Inequality and Concentration in Farmland Size: A Regional Analysis for Western Europe

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Abstract
This paper uses regional data for Western Europe to explore relative and absolute farmland size inequality and farm size concentration, demonstrating that specific indicators provide somewhat differing country characterisations. The paper uses exploratory spatial data analysis techniques to measure the degree of spatial dependence in farm size at a NUTS2 level. Regional farm size clusters are identified, some of which straddle national borders. The results have policy implications, demonstrating that the association between land inequality and farm productivity and resistance to change in farm support structures may relate to pan national regional considerations more so than national concerns. The research is conducted at a NUTS3 level for the Italian case and these findings suggest that the level of spatial disaggregation is an important consideration.

Keywords: Farm Size, Inequality, Western Europe, Spatial Autocorrelation

1 Introduction
Distributional issues in primary agriculture are an important consideration for rural economic and social development. Distributional issues are gaining a prominent position within agricultural economics, particularly in relation to farm income inequality. Numerous recent studies have focused 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 both farm size inequality and farm size concentration across some of the countries of Western Europe. Farm size inequality refers to the distribution of farmland within the farming population while farm size concentration can refer to the median farm size or the midpoint hectare statistic. The research identifies significant spatial dependence between neighbouring regions in terms of the inequality and concentration of farm size.

The literature on farm size is increasingly concerned with distributional issues notably in the work of (Olper 2007; Roberts and Key 2008 and Lowder et al., 2016). Frankema (2010) describes land inequality as ‘one of the crucial underpinnings of long-run persistent wealth and asset inequality’. 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 and rural society (Kay et al., 2015; Van Der Ploeg et al., 2015). This land grabbing phenomenon is also evident in Africa and Southeast Asia where European Union policies with regard to the reduction of carbon dioxide (CO₂) emissions are motivating EU investors to pursue land grabbing (Carroccio et al., 2016).

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 EU 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.
More recently, Piet (2016) has provided a detailed description of the recent trends in farm-size inequality for the EU-27. Our analysis differs from Piet’s research in that we apply exploratory spatial data analysis techniques to assess the farm size inequality across Western Europe. We therefore add to the recent body of literature, which has involved similar methodological approaches to deal with economic issues in European agriculture. For instance, Ezcurra et al (2008) have used similar approaches to analyse 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.

In the next section of this paper, we describe some of the theoretical background to land inequality and farm size inequality. In the third section, we describe the link between the farm size distribution and the farm income distribution via the distribution of direct payments and the associated political economy dimension. We follow this with a description of the data. In section 5, we discuss the methodology used to develop the model. This is followed with the results sections, divided into three parts. In the first part, we illustrate the spatial pattern of farm size inequality in Western Europe. In the second part, we illustrate the results with respect to the exploratory spatial data analysis techniques and the identification of spatial dependence between neighbouring regions. In the third part, we concentrate the analysis on the Italian case. The final section of the paper provides conclusions.

2 Theory and History of Farm Size Inequality

In this section, we provide some theoretical and historical background regarding the study of the farm size distribution and the causes of variability in farm size inequality between different regions and countries. Frankema (2005) classifies the determinants of the farm size distribution into three factors 1) geographical conditions or natural endowments 2) factor endowments i.e. the land-labour ratio and 3) (colonial) rule and institutions. Eastwood et al (2010) describe a similar system of classification distinguishing between ‘concerted human intervention’ and other sources of farm size inequalities.

In terms of geographical conditions or natural endowments, Frankema (2005) concluded that geographical areas, which are suitable for growing scale-intensive cash crops, tend to have higher levels of farm size inequality than areas primarily focused on livestock farming or scale neutral crop farming.

Frankema concludes that land abundance (high land to labour ratio) is associated with labour saving production methods, which favours large scale crop production. By contrast, high population density in rural areas, ceteris paribus, tends to be associated with pressure for agricultural land tenure, a labour intensive form of agriculture and a relatively small farm size. This so-called family farm theory of agrarian production relations posits that the addition of hired labour requires high supervision costs and these costs lead to a situation whereby the optimal production unit becomes the family farm.

Eastwood et al (2010) concludes however, that hired labour supervision costs and constant technical returns to scale cannot guarantee the dominance of family farming. Eastwood et al point to the insights from Eswaran and Kotwol (1986), which emphasised the role of household-specific capital endowments (including owned land) in the formation of four distinct farm size classes. Eastwood et al explains that economic development tends to raise ‘the reservation utility of families’ so that the improvement in the off-farm economy attracts labour away from primary agriculture. Eastwood et
al caution that this may be complicated by the nature of the population growth and the technological change.

The theoretical literature, in relation to the role of institutions, tends to be in the political economy domain. Within this domain, Galor et al (2004) theorise that economies with land abundance and a relatively unequal distribution of land ownership will tend to under-invest in human capital and therefore experience slower than otherwise economic growth. This under-investment is attributed to the incentives of the large-scale landowners. Galor et al provide a number of examples, including the United States and Korea, where the evolution of the land distribution impacted on the timing of educational reforms. In the case of developing countries, the weakness of secure property rights is another channel for asset inequality to negatively affect growth (See, for example, Keefer and Knack 2002). In both developing and developed countries, the presence of imperfect capital markets and decreasing returns to capital can lead to a situation whereby the inequality in the wealth distribution has a negative effect on aggregate output (Stiglitz 1969). On the other hand, the presence of family labour can also provide a productivity advantage for relatively small to medium sized farms and this will tend to reduce the farm size concentration (Vollrath 2007).

In most countries, the area of agricultural land transferred annually (via sales) tends to account for a small proportion of total agricultural area (Ciaian et al 2012). History therefore plays a key role in determining the shape of the current farm size distribution. Economic historians have studied extensively the evolution of the farm size distribution in individual countries and over many centuries. For instance, Shaw-Taylor (2012) examines the agrarian social structure of England from 1600 to 1850 and finds that large scale agrarian capitalism was already dominant in southern and eastern England by the early eighteenth century while family farming remained prevalent in many parts of northern England. Shaw-Taylor concludes that the decisive shift to agrarian capitalism occurred in the south-east during the seventeenth century and that the wealthiest and most commercialised parts of England were the first to enter agrarian capitalism.

O’Brien (1996) compared structural change in French and British agriculture from the sixteenth century onwards and identified a number of factors which contributed to the slower industrialisation of France including the greater population growth in Britain and the associated urbanization. Relative to the French peasantry, British farmers could take ‘the longer view’ and experienced fewer problems in gaining access to credit and raising the necessary savings to make investments. French landowners operated under a more rigid framework of property rights, which provided weaker incentives for the reconstruction of estates or the altering of tenure arrangements. The shift in Britain to a more capital intensive form of agriculture, in the early eighteenth century, was partly facilitated by the existing distribution of property rights, the tenurial system and the system of poor relief.

In relation to the past century, Swinnen et al. (2016) have provided a comparative analysis regarding the evolution of land use and regulations for several countries in Europe. Swinnen et al. highlight that the major policy reforms in the agricultural land markets of Western Europe occurred after one particular major political change i.e. the extension of voting rights in the late nineteenth and early twentieth centuries. In considering the current functioning of agricultural land markets in Western Europe, Swinnen et al. conclude that ‘enhanced access to land and secure operation for small farmers can be achieved by a variety of policies’ but governments may wish to concentrate on rental arrangements given that reforms tend to be ‘politically very difficult’. Swinnen et al. conclude that restrictions on foreign ownership will constrain inward investment in agriculture and that a suitable mix of liberalisation and regulation can address political concerns. Such regulations may include rules relating to maximal ownership and the security of rental agreements.
3 Farm Size and Direct Payments

Severini and Tantari (2015) show that the distribution of farm income in the European Union countries is heavily influenced by the farm size distribution via the distribution of direct payments. From a political economy dimension, the presence of large farms can also 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 because the reform would mean that these countries could potentially lose some of their share of the CAP budget. 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.

In table 1, we use European Commission data to show the proportion of all direct payments accruing to the recipients with direct payment amounts in excess of €150,000. In addition, we show the implementation model for each country relevant to the CAP for the 2014-2020 period. Table 1 shows that some countries will not apply capping but will apply measures, which are likely to reduce farm income inequalities. For instance, Germany does not apply real capping, but will apply a national flat rate per hectare payment by 2019. Germany is also among the countries which will apply an additional redistributive payment for the first number of hectares. The redistributive payment is a policy which ought to reduce the role of farm size inequality by altering the distribution of support payments to individual farms.

While the policy of a flat rate per hectare is often considered radical, it is a policy which clearly favours those farms with a relatively large number of hectares. Reducing the link between farm size inequality (in terms of land) and farm income inequality may require more fundamental policy reforms. O'Neill (2014) explores the impact on farm income inequality of a flat rate per hectare policy and a flat rate per farm policy in the UK and Ireland. O'Neill concludes that a flat rate per hectare policy does not uniformly reduce farm income inequalities in the UK and Ireland. This contrasts with a reform involving a flat rate payment per farm, which reduces farm income inequalities significantly. Apart from a flat rate per farm policy, a number of studies have examined other alternatives, including the introduction of a CAP bond (Harvey and Jambor 2011; Howley 2016). Harvey and Jambor (2011) identified a number of advantages to the replacement of the single farm payment with a bond system including a significant reduction in administration costs and bureaucracy. Howley (2016) has however identified from survey data in Ireland that most farm operators are reluctant to voluntarily choose the option of a CAP bond 'even with very high lump sums'. Swinbank and Tranter (2004) discuss the advantages and disadvantages of a CAP bond scheme under circumstances where the entitlements to the bond are transferred on an annual basis rather than on the basis of one lump sum. While emphasising the efficiency benefits of a CAP bond system, the author’s also point to the possible negative implications for land abandonment.

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1 In Germany, the expected value per hectare of the additional payment is approximately €50 per hectare for the first 30 hectares and €30 per hectare for the next 16 hectares i.e. up to 46 hectares. In Belgium (Wallonia), this additional payment applies to the first 30 hectares and is estimated at approximately €115 per hectare. In France, the payment will reach €98 per hectare by 2018 for the first 52 hectares (European Commission 2016).
4 Data

The main data source is based on the 2010 round of the World Programme for the Census of Agriculture as provided by Eurostat (2017). In addition, we provide national-level results using the 2007 Farm Structure Survey. These data provide 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. There are eight size classes in each country with the largest size class being those farms with 100 hectares or greater.

There is some variability between countries and over time in the application of minimum thresholds. Very small farms below the national minimum threshold are excluded from the survey. For most countries, this leads to relatively minor differences in the farm size inequality between the 2007 Farm Structure Survey and the 2010 Census of Agriculture. Inequality and concentration is somewhat lower in the case of Germany and Ireland, if one relies upon the 2007 data but the differences are minor in other cases. In the appendix, we include the results from the 2007 Farm Structure Survey so that comparisons can be formed between the results with the 2007 and 2010 data.

The 2010 data are available for all European Union and EEA (European Economic Area) countries but we have decided, for reasons of feasibility, to concentrate the analysis on 13 western European countries. 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. For the Italian case, we carry out the analysis at the NUTS 3 level, since the availability of data to this level of detail allows us to explore some on the initial results in greater depth.

5 Methodology

The methodology for this research consists of two main components. The first component involves the estimation of farm size inequality and concentration with grouped data. The second component involves the estimation of spatial dependence or spatial autocorrelation between neighbouring regions. In assessing the farm size inequality, we examine both the relative and absolute farm size inequalities. Relative inequality refers to the share of the overall utilisable agricultural area (UAA) in a country or region, with respect to the size of each individual farm. Absolute inequality refers to the average size difference between all farms in the population. Following Kolm (1976), Atkinson and Brandolini (2010) explain that ‘inequality measures are described as “relative” when they are invariant to proportional transformations (scale invariance), and “absolute” when they are invariant to additive transformations (translation invariance)’.

For the estimation of relative farm size inequality, we rely on Abounoori and McCloughan (2003) who have modified the relative Gini coefficient formula of Milanovic (1994) in the following:

\[
RG = C \sum_{k=1}^{k} w_k \left( 1 - \frac{\bar{y}_k}{\bar{y}} \right)
\]  

We acknowledge the contribution of Steve Langton of DEFRA in pointing out the extent of the changes to the thresholds for the UK between the 2007 Farm structures survey and the 2010 Census of agriculture. We acknowledge the contribution of Kevin Hanrahan of Teagasc in relation to the information regarding the thresholds for other European countries. Further information with regard to the minimum thresholds is available from Eurostat (2013).
Where RG refers to the estimated relative Gini coefficient of farm size, \( C = \frac{2}{n} (n + 1) \) and \( w_k \) represents the weight for each size class of farmers. The formulae used to calculate the weights is described in detail in (Abounoori and McCloughan 2003). 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. For the absolute Gini coefficient, we simply multiply the relative Gini coefficient by the mean farm size (Lerman and Yitzhaki 1984; Ferreira and Gignoux 2014). The absolute inequality is essentially the mean absolute difference between all farms in terms of farm income.

\[
AG = RG \times \bar{y}
\]

(2)

The absolute Gini coefficient can also be written as twice the covariance between the individual farm size \( y_i \) and the cumulative distribution of farm size area \( F(y_i) \).

\[
AG = 2 \times \text{cov}[y_i, F(y_i)]
\]

(3)

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:

\[
I = \frac{n \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} (y_i - \bar{y})(y_j - \bar{y})}{S_0 \sum_{i=1}^{n} (y_i - \bar{y})^2}
\]

(4)

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 \( S_0 \). 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 of 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:

\[
I_i = \frac{\sum_{i=1}^{n} (y_i - \bar{y}) \sum_{j \in f_i} w_{ij} (y_j - \bar{y})}{\sum_{i=1}^{n} (y_i - \bar{y})^2} \text{sum}_{j \in f_i} w_{ij} (y_j - \bar{y})
\]

(5)

where \( f_i \) 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. We also conduct the analysis without this assumption by following Anselin’s randomization process based on the empirical distribution of farm size inequalities.

For the estimation of farm size concentration, we estimate the mid-point hectare at the regional and national level (Lund and Price 1998). The Census data of farm size is based on size class groups, but it is possible to estimate these statistics using the size class information. Estimating the
midpoint hectare statistic firstly involves identifying the size class containing the median hectare i.e. the 50th percentile of the distribution and applying the following formula:

$$\bar{X} = LL + w * \frac{n/2-F}{f}$$  \hspace{1cm} (6)

Where $\bar{X}$ 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 number of hectares in the population, $F$ represents the cumulative distribution of hectares up to the lower limit (LL) of the median size class and $f$ represents the number of hectares in the interval containing the median farm.

6 Results

In this section, we present results showing the extent of the farm size inequality and concentration in each country. These initial results do not address the question of spatial dependence in a formal test, but do provide some indicators regarding the farm size inequality and concentration that exists across Western Europe.³

It is evident from table 2 that the relative Gini coefficient of farmland size is high in the Mediterranean countries and much lower in some of the Northern European countries such as Ireland and Belgium. The findings with regard to the absolute Gini coefficient give a different picture. Absolute inequality is lowest in Italy (6), followed by Portugal (10), while it is highest in the United Kingdom (57) followed by Denmark (38), Germany (35) and France (31). We should not conclude that there is a clear North-South divide. For example, absolute inequality is higher in Spain (19) than in Belgium (18) or the Netherlands (15). If one concentrates on the farm size concentration (midpoint hectare value), it is clear that Italian agriculture does not have a highly concentrated farmland distribution relative to other countries. The farm size concentration value statistic for Italy (36.34 hectares) is the second lowest value among the 13 countries and suggests that small farms account for a large share of the agricultural area in Italy. Salvioni et al. (2014) examines the survival of small farms in Italy and points to their economic and societal importance, particularly in places where there is an absence of off-farm employment opportunities.

In Figure 1, we show the midpoint hectare statistic for each region and the Gini coefficient of farm size inequality in Figure 2. Figure 1 shows a good deal of variability in the midpoint hectare statistic among the regions considered. In a number of countries, there appears to be a quite uniform degree of farm size concentration. For instance, the farm size concentration exceeds 100 hectares in the vast majority of the United Kingdom and France, while the midpoint farm size statistic is below 60 hectares in most of Italy, Switzerland and Austria. Portugal appears to be something of an exception where there is considerable difference between the north and the south, the origins of which are explained in more detail in (Salvioni et al. 2014). There also appears to be heterogeneity within Germany, with relatively high farm size concentration in the North and lower concentration in the south. While the southern region of Bavaria has a tradition of small-scale farming, the median farm size appears to have risen in recent times along with the rest of southern and western Germany (Piet 2016, p. 15). It appears that the median farm size exceeds 100 hectares in all of the regions, which previously formed the German Democratic Republic (GDR) and this is to some extent a legacy of

³ Due to the data limitations, we do not estimate the precise midpoint hectare statistic for those countries where the midpoint hectare lies in the size category of greater than 100 hectares. Eurostat does not provide a level of disaggregation beyond the threshold of 100 hectares.
the expropriation, collectivization and pressure to increase farm size under the soviet regime (Gross 1996).

While the midpoint statistic gives an account of the farm size concentration, the relative Gini coefficient can provide a measure of farm size inequality. The relative Gini coefficient 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 farm population. In Figure 2, we show that the relative 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). In our analysis, we identify some heterogeneity within individual countries including Spain where the relative inequality appears greater in the south relative to the north.

Interestingly, a recent study by Rocamora-Montiel et al (2014) examined the social attitudes of citizens in Southern Spain with regard to CAP reform and reported a majority (58.7%) calling for a reduction in the inequality of the CAP support distribution.

We identify some within-country variability in the United Kingdom. The south and south-western parts of England appear to have higher farm size 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. This can be attributed to the land clearances, which created a bimodal distribution consisting of large farms in much of the highlands and small crofting farms on the western seaboard and offshore islands (Bryden and Geisler 2007).

A number of academic studies have addressed the issue of land inequalities in the Highlands of Scotland (MacMillan, 2000; Hoffman, 2013). In examining the broader issue of farm income inequalities in Scotland, Allanson et al (2017) find that a large proportion of the farm income inequality is due to structural factors such as the farm business size. Allanson et al. conclude that the Scottish Government's policy decisions with regard to the CAP 2014-2020 period has 'sought to limit the resultant scale of farm income redistribution'. This is due to the explicit use of non-geographic regions reflecting the variation in the productive capacity of the land (For further details, Scottish Government 2014). 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).

Spatial Dependence

Applying Exploratory Spatial Data Analysis techniques (Anselin, 1995) 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 4, 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 2. 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.

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 3, we therefore show the results for the local Moran’s I test for each of the 169 regions. It is clear from Figure 3 that some significant geographical clusters can be detected in terms of the inequality of farm size. Figure 3 refers to relative inequality and the picture could be somewhat different under absolute inequality. The model detects the Highlands of Scotland as a significant outlier. 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 spatially disaggregated level.

In Figure 3, 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. There appears to be some overlap with the spatial patterns identified in Ezcurra et al. (2008) whereby regions with relatively high farm size inequality appear to have weaker agricultural productivity relative to the regions with relatively low farm size inequality such as Northern France. This tends to confirm the findings of Vollrath (2007) which identified a negative cross-country relationship between land inequality and agricultural productivity.

**Italian Results**

Here, we take a closer look at the Italian case. This is due to our contrasting findings for relative inequality (high), absolute inequality (low) and concentration (low) for the Italian case. The quality of data available at the NUTS 3 level for the Italian case is also a factor. Unlike the Census of Agriculture in most other European countries, the Italian Census of Agriculture provides easily accessible detailed data on farm size classes at the NUTS 3 level (ISTAT 2010). Farm size inequality has been the subject of much academic interest in Italy. Martinelli (2014) explored farm size inequality in Italian agriculture during the early 20th century concluding that the high land inequality shifted ‘relative factor prices against labour and in favour of land, as predicted by a monopsony model’. Elsewhere, Percoco (2015) finds that high land inequality with strong family ties reduced the probability of becoming an entrepreneur in Italy during the 1950s. This result confirmed the argument of Banfield (1958) that unequal land ownership motivates individuals towards a greater reliance on relatives and a reduction in the degree of cooperation with the rest of society.

In this paper, we show in figure 4, the farm size concentration (midpoint hectare value) for each NUTS 3 region in Italy. In figure 5, we show a map detailing the relative Gini coefficient of farm size in each NUTS 3 region. In figure 4, there appears a good deal of spatial variability within Italy but the midpoint hectare exceeds 100 hectares in only a few parts of the country. The few exceptions include the provinces of Verbano-Cusio-Ossola and Sondrio, both situated near the Swiss border. In general, the median farm size appears higher in Northern Italy where the cultivation of Durum wheat and other scale-intensive crop production is popular. The concentration in farm size is lower in much of Southern Italy where the midpoint hectare is less than 30 hectares in most places. In southern Italy, there were significant land reforms after WWII, which involved areas of land being transferred from large estates and allocated to local farmers (For more detail, see, Bonanno 1988, Alacevich 2013). In Northern Italy, there is some heterogeneity between neighbouring regions. Many parts of North-eastern Italy have a midpoint hectare less than 30 hectares. The difference in farm size between neighbouring provinces and regions may be influenced by regional-level policy. Defrancesco et al (2008) explain that regions hold legislative power with regard to agricultural policies and this may influence the scale and type of farming pursued in each province or region. For instance, the Veneto region is noted for pursuing conservation agriculture (Piccoli et al 2016).

In figure 3, we showed that the Gini coefficient of farm size exceeded 0.65 in almost every NUTS 2 region in Italy. However, if one takes a more spatially disaggregated approach, it becomes clear that farm size inequality is not particularly high in many parts of Italy. It is evident from figure 5 that the east coast of Italy, beside the Adriatic sea, has relatively low farm size inequality. This pattern of
relatively low inequality is also evident from the work of Percoco (2015) with regard to farm size inequality in the early 1930s. This indicates that there is some persistence in the spatial variability of farm size inequality through time.

Relatively low inequality also appears to be the case for some parts of Northern Italy between Genoa and Venice where the inequality within each NUTS 3 region is typically less than 0.60. Inequality tends to be high in mountainous Northern regions such as Trento and the Aosta Valley. The presence of low inequality did not appear in figure 3, partly due to the different regional disaggregation. Based on the results of Percoco (2015) for the early 1930s, it appears that land inequality declined significantly in much of Northern Italy since that time. Much of the regional inequality literature in Italy shows that economic growth in Northern Italy far surpassed that of Southern Italy during the second half of the 20th century (see, for example, Felice 2011 and Felice and Vasta 2015).

7 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. On the policy front, high farm size 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.

Our analysis identifies regional farm size clusters, which in some instances straddle national borders. For example, the farm size concentration is relatively low in the Netherlands and neighbouring Belgium and is also low in Bavaria, Austria and Northern Italy. The farm size concentration is relatively high in Southern Portugal and Southern Spain. These patterns imply that national level policy is not the sole determinant of farm size inequality and that the extent of inequality has origins in pan national regional considerations, which may relate to natural endowments, population density or deeply embedded historical, societal and cultural factors. For these reasons, a regression based analysis of the determinants of farm size inequality should include historical farm size and population data from an appropriate benchmark year, as in the case of (Deininger and Squire 1998; Frankema 2005).

The farm size distribution dictates a large proportion of the farm income distribution in many European countries. The historical and regional models of implementation for the single farm payment may, in some instances, differ in terms of their effect on the extent of farm income inequality. The regional model of implementation is often found to reduce inequality relative to the historical model but this is not universal due to the unequal distribution of agricultural land. Both the regional and historical policy models heavily favour particular farms on the basis of farm size or the level of historical production, thereby limiting the progress of new entrant farmers or farmers wishing to expand from a small land endowment.

The research points to the important distinction between relative and absolute inequality of farmland size. The relative inequality is highest in Spain and Portugal while absolute inequality is greatest in the United Kingdom. It appears that individual countries differ in the approach to farm size inequality. For instance, French policy appears to place considerable weight on the relative distribution, as the rise in the average farm size has been accompanied by a stable relative income
inequality, influenced by the interventions of the SAFER organisation. By contrast, in Italy, the emphasis appears to be geared towards containing the absolute inequalities via the protection of small farms. The interpretation of farm size inequality may differ between countries, but it remains critical that this issue is considered in developing the CAP and in attempting to balance market objectives and societal goals.

8 References


## 9 Appendix

Table 1: Implementation of the CAP 2014-2020 including Largest Payment Policy

<table>
<thead>
<tr>
<th>Country</th>
<th>Implementation Model 2014-2020</th>
<th>Degressivity/ Capping</th>
<th>Redistributive Payment</th>
<th>% Share of Direct Payments Above €150,000 in 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE</td>
<td>Partial convergence 60%/90%</td>
<td>Max €150,000 (Flanders) Not Implemented (Wallonia)</td>
<td>No (Flanders) Yes (Wallonia)</td>
<td>0.06</td>
</tr>
<tr>
<td>DK</td>
<td>National flat rate payment in 2019</td>
<td>5% Reduction on Amounts Above 150,000</td>
<td>No</td>
<td>1.45</td>
</tr>
<tr>
<td>DE</td>
<td>National flat rate payment in 2019</td>
<td>Not Implemented</td>
<td>Yes</td>
<td>1.14</td>
</tr>
<tr>
<td>IE</td>
<td>Partial convergence 60%/90%</td>
<td>Max €150,000</td>
<td>No</td>
<td>0.03</td>
</tr>
<tr>
<td>ES</td>
<td>Partial convergence 60%/90%</td>
<td>5% Reduction on Amounts Above 150,000, Max €300,000</td>
<td>No</td>
<td>0.16</td>
</tr>
<tr>
<td>FR</td>
<td>Partial convergence (Mainland) 60%/100% Regional flat rate 2015 (Corsica)</td>
<td>Not Implemented</td>
<td>Yes</td>
<td>0.25</td>
</tr>
<tr>
<td>IT</td>
<td>Partial convergence 60%/90%</td>
<td>Max €500,000</td>
<td>No</td>
<td>0.12</td>
</tr>
<tr>
<td>LU</td>
<td>Partial convergence 60%/90%</td>
<td>5% Reduction on Amounts Above 150,000</td>
<td>No</td>
<td>0.67</td>
</tr>
<tr>
<td>NL</td>
<td>National flat rate payment in 2019</td>
<td>5% Reduction on Amounts Above 150,000</td>
<td>No</td>
<td>5.58</td>
</tr>
<tr>
<td>AT</td>
<td>National flat rate payment in 2019</td>
<td>Max €150,000</td>
<td>No</td>
<td>1.41</td>
</tr>
<tr>
<td>PT</td>
<td>Partial convergence 60%/90%</td>
<td>5% Reduction on Amounts Above 150,000</td>
<td>No</td>
<td>9.73</td>
</tr>
<tr>
<td>UK</td>
<td>Regional flat rate payment in 2015 (England) Regional flat rate payment in 2019 (Scotland and Wales) Regional flat rate payment in 2021 (Northern Ireland)</td>
<td>5% Reduction on Amounts Above 150,000 (England) Max €150,000 (Northern Ireland) 5% Reduction on Amounts Above 150,000 and Max €500,000 (Scotland)</td>
<td>No</td>
<td>13.65</td>
</tr>
</tbody>
</table>
15% Reduction on Amounts Above
150,000, 30% to 200,000, 55% to 250,000, Max 300,000 (Wales)


Table 2: Gini Coefficient of farm size inequality and Midpoint Hectare (farm size concentration) for 13 Western European Countries

<table>
<thead>
<tr>
<th>Region</th>
<th>Relative GINI</th>
<th>Absolute GINI</th>
<th>Midpoint Hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>0.58</td>
<td>11.19</td>
<td>38.18</td>
</tr>
<tr>
<td>Belgium</td>
<td>0.54</td>
<td>17.50</td>
<td>63.07</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.58</td>
<td>37.87</td>
<td>100+</td>
</tr>
<tr>
<td>France</td>
<td>0.58</td>
<td>31.90</td>
<td>100+</td>
</tr>
<tr>
<td>Germany</td>
<td>0.62</td>
<td>34.78</td>
<td>100+</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.48</td>
<td>17.14</td>
<td>51.57</td>
</tr>
<tr>
<td>Italy</td>
<td>0.75</td>
<td>6.00</td>
<td>36.34</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>0.48</td>
<td>28.75</td>
<td>100+</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.56</td>
<td>14.84</td>
<td>51.22</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.82</td>
<td>9.92</td>
<td>100+</td>
</tr>
<tr>
<td>Spain</td>
<td>0.77</td>
<td>18.94</td>
<td>100+</td>
</tr>
<tr>
<td>Switzerland</td>
<td>0.39</td>
<td>7.10</td>
<td>25.24</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0.62</td>
<td>57.29</td>
<td>100+</td>
</tr>
</tbody>
</table>

Source: Own calculations using Censuses of Agriculture 2010 data (Eurostat 2017).

Table 3: Gini Coefficient of farm size inequality and Midpoint Hectare (farm size concentration) for 13 Western European Countries with 2007 Farm Structure Survey Data

<table>
<thead>
<tr>
<th>Region</th>
<th>Relative GINI</th>
<th>Absolute GINI</th>
<th>Midpoint Hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>0.61</td>
<td>11.79</td>
<td>39.72</td>
</tr>
<tr>
<td>Belgium</td>
<td>0.55</td>
<td>16.05</td>
<td>57.48</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.57</td>
<td>34.06</td>
<td>100+</td>
</tr>
<tr>
<td>France</td>
<td>0.57</td>
<td>29.98</td>
<td>100+</td>
</tr>
<tr>
<td>Germany</td>
<td>0.66</td>
<td>30.21</td>
<td>100+</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.44</td>
<td>14.12</td>
<td>46.71</td>
</tr>
<tr>
<td>Italy</td>
<td>0.73</td>
<td>5.57</td>
<td>32.72</td>
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<tr>
<td>Luxembourg</td>
<td>0.48</td>
<td>27.43</td>
<td>95.88</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.55</td>
<td>14.04</td>
<td>48.15</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.82</td>
<td>10.35</td>
<td>100+</td>
</tr>
<tr>
<td>Spain</td>
<td>0.78</td>
<td>18.76</td>
<td>100+</td>
</tr>
<tr>
<td>Switzerland</td>
<td>0.39</td>
<td>6.71</td>
<td>24.15</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0.63</td>
<td>48.64</td>
<td>100+</td>
</tr>
</tbody>
</table>

Source: Own calculations using Farm Structure Survey 2007 data (Eurostat 2017).

Table 4: Global Moran’s I Test

<table>
<thead>
<tr>
<th>Region</th>
<th>Global Morans I</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Europe</td>
<td>0.120</td>
<td>0.000***</td>
</tr>
</tbody>
</table>
Figure 1: Midpoint Hectare Statistic [UAA Hectares] by NUTS2 Region in Western Europe

Source: Own calculations using Censuses of Agriculture 2010 data (Eurostat 2017).
Figure 2: Gini Coefficient for Farm Size Inequality by NUTS 2 Region in Western Europe

Source: Own calculations using Censuses of Agriculture 2010 data (Eurostat 2017).

Figure 3: Local Moran’s I Results for Inequality by NUTS2 Region [Normal Distribution Method]

Source: Own calculations using Censuses of Agriculture 2010 data (Eurostat 2017).
Figure 4: Mid-Point Hectare for Farm Size Concentration by NUTS 3 Region in Italy

Source: Own calculations using Italian Census of Agriculture 2010 data (ISTAT 2010).

Figure 5: Gini Coefficient for Farm Size Inequality by NUTS 3 Region in Italy

Source: Own calculations using Italian Census of Agriculture 2010 data (ISTAT 2010).