendix, we include a map showing the results under the normal distribution but at the 90% Significance Level. Under this less stringent criteria, one could classify all of Spain as a cluster of high farmland size inequality and the Republic of Ireland and Northern Ireland as a cluster of low inequality and much of North-Western Germany as well as Northern France as a cluster of low inequality.

cereal production tend to have a relatively low farm size inequality (Miljkovic 2005; Piet et al 2012). From a comparison with figure 3, it appears that north-eastern France is one useful example of this pattern within Western Europe but the relationships elsewhere does not appear very striking.

Figure 7: Percentage Share of UAA in Fruit or Vegetable Production



5 FARMLAND PRICES AND RENTAL SHARES

In this section, we make comparisons between the relative ranking of the countries under study in terms of farm size inequality, farmland purchasing prices and farmland rental prices. This provides us with some indication of the inequality of opportunity facing those farmers who wish to expand from a low initial land endowment. In future work, we will also consider other elements including the land regulation indicators as explored by (Swinnen et al 2014). In this work, we utilise both Eurostat and national data sources for the farmland prices and rental shares given that Eurostat only reports farmland price data for the years up to 2009. These results are presented in Table 4.

The statistics presented in Table 4 reflect the differences in the level of data availability between countries, notably the limited data availability in the case of a number of countries. As yet, no reliable source of purchase price or rental price data can be identified for Portugal, Austria and Switzerland. In the case of Ireland, the data regarding the average land sales price is obtained from the Farmer's Journal Annual Report, but this does not cover all of the agricultural land sales transactions in Ireland (Irish Farmers Journal 2014). Previously, the Central Statistics Office in Ireland reported the average land price per hectare, but this practice ceased in the first quarter of 2005.

Table 4: A Comparison of Land Inequality, Prices and Rental Shares

Country	**Farm Size Inequality**	**Rental Share**	**Average Price and Year**[7]	**Source**
Portugal	0.8222	20.49	N/A	N/A
Spain	0.7722	32.92	9,633	MAGRAMA - Spanish Ministry of Agriculture (2015)
Italy	0.7452	34.17	~20,000	SAFER (2015)
Germany	0.6157	59.99	16,519	Statistisches Bundesamt (2014)
United Kingdom	0.6151	29.11	24,732	Savills (2014)
France	0.5841	78.10	4,240	French Ministry of Agriculture
Denmark	0.5832	32.11	22,255***	Statistics Denmark (2015)
Austria	0.5795	33.33	N/A	N/A
Netherlands	0.5592	26.68	52,023	Kadaster/DLG, LEI
Belgium	0.5394	63.05	22,053 (2005)	Eurostat
Luxembourg	0.4818	58.62	20,000 (2009)	Eurostat
Ireland	0.4794	16.13	23,228	Irish Farmers Journal (2014)
Switzerland	0.3907	47.18	N/A	N/A

***Excluding intra-family transactions, N/A Not Available

One can see from Table 4 that there are examples of countries with relatively high inequality and relatively high farmland prices. This is certainly the case for both the United Kingdom and Italy. Ireland and Luxembourg are examples of countries with a relatively low farm size inequality, but with relatively high farmland prices. At a national level, France has a farm size inequality that is relatively close to that of the United Kingdom, but this is significantly influenced by the relatively higher inter-regional variability in farm size in France. In that context, it appears that French agriculture has the characteristic of relatively low farm size inequality, particularly in northern regions, relatively low farmland purchasing prices and a high rental share.

[7] 2013 unless stated

Ceteris paribus, low farm size inequality, low land sales prices and a high rental share are three characteristics that ought to be positive forces that would assist new-entrant farmers or farmers wishing to expand their land base from a relatively low level. While Germany has a farm size inequality close to that of the United Kingdom, it is clear that the farmland prices are somewhat lower. The Netherlands is an outlier in terms of its high farmland prices, but this is also accompanied by relatively high Dutch farm incomes (European Commission, 2015).

6 CONCLUSION

We have examined the spatial patterns in farm size inequality across Western Europe. Spatial clusters of relatively low and relatively high farm size inequality are detected using exploratory spatial data analysis techniques. The clusters are not randomly distributed and are concentrated in specific areas. This research is of high relevance to the future of agriculture and rural development in Europe. A combination of high land inequality, high farmland prices and sparse land rental opportunities can be detrimental to the prospects of new-entrant farmers or farmers wishing to expand from a low initial land endowment. Furthermore, a high land inequality can contribute to rigidities in the CAP payments system, since the extent of the inequality may influence the national policy position regarding a proposed reduction in support for the larger farms, thus making it politically unacceptable to reduce support for large farms in some countries.

In addition, a high farmland size inequality can have implications for the market power of farmers. Olper (2007) finds a negative relationship between the farm size inequality and the strength of collective action and co-operation in the area of public subsidies and this may also translate into lower market power within other parts of the supply chain. Building upon the work of Severini and Tantari (2015) and Sinabell et al. (2013), future research will consider the extent of inequality of CAP direct payments at a spatially disaggregated level and further research will examine the functioning of agricultural land markets in Ireland and other EU member states.

7 BIBLIOGRAPHY

Abounoori, E., and McCloughan, P. (2003). A simple way to calculate the Gini Coefficient for grouped as well as ungrouped data. *Applied Economics Letters, 10*(8), 505-509.

Allanson, P. (2006). The redistributive effects of agricultural policy on Scottish farm incomes. *Journal of Agricultural Economics*, *57*(1), 117-128.

Anselin, L. (1995). Local indicators of spatial association-LISA. *Geographical analysis*, *27*(2), 93-115.

Bhalla, S. S., and Roy, P. (1988). Mis-specification in farm productivity analysis: the role of land quality. *Oxford Economic Papers*, *40*(1), 55-73.

Bojnec, Š., and Latruffe, L. (2013). Farm size, agricultural subsidies and farm performance in Slovenia. *Land Use Policy*, *32*, 207-217.

Bureau, J. C., and Mahé, L. P. (2015). Was the CAP Reform a Success. *The Political Economy of the 2014-2020 Common Agricultural Policy: An Imperfect Storm, CEPS Paperback, Centre for European Policy Studies, Brussels*.

Deolalikar, A. B. (1981). The inverse relationship between productivity and farm size: A test using regional data from India. *American Journal of Agricultural Economics*, *63*(2), 275-279.

European Commission (2016). Farm Accountancy Data Network- Field of Survey Available at http://ec.europa.eu/agriculture/rica/methodology1_en.cfm

European Commission (2015). Comparison of Farmers Incomes in the EU member states, Available at http://www.europarl.europa.eu/RegData/etudes/STUD/2015/540374/IPOL_STU(2015)540374_EN.pdf

Ezcurra, R., Iraizoz, B., Pascual, P., and Rapun, M. (2008). Spatial disparities in the European agriculture: a regional analysis. *Applied Economics*, *40*(13), 1669-1684.

Feder, G. (1985). The relation between farm size and farm productivity: The role of family labor, supervision and credit constraints. *Journal of development economics*, *18*(2), 297-313.

French Ministry of Agriculture. (2015). Prix des terres agricoles et prés, NOUVELLES SÉRIES, par région et en France métropolitaine, évolution de 1997 à 2013, Available at http://agreste.agriculture.gouv.fr/thematiques-872/prix-indices-887/#Prix_des_terres

Giannakis, E., and Bruggeman, A. (2015). The highly variable economic performance of European agriculture. *Land Use Policy*, *45*, 26-35.
Gibrat, R. (1931). *Les inégalités économiques*. Recueil Sirey.
Hoffman, M. (2013). Why community ownership? Understanding land reform in Scotland. *Land Use Policy, 31*, 289-297.
Irish Farmers Journal (2014). Agricultural Land Price Report 2013. Available at http://www.farmersjournal.ie
Kay C., Peuch J. and Franco J. (2015) Extent of Farmland Grabbing in the EU, Study for the European Parliament's Committee on Agriculture and Rural Development, Available at http://www.europarl.europa.eu/RegData/etudes/STUD/2015/540369/IPOL_STU(2015)540369_EN.pdf
Macmillan, D. C. (2000). An economic case for land reform. *Land Use Policy, 17*(1), 49-57.
MAGRAMA (2015). EVOLUCIÓN DE LOS PRECIOS DE LA TIERRA 1983-2013, Available at http://www.magrama.gob.es/es/estadistica/temas/estadisticas-agrarias/Encuesta_Precios_Tierra_2013_tcm7-349643.pdf
Milanovic, B. (1994). The Gini-type functions: an alternative derivation, *Bulletin of Economic Research*, 46, 81–90.
Moreddu, C. (2011). Distribution of Support and Income in Agriculture, *OECD Food, Agriculture and Fisheries Working Papers*, No. 46, OECD, Paris.
Mugera, A. W., and Langemeier, M. R. (2011). Does farm size and specialization matter for productive efficiency? Results from Kansas. *Journal of Agricultural and Applied Economics*, *43*(04), 515-528.
Piet, L., Latruffe, L., Le Mouël, C., and Desjeux, Y. (2012). How do agricultural policies influence farm size inequality? The example of France. *European Review of Agricultural Economics*, *39*(1), 5-28.
SAFER (2015). *Le prix des terres." Analyse des marchés fonciers ruraux 2012”*. Paris, Éditions de la FNSAFER.
Sahrbacher, A.; Balmann, A.; Sahrbacher, C. (2015). The Political Economy of Capping Direct Payments: Applications in – and implications for – Germany. *In: Swinnen, J. (ed.): The Political Economy of the 2014-2020 Common Agricultural Policy - An Imperfect Storm*, 277-306: Rowman & Littlefield International.

Savills (2014) Market Survey UK Agricultural Land, Available at http://pdf.savills.com/documents/Savills-ALMS-Feb-2014.pdf

Scottish Parliament (2015). Land Reform (Scotland) Bill, Available at http://www.scottish.parliament.uk/parliamentarybusiness/Bills/90675.aspx

Severini, S., and Tantari, A. (2015). Which factors affect the distribution of direct payments among farmers in the EU Member States?. *Empirica*, *42*(1), 25-48.

Sinabell, F., Schmid, E., and Hofreither, M. F. (2013). Exploring the distribution of direct payments of the Common Agricultural Policy. *Empirica*, *40*(2), 325-341.

Statistics Denmark (2015). Prices at agricultural input by product and unit, Available at http://www.statbank.dk/LPRIS35

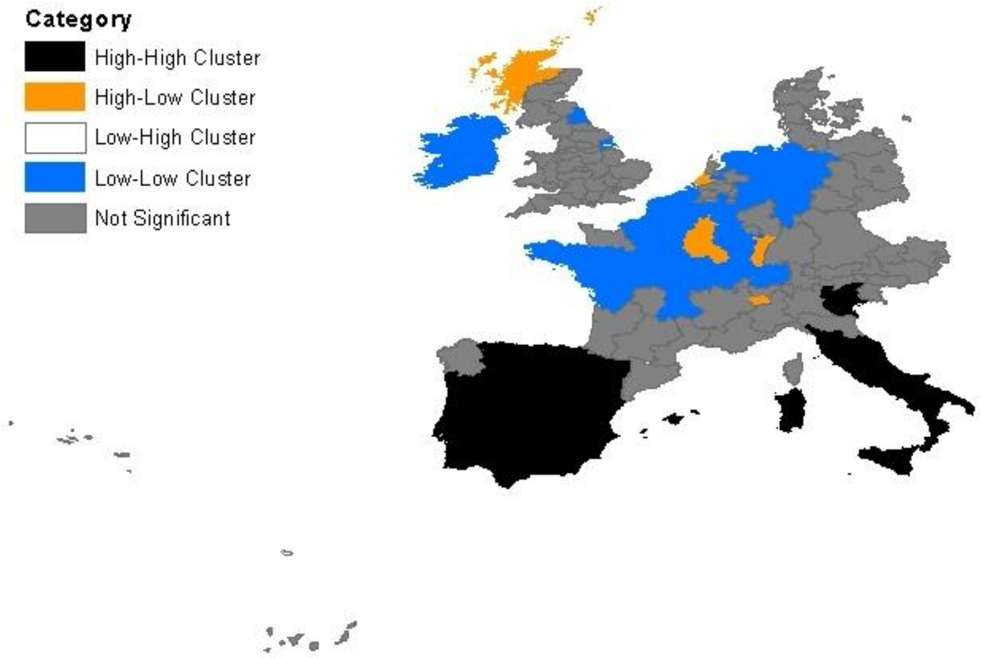
Statistisches Bundesamt (2014). Kaufwerte für landwirtschaftliche Grundstücke, Available at https://www.destatis.de/DE/Publikationen/Thematisch/Preise/Baupreise/KaufwerteLandwirtschaftlicheGrundstuecke2030240137004.pdf?__blob=publicationFile

Swinnen, J., Van Herck, K. and Vranken, L. (2014). The Diversity of Land Institutions in Europe. LICOS Discussion Paper 355/14, KU Leuven, Leuven.

van der Ploeg, J. D., Franco, J. C., and Borras Jr, S. M. (2015). Land concentration and land grabbing in Europe: a preliminary analysis. *Canadian Journal of Development Studies/Revue canadienne d'études du développement*, 1-16.

8 APPENDIX

Figure 8: Local Morans I Results for Inequality in each Region**



**Normal Distribution 90% Significance

Figure 9: Share of UAA in Specialist Cereal/General Field Crop Production