A comparative analysis of the redistributive effects of agricultural policy in Tuscany and Scotland

Paul ALLANSON, Benedetto ROCCHI***

* Economic Studies, School of Social Sciences, University of Dundee, Dundee DD1 4HN, United Kingdom
e-mail : p.f.allanson@dundee.ac.uk

** Department of Agricultural and Resource Economics, University of Florence, Italy

Summary – *The article provides an empirical study of the redistributive effects of agricultural policy in Tuscany which finds that the provision of support increased absolute income inequality within the agricultural community because the distribution of transfers was both vertically and horizontally inequitable. These conclusions are shown to hold whether or not non-farm incomes are taken into account and for a range of alternative definitions of the agricultural community. The results for Scotland are broadly comparable except that the distribution of transfers was progressive not regressive, reflecting differences between the two regions in the degree of dependency of agriculture on support.*

Keywords: *Income redistribution, agricultural policy, Tuscany, Scotland*

Analyse comparative des effets redistributifs de la politique agricole en Toscane et en Écosse

Résumé – L'article développe une étude empirique des effets redistributifs de la politique agricole dans la région de Toscane. Il apparait que les aides ont augmenté les inégalités de revenu en absolu parmi les agriculteurs en raison d'une distribution des transferts inéquitable, à la fois verticalement et horizontalement. On montre que ces conclusions demeurent valables que l'on considère ou non les revenus non-agricoles et pour différentes définitions de l'exploitant agricole. Les résultats pour l'Écosse sont globalement comparables sauf que la distribution des transferts est progressive et non-régressive, reflétant les différences entre les deux régions dans le degré de dépendance de leur agriculture aux aides.

Mots-clés: redistribution des revenus, politique agricole, Toscane, Écosse

Descripteurs JEL : D63, I38, Q18

The work for this article was undertaken with financial support from the Carnegie Trust for the Universities of Scotland and the Faculty of Arts and Social Sciences, University of Dundee. The authors would also like to thank the Statistical Office of the Regional Government of Tuscany and the Scottish Executive Environment and Rural Affairs Department for making available the data employed in the study. All opinions expressed in this article are solely the responsibility of the authors.

1. Introduction

The European Commission (1991, 1997, 2002) has for many years expressed concerns about the inequitable distribution of farm income support, while successive reforms of the Common Agricultural Policy (CAP) have made the distribution of that support both more transparent and, potentially, more amenable to manipulation. However there has been relatively little empirical work to characterise and quantify the effects of farm support programmes on the distribution of income within the agricultural community. One set of studies (see *e.g.* Roberts and Russell, 1996; Rocchi *et al.*, 2005; Cavalletti and Rocchi, 2006) has examined the distributional effects of agricultural policy using macroeconomic models in which the agricultural household sector is disaggregated by total household income class. In particular, Rocchi *et al.* (2005) present a SAM-based model for Italy which shows *inter alia* that agricultural households in higher total income classes receive a larger share of the total value of CAP support accruing to the sector. A second line of work (see *e.g.* Keeney, 2000; OECD, 2003; Allanson, 2006 and 2008) has sought to explore the issues using farm business survey data. The use of micro-level data allows a more detailed characterisation of the redistributive properties of agricultural policy transfers, but limitations in farm business survey coverage and content have typically restricted the scope of such studies to the commercial farm sector and the analysis to measures of farming income. Thus Allanson (2008) is only able to establish that agricultural support would have had an equalizing effect on the distribution of farming income across full-time farms in Scotland but for the adverse distributional consequences of horizontal inequities induced by farm support measures. What remains to be shown is whether such estimates of the redistributive effects of the CAP are specific to the empirical setting or might hold more generally for broader measures of income, more inclusive definitions of the agricultural community and other regions of the European Union.

The main contribution of this article is to report the results of a microeconomic study of the redistributive effects of agricultural support in Tuscany that serves to throw light on all three of these issues. First, the study offers a broader analysis of the impact of farm income support on the economic welfare of the farming community by taking into account both farm and non-farm sources of income. Farm households that are entirely dependent on agricultural production for their livelihoods are a minority, with most also relying on some combination of income from other gainful activities, pensions, social security and other payments to a greater or lesser extent (Eurostat, 2002; United Nations Economic Commission for Europe, 2007). Yet the design of agricultural policy almost entirely fails to take the overall income situation of farm households into account. Second the study explores the implications of using less restrictive definitions of the agricultural community than the commercial farms sector. In particular, the article provides additional results based on both "broad" and "narrow" definitions of the agricultural household sector, where the former covers all households which derive some income from agriculture while the latter is limited to those for which farming is the main source of income. Finally, the article provides a comparative study, which can serve to establish whether the results obtained for Scotland are peculiar to that country or might be more generally characteristic of the effects of the CAP. The choice of Tuscany for this purpose is likely to highlight any

variability in the distributional consequences of the CAP across the European Union given the marked differences in both output mix and farm structures between the UK and Italy. Conversely, the identification of common features would help to establish the generality of any conclusions regarding the redistributive effects of the CAP.

The article is organised as follows. Section 2 outlines the measurement framework used to characterise and quantify the redistributive effects of agricultural policy transfers. Section 3 introduces the study, which is static in nature providing measures that are based on the observed provision of support given the existing distribution of pre-transfer incomes. That is to say, the empirical analysis does not allow for the impact of policy-induced changes in farm production choices, the state of agricultural input and output markets or agricultural structures on either the incidence of transfers or pre-transfer incomes. Nevertheless, the results that are presented in Section 4 usefully offer a fresh perspective on the redistributive performance of agricultural policy, complementing existing aggregate transfer measures such as the OECD's Producer Support Estimates. Section 5 concludes.

2. Measurement of the redistributive effects of agricultural policy transfers

The measurement framework is based on that proposed in Allanson (2008) to characterise and quantify the redistributive effects of agricultural policy transfers in terms of the resulting changes in absolute income inequality. Specifically, $R = A_X - A_Y$ is defined as an index of the overall redistributive effect of farm income support, where A_X and A_Y are the absolute Gini indices of pre-transfer and post-transfer incomes respectively. This measure is invariant to equal absolute changes in all incomes, providing a benchmark of distributional neutrality more in accord with both public and official perceptions of redistributive justice than one based on the more commonly used concept of relative inequality. R is expressed in monetary terms being equal to half the change in the average absolute income differential between farms due to the provision of support. Moreover, if the policy evaluation function is given by the Sen (1973) welfare index $W = \overline{y} - A$, where $\overline{y}$ is average income, then R may be interpreted as how much more or less would have to be given to each farmer under a distributionaly neutral policy of flat-rate payments to yield a welfare level equal to that under the actual support programme. Finally, the measure is able to handle the occurrence of negative farm incomes or losses, being well defined even if pre-transfer incomes are negative on average.

2.1. Decomposition of the overall redistributive effect

The index R is decomposed to provide an explicit characterisation of the redistributive properties of policy transfers as the sum of vertical equity and horizontal inequity (HI) components. The principle of vertical equity concerns the appropriate differentiation of the treatment of pre-transfer unequals, with norms specifying how transfers should vary with levels of pre-transfer income or welfare. The common belief that the poor are more deserving of support than the rich implies that transfer schedules should be progressive in absolute terms. Horizontal equity is classically defined as the equal

treatment of pre-transfer equals though it has also been associated with the absence of reranking of pre-transfer unequals (Jenkins and Lambert, 1999): A common denominator is that the presence of horizontal inequities will result in a loss in redistribution, *i.e.* post-transfer income inequality will be higher than it otherwise would have been. The full decomposition yields $R = H_W + H_B + H_R + V$, where H_W and H_B measure the redistributive effects of classical HI within and between farm types, H_R is a systematic reranking effect, and the vertical equity component V is determined by the scale and progressivity of transfers.

The key to the decomposition is the sequential identification of the post-transfer incomes that farmers with a given level of pre-transfer income would receive in the absence of the various sources of HI. Consider a population of N farms made up of an exhaustive set of K mutually exclusive farm types ($k = 1,... K$), where each type produces a more or less similar combination of commodities (*e.g.* specialist field crops, specialist grazing livestock, etc.). Let $\boldsymbol{y} = (\boldsymbol{y}_1,\ldots \boldsymbol{y}_k,\ldots \boldsymbol{y}_K)$, $\boldsymbol{t} = (\mathrm{t}_1,\ldots \boldsymbol{t}_k,\ldots \boldsymbol{t}_K)$ and $\boldsymbol{x} = (\boldsymbol{x}_1,\ldots \boldsymbol{x}_k,\ldots \boldsymbol{x}_K)$ be the vectors of observations on post-transfer income, transfers and pre-transfer incomes respectively, where $\boldsymbol{y}_k$, $\boldsymbol{t}_k$, and $\boldsymbol{x}_k$ are constituent sub-vectors of observations on farms of type k. By definition, $\boldsymbol{y} = \boldsymbol{x} + \boldsymbol{t}$. Moreover the relationship between transfers and pre-transfer incomes can be written as:

$$\boldsymbol{t}_k = \mathrm{E}[\boldsymbol{t}_k | \boldsymbol{x}_k] + \boldsymbol{\varepsilon}_k = f_k(\boldsymbol{x}_k) + \boldsymbol{\varepsilon}_k; \qquad k = 1,\ldots K \tag{1}$$

where the farm type transfer function $f_k(\boldsymbol{x}_k)$ is identified as the expected value of transfers conditional upon type and pre-transfer income; and $\boldsymbol{\varepsilon}_k$ is a vector of 'disturbance' terms having zero mean at each pre-transfer income level.

This characterisation of transfers allows for two possible sources of classical HI. First, the disturbance terms in (1) allow for the possibility that farms of type k with identical pre-transfer incomes may not receive the same level of transfers due to differences in natural resource endowments, managerial ability and historical development. For example, high-performance farms, in terms of output per unit input, will typically receive below average transfers conditional upon pre-transfer income if support is coupled to current output and/or input levels. Post-transfer incomes in the absence of this within-type HI would be given by the non-stochastic reference function $h_W(\boldsymbol{x}) = \boldsymbol{x} + (f_1(\boldsymbol{x}_1),\ldots f_k(\boldsymbol{x}_k),\ldots f_K(\boldsymbol{x}_K))$ as all farms would receive the expected level of transfers conditional upon type and pre-transfer income. Accordingly, within-type HI is measured as the difference in inequality between $h_W(\boldsymbol{x})$ and $\boldsymbol{y}$, that is $H_W = A_W - A_Y$, where A_W is the absolute Gini index of $h_w(\boldsymbol{x})$, which will in general be non-positive (Rodríguez *et al.*, 2005). Only if there is no dispersion of transfers about the farm type transfer functions will there be no within-type HI.

Second, the specification of separate functions for each farm type in (1) allows for the possibility that different types of farm with identical pre-transfer incomes may not expect to receive the same transfers because of systematic differences in the organization and level of support for different commodities. Assuming that such discrimination between farm types changes the distribution but not the overall value of transfers at any given level of pre-transfer income (see Kakwani and Lambert, 1999), post-transfer incomes in the absence of all classical HI would be given by the non-discriminatory reference function:

$$h_B(\boldsymbol{x}) = \boldsymbol{x} + E[\boldsymbol{t} \mid \boldsymbol{x}] = \boldsymbol{x} + \sum_{k=1}^{K} w_k(\boldsymbol{x})\, f_k(\boldsymbol{x}) \equiv \boldsymbol{x} + f_B(\boldsymbol{x})\,; \qquad \sum_{k=1}^{K} w_k(\boldsymbol{x}) = 1, \quad (2)$$

where the weights $w_k(\boldsymbol{x})$ are locally determined by the relative frequencies of the farm types at any given pre-transfer income, $f_B(\boldsymbol{x})$ is identified as the non-discriminatory transfer function, and 1 is the unit vector. Accordingly, between-type HI is measured as the difference in inequality between $h_B(\boldsymbol{x})$ and $h_W(\boldsymbol{x})$, that is $H_B = \mathrm{A}_B - \mathrm{A}_W$, where A_B is the absolute Gini index of $h_B(\boldsymbol{x})$, which will again be non-positive (see Kakwani and Lambert, 1999). Only if there is no divergence between the farm type transfer functions will there be no between-type HI.

The non-discriminatory reference function in (2) provides a unique mapping from pre-transfer to post-transfer incomes but may induce systematic changes in the ranking of farms if higher pre-transfer incomes are associated over some range with lower non-discriminatory incomes. The effect of this systematic reranking is measured as $H_R = \overline{y}_B C_B - A_B = \overline{y}_B H_{AP}$, where $\overline{y}_B$ is mean non-discriminatory income, C_B is the (ordinary) concentration coefficient of non-discriminatory income ranked by pre-transfer income and H_{AP} is the well-known Atkinson-Plotnick reranking index (Atkinson, 1980; Plotnick, 1981). H_R is non-positive by definition, capturing the idea that systematic reranking is a manifestation of procedural unfairness in the provision of support. Only if the non-discriminatory reference function contains no "income traps" will there be no systematic reranking of farms.

The identification of the various horizontal inequity effects leaves the vertical equity component $V = A_X - \overline{y}_B C_B$ as a residual. This may be interpreted as an index of gross redistributive effect and measures the impact of differences in non-discriminatory policy transfers between farms with different pre-transfer incomes. V will be positive if support is progressive (regressive) in absolute terms such that mean non-discriminatory transfers are a decreasing (increasing) function of pre-transfer income, and will equal zero if the transfer schedule is uniform. More specifically, V can be shown to depend on the distribution and scale of non-discriminatory transfers in the manner of Kakwani (1977). Thus, $V = D\overline{t}_B$ where the absolute progressivity or disparity index D is equal to the negative of the (ordinary) concentration coefficient of non-discriminatory transfers ranked by pre-transfer income and $\overline{t}_B$ is the mean level of non-discriminatory transfers. In general, V will be more positive (or less negative) than R due to the various sources of HI that will typically undermine the redistributive effectiveness of policy transfers.

2.2. Reference function estimation

The reference functions $h_W(\boldsymbol{x})$ and $h_B(\boldsymbol{x})$ may be directly estimated as in Allanson (2008), but an indirect approach via estimation of the set of farm type transfer functions $f_k(\boldsymbol{x}_k)$ in (1) and the non-discriminatory transfer function $f_B(\boldsymbol{x})$ in (2) is preferable inasmuch as this yields more meaningful regression summary statistics. The choice of a suitable non-parametric technique for this purpose gets round the need to impose any parametric assumptions on the form of the transfer functions. In this study, the variable span smoother of Sasieni (1998) is used to fit a local linear regression to the observations on transfers and pre-transfer incomes in the neighbourhood of each

data point in the relevant sample. Local linear regression may be expected to provide reasonable approximations to the transfer functions so long as their curvature is not excessive (Hastie and Loader, 1993). Moreover the choice of estimator allows the use of inferential procedures that are analogous to those familiar from the least-squares fitting of parametric functions (Cleveland and Devlin, 1988). Finally, the procedure ensures that the predicted level of non-discriminatory transfers at any given pre-transfer income will automatically reflect the farm type composition of the pooled sample in the neighbourhood of that point.

3. Data sources and derivation of variables

Calculation of the redistributive effect measures requires access to individual farm data on pre-transfer and post-transfer incomes. The empirical study is based on weighted micro-level data for Tuscany from the Italian Agricultural Business Survey (REA) for 2002 and for Scotland from the Scottish Farm Accounts Survey (FAS) for the farming year 2002/2003. The two surveys form the main sources of microeconomic data on farm businesses in their respective countries, with sub-samples from each forming part of the European Union's Farm Accountancy Data Network (FADN). Nevertheless there are significant differences between the surveys in terms of coverage and content, which constrain the common definition and derivation of variables used in the study.

3.1. Italian data [1]

The Italian Farm Business Survey (REA) has been carried out annually since 1999 by the National Institute of Statistics (ISTAT, 2005). The original purpose of the survey was to provide microeconomic information compatible with the new European System of National Accounts (ESA95) to assist in the construction of the Economic Accounts for Agriculture. Accordingly, the REA sample is designed to represent the universe of agricultural holdings, with farms chosen to be representative of their economic size and type at the regional level, where the economic size of businesses is measured in terms of standard gross margins and the farm type classification is based on the relative importance of the various crop and livestock enterprises. The inclusion in the observation field of all holdings makes the survey representative of the totality of agricultural households, whatever the importance of farming as a source of income. From 2002 onwards, the information required by FADN has been collected from a sub-sample of the farms in the REA survey [2].

[1] Access to the Italian data was authorised as part of the research project on "The use of microeconomic information for the analysis of income distribution in Tuscan Agriculture" funded by the Regional Government of Tuscany and carried out by the Department of Agricultural and Resource Economics of the University of Florence.

[2] The observation field of the REA survey is the same as that of the 5th Italian General Census of Agriculture, covering farms of at least 1 hectare plus those of less than one hectare marketing at least 2 066 euros of agricultural products. The FADN sub-sample is restricted to holdings exceeding a size of 4 Economic Size Units (ESU). The FADN part of the REA survey is carried out by the National Institute of Agricultural Economics (INEA).

The REA sample for Tuscany in 2002 consisted of 643 farms, of which 569 were operated by households. Data are available on a sufficient range of financial variables to identify farming income but the underlying physical quantities are not generally recorded in the database. Complete data on hours and remuneration, both on and off the farm, are also available for each economically active farm household member and for any other partners and directors who are actively engaged in the farm. This allows for an estimation of the total income of farming households and an assessment of their relative position within the income distribution of the society. The data are weighted by size and type according to the number of holdings enumerated in the 5th General Agricultural Census 2000, to yield summary statistics for the population of agricultural holdings. With 83 459 farms in the sampling frame, the sampling fraction for each size and type is 0.77 per cent on average.

3.2. Scottish data

The FAS is an annual survey carried out on behalf of the Scottish Executive Environment and Rural Affairs Department (SEERAD). The survey is based on a sample of farm businesses representing the main farm types in Scotland and is designed to provide information on commercial undertakings providing work for at least one full-time person, preferably where the occupier is largely or wholly engaged in managing and or working the farm. The field of observation therefore excludes farms smaller than 8 ESU as well as specialist livestock units larger than 200 ESU and certain minor farm types (most notably horticulture and specialist pigs and poultry farms). Farms in the survey are chosen to be representative of their economic size and type, but part-time farmers and those with substantial involvement in other agricultural or non-farm activities are normally excluded [3] so the survey results are likely to understate both the prevalence of pluriactivity and the importance of non-farm income sources.

The survey is conducted on an accounting year basis with a typical year-end in early March so FAS 2002/03 centres on the 2002 production and subsidy year. Accounts for 429 farms were collected in 2002/03, but the effective sample size is reduced to 376 once farms directly affected by the Foot-and-Mouth Disease outbreak are excluded from the analysis [4]. Data were collected on a wide range of physical and financial variables, including crop areas, livestock numbers, quotas, production, sales, revenues, subsidies and costs, which allows for the detailed identification of policy transfers as well as of farm income, together with information on other sources of income recorded by income class. The data are weighted by size and type according to the number of farms enumerated in the June 2002 Agricultural Census, to yield summary statistics for the population of full-time farms. With 14 708 farms in the sampling frame, the sampling fraction for each size and type is 2.6 per cent on average.

[3] Income from farm-related activities, such as contracting or wholesaling, should not exceed approximately 20 per cent of the total farm output. However, if the costs and returns from the activity can easily be separated out from the Net Farm Income account, the farm may be retained in the sample. Similarly, if a farm business has associated non-farm activities that can be separated from the Net Farm Income account, the farm may be retained in the sample.

[4] SEERAD (2004) notes that the resultant sub-sample is still sufficient "to give a representative picture of full-time Scottish farm businesses".

3.3. Definition and derivation of variables

The first issue relates to the identification of the agricultural community, which is a notoriously poorly defined concept (Hill, 1990). In the case of Italy, the information available allows us to work with three different definitions of the agricultural community that are commonly used in the literature. The most inclusive is based on the total population of holdings, defined as the set of all farms covered in the General Census of Agriculture, and corresponds with the definition of 'agriculture' as an industry in the National Accounts framework (Eurostat, 1997). This universe will encompass some holdings that are operated by corporate entities using hired managers and workers exclusively. A second more restrictive definition includes only holdings operated by individuals or households, whether with or without the employment of additional hired labour. This corresponds to the broad definition of the agricultural household institutional sector as employed in the Total Income of Agricultural Households methodology (Eurostat, 1995) and may be further restricted to include only holdings operated by households that gain the major part of their income from agriculture. Finally, the universe includes both commercial and non-commercial holdings where the former are defined by FADN to be farms that are *"large enough to provide a main activity for the farmer and a level of income sufficient to support his or her family"*. A third definition therefore is limited to those holdings that can be classified as commercial in the sense of exceeding a minimum economic size, which in the case of Italy in 2002 was set by FADN at 4 ESU. For Scotland, the limited information available restricts the analysis to this third commercial definition of agriculture, for which the threshold size was fixed by FADN at 16 ESU in 2002, within which may be identified a sub-set of farms operated by individuals or households.

The second question concerns the definition of post-transfer income. For Italy, the information allows us to consider concepts of both farm income and total household income. (Post-transfer) farm income is measured by cash income, which represents the cash return to the group with an entrepreneurial interest in the farm, which typically will consist only of members of the household [5], for their manual and managerial labour and on all their investment in the business. Being the difference between total receipts and total expenditure, this measure is seen to correspond closely to the income position as perceived by the farm household (see, for example, Department of the Environment Food and Rural Affairs (DEFRA), 2002) and to be broadly comparable with other non-farm sources of income. (Post-transfer) total household income is equal to the sum of farm income and non-farm incomes, including income from other gainful activities, pensions, social security and other payments. Using information on the total number of household members further allows the measurement of household income on a per-capita basis. This measure may be more appropriate for an analysis of the impact of agricultural policy transfers on the welfare of the agricultural community. For Scotland, cash income as recorded in FAS must be supplemented by

[5] Household and non-household members of the entrepreneurial group are not separately identified in the REA survey; however numbers of the latter are likely to be negligible. In the case of Scotland, 97% of farms in the FAS sample operate as sole traders and partnerships, of which only 1% includes non-family members.

wages paid to family workers, which are separately identified, to yield a comparable measure of farm income. FAS also records non-farm income sources, but of the farmer and spouse only, leading to a total income measure which can serve as a lower-bound estimate of household income that will be exact if there are no other household members that have non-farm sources of income. A *per capita* measure is also workable using information on the number of household members actively involved in the management or operation of the farm business.

Pre-transfer income is simply defined as post-transfer (farm, total household or *per capita*) income minus the net value of transfers due to the provision of support, where the latter is assumed equal to that part of gross support which accrues to farm occupiers as owners of factors of agricultural production. This approach recognizes that farmers may not be the ultimate beneficiaries of farm support programmes, which will also reward other suppliers of agricultural inputs including landlords.

Three types of support are identified in the analysis. First, the impact of market price support on the value of farm output and the cost of purchased feed and seed inputs is calculated using data on the gap between domestic market and border prices for agricultural commodities, measured at the farm gate level, taken from OECD (2005) and Rapanà (2006). One complication is that the REA database records the output of crops, livestock and livestock products, not of individual commodities, so estimates of market price support are constructed for these output categories using FADN data on the average commodity composition of farm output by farm type and region [6]. Second, direct support payments cover those payments made under CAP 'Pillar I' commodity schemes, after taking account of the implicit loss in revenues resulting from obligatory set-aside requirements under the Arable Area Payment scheme. Third, the value of other grants and subsidies includes all other payments to farmers except for those in respect of permanent improvements.

The net value of this support to farmers will depend on the extent to which it results in increased returns to the farm-owned factors of production and hence in increased farm incomes. Following OECD (2003, Part II), the static effect on farm income of a unit increase in output revenues, whether due to market price support, output payments or a reduction in set-aside requirements, is identified as the combined income share of the farm-owned factors of production, while that of a unit increase in direct payments, grants or subsidies to individual inputs (*i.e.* land and breeding livestock) is simply the farm-owned share of those inputs. Estimates of the combined income share of land, labour and capital by farm type are derived from the cross-section survey data as the ratio of average gross value added to average output revenue. Income shares attributable to land and labour are then separately estimated from sub-samples containing only those farms with hired labour and rented land respectively [7], to leave a residual share that is assumed to accrue to capital. Farm-owned shares of factors of

[6] The use of individual farm rather than FADN farm-type average data on the commodity composition of output by output category yields very similar estimates of the main redistributive effects in the case of Scotland.

[7] Note that it is not necessary to separately identify these factor income shares on farms without hired labour and/or rented land.

production are derived for each farm from the sample data. Hence the effective incidence of support is allowed to vary across farms depending on both the mix of support measures and the type and ownership structure of the farm.

4. Empirical findings

Allanson (2008) provides a detailed account of the distributional impact of agricultural support in Scotland over the period 2000/01 to 2004/05. Accordingly, this section focuses on the results for Tuscany and more particularly on the redistributive effects of agricultural policy transfers on the farm incomes of all holdings, and on the total household incomes of the broadly defined agricultural household institutional sector. Comparisons are drawn where appropriate with the results from using alternative definitions of post-transfer incomes and the agricultural community, and those obtained for Scotland.

4.1. Descriptive statistics for Tuscany

The upper panel of table 1 presents weighted summary statistics on farm incomes by farm type for the universe of all farms in Tuscany. The first column presents the results for all farm types and shows that farm income was 10 553 euros on average, but that 21% of farms recorded losses in spite of the support available. The main source of support was provided in the form of direct payments but market price support was also significant with domestic producer prices for most livestock and livestock products well above corresponding world price levels. Leakages to other owners of factors of production mean that farmers are estimated to have received only 65% of the gross value of support on average. Overall, the net value of transfers to farmers was 22% of post-transfer farm incomes, compared to 103% in Scotland, reflecting the lower levels of support for Mediterranean products (Tracy, 1998).

The remaining columns of the top panel present comparable summary information for the eight distinct farm types identified in the FADN General Type classification. Post-transfer income levels were highest on specialist granivore and horticulture farms, which are typically much larger business enterprises. Direct payments only provided the main source of support on crop farms, but are much more significant as a source of transfers given the lower income transfer efficiency of market price support measures [8]. Gross support varied across types, with the highest levels on specialist granivore farms and the lowest on specialist permanent crop farms. Average transfers to farmers follow a broadly similar pattern but differences in transfer efficiency rates lead to a lower degree of variation across farm types. Controlling for average levels of post-transfer income, dependency on policy transfers by farm type varies inversely with international competitiveness (see IRPET, 2004), being particularly low on specialised permanent crop and specialised horticulture farms engaged in the production of wine and

[8] The average value added share of output revenues is positive for all farm types, ranging from 0.44 to 0.70, as is the residual share accruing to the farm-owned factors of production on all but a handful of mixed cropping farms that are heavily reliant on both hired labour and rented land and for which the residual share is set equal to zero.

Table 1. **Weighted summary statistics by farm type, Tuscany**

	General Type of Farming (FADN class)								
Average per farm	All	1	2	3	4	5	6	7	8
Farm Income. Universe of all farms									
Number of observations	643	139	77	234	40	24	95	11	23
% of raised sample		*18.5%*	*2.8%*	*45.2%*	*6.7%*	*0.2%*	*18.6%*	*2.4%*	*5.7%*
Farm business size (ESU)	11	18	43	9	8	48	8	9	7
Post-transfer income (€)	10553	11187	20853	12128	9900	60541	5575	8707	6962
Proportion of farms <0	*21.2%*	*25.7%*	*9.0%*	*23.0%*	*21.6%*	*3.1%*	*21.4%*	*0.3%*	*7.3%*
Gross support (€)	3503	5383	6265	1742	6466	9334	2997	7273	6467
Of which due to:									
Market price support	1309	282	2410	872	4495	8277	864	4498	3727
Direct support payments	1527	4504	384	304	1847	585	1311	2592	2071
Other grants and subsidies	668	597	3471	565	124	472	822	184	670
Transfers to farmers (€)	2283	4321	2177	1015	4535	5816	1741	4517	3882
Of which due to:									
Market price support	665	84	1029	428	3070	4369	315	2448	1714
Direct support payments	1261	3891	282	271	1393	1188	973	1898	1598
Other grants and subsidies	357	347	866	317	72	259	453	171	570
As % of post-transfer income	21.6%	38.6%	10.4%	8.4%	45.8%	9.6%	31.2%	51.9%	55.8%
Pre-transfer income (€)	8270	6865	18676	11112	5365	54725	3833	4191	3080
Proportion of farms <0	*24.9%*	*31.1%*	*9.9%*	*25.8%*	*28.3%*	*6.9%*	*17.4%*	*68.1%*	*9.0%*
Total Household Income. 'Broad' definition of agricultural community									
Number of observations	569	124	75	197	38	22	81	10	22
% of raised sample		*18.8%*	*2.9%*	*45.4%*	*6.0%*	*0.2%*	*18.5%*	*2.4%*	*5.8%*
Farm business size (ESU)	10	18	43	9	8	48	8	9	7
Post-transfer income (€)	20003	20827	25972	20919	20708	47030	17080	24571	13056
Of which: Farm income	9633	10600	20782	10242	11222	39465	5425	9975	6895
Non-farm income	10370	10227	5190	10677	9485	7565	11654	14596	6160
Proportion of farms <0	*1.1%*	*0.8%*	*5.8%*	*0.5%*	*0.2%*	*3.2%*	*0.8%*	*0.0%*	*7.3%*
Gross support (€)	3131	4808	6273	1281	7393	9571	2499	7090	6380
Of which due to:									
Market price support	1171	281	2408	597	5131	8408	715	4479	3673
Direct support payments	1385	4055	385	225	2121	673	1110	2427	2036
Other grants and subsidies	575	473	3480	460	142	490	674	184	670
Transfers to farmers (€)	2127	3879	2184	815	5292	5466	1659	4457	3841
Of which due to:									
Market price support	644	85	1025	338	3595	3849	335	2537	1709
Direct support payments	1151	3519	282	189	1614	1381	884	1748	1562
Other grants and subsidies	332	274	876	288	82	236	440	172	571
Pre-transfer income (€)	17876	16948	23789	20104	15416	41564	15420	20114	9214
Proportion of farms <0	*1.5%*	*0.9%*	*5.8%*	*0.7%*	*3.8%*	*3.2%*	*0.8%*	*0.0%*	*9.0%*

Source: Own calculations using REA data

Notes: FADN Classes: 1 Specialist field crops; 2 Specialist horticulture; 3 Specialist permanent crops; 4 Specialist grazing livestock; 5 Specialist granivores; 6 Mixed crops; 7 Mixed livestock; 8 Mixed crops-livestock.

ornamental plants respectively. Overall, the dispersion of average incomes by farm type was lower for post-transfer incomes than for pre-transfer incomes, implying that the provision of support generally served to reduce rather than exacerbate farm income disparities between farm types in Tuscany. This was also the case in Scotland (see Allanson, 2008), though OECD (2003, Part I) reports that the provision of support increases average income disparities between farm types in most countries.

The lower panel of table 1 reports a similar set of summary statistics on total household incomes by farm type for the broad definition of the agricultural community. The first column again presents the results for all farm types and shows that average total household income was 20 003 euros, of which just less than 50% was derived from farming. Even net of the value of policy transfers, less than 2% of farms recorded a negative income. Total household income levels were highest on specialist granivore farms and lowest on mixed crops-livestock farms, with the ranking of the farm types by total household income roughly the same as that by farm income. In contrast, the ranking of farm types by non-farm income is almost the reverse of that by farm income, with specialist granivore and horticulture farms particularly dependent on farming as a source of income relative to the much lower levels of dependence on non-specialised crop and livestock farms. Overall, non-farm income sources generally served to reduce rather than exacerbate income disparities between farm types in Tuscany with the dispersion of total household incomes by farm type slightly lower than that of farm incomes. The picture that emerges of the relationships between farm, non-farm and total household incomes is broadly similar to that painted by Hill (1999) from reviews of available microeconomic data in a number of countries.

4.2. Empirical findings for Tuscany

Table 2 reports regression summary statistics from the non-parametric estimation of the transfer functions for Tuscany, together with comparable results from the linear regression of transfers on pre-transfers incomes. The first point to note is that the predictive power of the non-discriminatory transfer function, defined as the square of the correlation coefficient between the fitted and observed values (see Zheng and Agresti, 2000), is superior to that of the linear model for all definitions of the agricultural community and measures of income. Pre-transfer income is highly significant in the linear model, but the assumption of linearity can generally be rejected in favour of the non-discriminatory function using an appropriate F test procedure (Cleveland and Devlin, 1988, p. 599). Second the predictive power of the set of farm type functions is superior to that of the non-discriminatory function in all cases. The set of restrictions implicit in the pooled non-discriminatory function are consistently rejected, implying that farm type had a significant influence on the level of transfers conditional on pre-transfer income. Third, the predictive power of the non-parametric models is higher using the farm rather than the household concept of income, which is not unexpected in the absence of any direct link between transfers and non-farm incomes.

Table 3 presents the main findings of the study for Tuscany. The first column provides the results on the redistributive effects of agricultural policy transfers on farm incomes for the universe of all farms. Absolute inequality in post-transfer farm incomes

Table 2. **Summary statistics from transfer function regressions, Tuscany**

Field of coverage	All	Cmrcl	Broad	Broad	Broad	Narrow
Income measure	Farm	Farm	Farm	Hhld	Hhld/hd	Hhld
Predictive power of:						
Linear regression model	0.134	0.122	0.070	0.064	0.054	0.058
Non-discriminatory function $f_B(x)$	0.256	0.211	0.217	0.155	0.120	0.162
Set of farm type specific functions $f_k(x)$	0.372	0.334	0.392	0.279	0.315	0.308
F test of:						
Pre-transfer income effect in linear model	98.85	78.66	42.36	38.56	20.11	35.17
	6.67	*6.68*	*6.68*	*6.68*	*6.71*	*6.68*
Linearity in non-discriminatory function	17.89	16.80	28.43	18.39	8.62	23.40
	6.72	*8.91*	*10.07*	*16.79*	*8.77*	*20.04*
Farm type effects in farm type functions	4.00	3.60	5.49	3.54	3.67	4.41
	2.58	*2.31*	*2.57*	*3.28*	*2.45*	*3.06*

Source: Own calculations using REA data.
Notes: Critical values of the *F* statistics at the 1% significance level are reported in italics.
Fields of coverage: All – Total population of agricultural holdings; Commercial (Cmrcl) – Commercial farm sector; Broad – 'Broad' definition of agricultural households; Narrow – 'Narrow' definition of agricultural households.
Income measures: Farm – Cash income (derived from agricultural activity); Hhld – Total household income; Hhld/hd – *Per capita* household income.

is shown to have been substantial, implying that the average absolute income differential between farms was nearly double average income. In comparison, the distribution of pre-transfer income exhibited somewhat lower levels of absolute inequality. The provision of support thus increased absolute income differentials as indicated by the negative values of the index of net redistributive effect R, which is significantly different from zero at the 1% level. Overall, agricultural policy transfers increased average farm income disparities by 15 per cent.

The decomposition of R reveals three main points of interest. First, the distribution of non-discriminatory transfers was regressive in absolute terms, as indicated by the negative values of the vertical redistribution and disparity indices, V and D. By implication, farmers with high pre-transfer incomes received a more than equal share of non-discriminatory transfers, which is consistent with the findings reported in Rocchi *et al.* (2005) for Italy as a whole. Second, the redistributive impact of the regressive distribution of non-discriminatory transfers was reinforced by the combined effect of the various sources of horizontal inequity, as measured by the sum of the indices H_R, H_B and H_W. Third, the redistributive effect of within-farm type HI was the dominant source of horizontal inequities, with neither the estimate of between-type HI nor that of the systematic reranking effect significantly different from zero at the 5% level. By implication, the main factor underlying horizontal inequities was the stochastic nature of the relationship between transfers and pre-transfer incomes at the farm type level, rather than systematic discrimination between farm types due to the commodity organisation of agricultural support or systematic reranking due to the presence of income traps in the non-discriminatory benefit schedule.

Table 3. **Redistributive effects of agricultural support policy, Tuscany**

Field of coverage		All	Cmrcl	Broad	Broad	Broad	Narrow
Income measure		Farm	Farm	Farm	Hhld	Hhld/hd	Hhld
Number of observations	n	643	567	569	569	569	357
Population		83459	34075	81463	81463	144134	20313
Average post-transfer income (€)	$\overline{y}$	10553	24455	9633	20003	11306	38060
		1253	*2456*	*1140*	*1314*	*712*	*3756*
Of which: Farm income		10553	24455	9633	9633	5444	34919
		1253	*2456*	*1140*	*1211*	*633*	*3675*
Non-farm income		-	-	-	10370	5861	3141
		-	-	-	*584*	*349*	*394*
Average gross support (€)		3503	8115	3131	3131	1770	10096
		357	*713*	*355*	*352*	*192*	*1101*
Average transfers to farmers (€)	$\overline{t}$	2283	5378	2127	2127	1202	6986
		233	*470*	*238*	*236*	*132*	*758*
Average pre-transfer income (€)	$\overline{x}$	8270	19077	7506	17876	10103	31075
		1105	*2218*	*989*	*1175*	*639*	*3380*
Absolute Gini index of post-transfer income	A_Y	10049	20574	8678	10142	5485	24767
		1112	*2037*	*979*	*1007*	*519*	*2752*
Absolute Gini index of farm type specific reference income	A_W	9662	19579	8317	9627	5171	23445
		1100	*2029*	*967*	*995*	*512*	*2750*
Absolute Gini index of non-discriminatory reference income	A_B	9652	19700	8364	9751	5131	23257
		1104	*2033*	*974*	*999*	*515*	*2763*
Absolute concentration index of non-discriminatory reference income	$\overline{y}_B\, C_B$	9652	19700	8364	9751	5131	23242
		1104	*2034*	*973*	*999*	*515*	*2762*
Absolute Gini index of pre-transfer income	A_X	8614	18105	7251	8990	4873	21682
		1030	*1950*	*894*	*929*	*482*	*2677*
Index of redistributive effect	R	-1434	-2469	-1426	-1151	-612	-3084
		165	*314*	*170*	*159*	*90*	*403*
Index of vertical redistribution	V	-1037	-1595	-1113	-761	-259	-1559
		171	*317*	*173*	*162*	*96*	*448*
Disparity of net transfers	D	-0.466	-0.291	-0.526	-0.352	-0.315	-0.278
		0.058	*0.050*	*0.055*	*0.061*	*0.062*	*0.057*
Av. non-discriminatory transfers	$\overline{t}_B$	2283	5378	2127	2127	1202	6986
		239	*478*	*238*	*256*	*158*	*785*
Index of systematic reranking	H_R	0	0	0	0	0	-16
		21	*22*	*22*	*3*	*1*	*91*
Between-farm type classical HI	H_B	-10	121	48	125	-39	-188
		87	*161*	*81*	*93*	*57*	*253*
Within-farm type classical HI	H_W	-387	-995	-361	-515	-314	-1321
		69	*140*	*62*	*91*	*53*	*202*

Source: Own calculations using REA data.

Notes: All measures are calculated using the population-weighted data. Absolute Gini and concentration indices are estimated using the formulae in Lerman and Yitzhaki (1989) for weighted samples. Bootstrap standard errors, based on 1 000 replications, are reported in italics and reflect not only the inherent sampling variability of the measures given the stratified nature of the sample, but also the uncertainty about the exact values of non-farm income. See notes to table 2 for explanation of column headings.

The remaining columns of table 3 present similar results on the redistributive effects of agricultural policy transfers based on alternative definitions of post-transfer incomes and the agricultural community. Thus, the second column also gives results based on farm incomes but for commercial farms only. By definition commercial farms are of above average economic size and exhibit correspondingly higher average post-transfer incomes than the universe of all farms. Higher average income disparities also emerge due to the elimination of the mass of small non-commercial farms with similar income levels to each other. Moreover, the negative redistributive impact of policy transfers is greater for two reasons. First the magnitude of V increases because the higher average value of transfers to commercial farms leads to an increase in $\bar{t}_B$ which is only partly offset by the resultant decrease in the disparity index D. Second within-type HI is higher because the conditional absolute variation in transfer levels is increasing in pre-transfer incomes.

Columns 3 and 4 present results based on farm and total household incomes for farms run by individuals and households, that is for the broadly defined agricultural community. The first main finding that emerges from the two sets of results is the increase in absolute inequality when passing from a farm to a household definition of income. Farm households with low farm incomes tend to have higher non-farm incomes than those with higher farm incomes so the distribution of non-farm incomes is progressive in absolute terms with respect to farm incomes. Nevertheless, taking non-farm incomes into account increases income inequality because of differences in the levels of non-farm income earned by households with similar levels of farm income (*i.e.* due to horizontal inequities in the incidence of non-farm incomes). Second, the vertical stance of agricultural policy appears less regressive relative to the distribution of pre-transfer income when using the total household definition of income. This is due to the reranking of households in the pre-transfer distribution when non-farm incomes are taken into account, leading to a reduction in the negativity of the disparity index D as farm-income poor households with low policy transfers move up the distribution at the expense of those with higher transfers. Third, the use of the total household income concept leads to an increase in measured within-type HI, as might be expected given that the provision of agricultural support is contingent on factors that are not directly related to non-farm incomes. In contrast, the likely effect on between-type HI is more ambiguous depending on the nature of any biases in agricultural policy transfers relative to the non-farm income potential of households by farm type. And the impact on the systematic reranking effect is likely to be small unless the relationship between non-farm and farm incomes is highly non-monotonic (see Hill, 1999, for a summary of evidence on this point).

Column 5 also presents results for the broad agricultural community, but with total income measured in *per capita* terms to accord with the concern for 'the individual earnings of persons engaged in agriculture' expressed in the founding objectives of the CAP (European Union, 2002, Article 33). The average number of household members is 1.77, so income levels, absolute income inequality and absolute redistributive effects are all understandably smaller when measured on an individual rather than a household basis. The distribution of transfer is also less regressive, as shown by the smaller negative value of the disparity index, reflecting the positive association between

household income and household size that is observed in Tuscany (see Lam, 1997). Interpreting the income *per capita* results in welfare terms (Atkinson and Bourguignon, 2000), annual transfers per household member could have been cut by € 612 with no effect on welfare if it had been possible to devise a distributionaly neutral policy regime, or by roughly half the average *per capita* transfer observed in practice.

Finally, column 6 presents results based on total household incomes, as in column 4, but for the narrow rather than the broad definition of the agricultural community. Limiting the size of the community in this way leads to an increase in both the average economic size of farms and total household incomes. Moreover, the nature of the threshold criterion leads to an increase in income disparities due to the elimination of the mass of households with low farm incomes but high non-farm incomes. Finally, the negative redistributive impact of policy R is also greater, both because V is more negative as the higher average level of transfers $\overline{t}_B$ to farms more dependent on farming as a source of income is only partially offset by the resultant decrease in the disparity index D, and because of the increase in within-type HI due to the higher dispersion in transfer levels on farms with higher pre-transfer incomes. These findings mirror those obtained from the comparison between all and commercial farms on the basis of farm incomes.

4.3. Comparative findings for Scotland

Table 4 reports the main empirical findings for Scotland. Column 1 presents results on the redistributive effects of agricultural policy transfers on farm incomes for the commercial farm sector [9], which are comparable to those reported in column 2 of table 3 for Tuscany. Commercial farms in Scotland must be larger than 16 ESU rather than 4 ESU so it is not surprising that average income and transfer levels are higher and that the size of the absolute redistributive effects is correspondingly greater. What really stands out in contrast to the Tuscan results is the finding that agricultural support in Scotland was progressive not regressive in absolute terms. However this finding does not indicate that the nature of the support provision in Scotland was fundamentally different, with transfers roughly proportional to the volume of production in both regions (cf. European Commission, 1991). Rather it reflects the nature of the data, which imply that the majority of Scottish farms would have made losses but for the provision of support, such that transfers in Scotland were negatively not positively correlated with pre-transfer incomes (see Allanson, 2008). In general, the vertical stance of agricultural policy in a region may be expected to reflect the degree of dependency of the region's agriculture on support, with Tuscany and Scotland towards opposite ends of the spectrum within the European Union (Zanias, 2002, table 1; European Commission, 2001, map 5.6).

[9] These results differ from those presented in Allanson (2008) for 2002/03, which are based on the FAS definition of cash income for all full-time farms larger than 8 ESU and derived using alternative transfer estimation techniques, though the picture that emerges concerning the redistributive properties of farm income support in Scotland is essentially the same.

Table 4. **Redistributive effects of agricultural support policy, Scotland**

Field of coverage		Cmrcl All	Cmrcl Broad	Cmrcl Broad	Cmrcl Broad
Income measure		Farm	Farm	Hhld	Hhld/hd
Number of observations	n	354	336	336	336
Population		*13277*	*13069*	*13069*	*25093*
Average post-transfer income (€)	$\overline{y}$	49455	49310	65434	34078
		1865	*1927*	*2209*	*1352*
Of which: Farm income		49455	49310	49310	25681
		1865	*1927*	*1992*	*1180*
Non-farm income		-	-	16123	8397
		-	-	*1399*	*761*
Average gross support (€)		81594	81272	81272	42327
		1561	*1523*	*1594*	*1213*
Average transfers to farmers (€)	$\overline{t}$	51110	51028	51028	26576
		1184	*1186*	*1220*	*772*
Average pre-transfer income (€)	$\overline{x}$	-1655	-1718	14405	7502
		1416	*1390*	*1869*	*991*
Absolute Gini index of post-transfer income	A_Y	23496	23432	24077	13105
		1160	*1169*	*1187*	*643*
Absolute Gini index of farm type specific reference income	A_W	16235	16526	16979	9497
		1196	*1234*	*1260*	*738*
Absolute Gini index of non-discriminatory reference income	A_B	13692	13388	15097	8554
		2057	*2131*	*2180*	*1289*
Absolute concentration index of non-discriminatory reference income	$\overline{y}_B C_B$	13253	13023	14837	8016
		2062	*2150*	*2180*	*1291*
Absolute Gini index of pre-transfer income	A_X	18762	18760	21195	11268
		1039	*1097*	*1153*	*660*
Index of redistributive effect	R	-4733	-4672	-2882	-1838
		1067	*1081*	*1167*	*590*
Index of vertical redistribution	V	5510	5737	6358	3251
		1305	1340	*1319*	*806*
Disparity of net transfers	D	0.096	0.103	0.127	0.113
		0.025	*0.025*	*0.019*	*0.022*
Av. non-discriminatory transfers	$\overline{t}_B$	51110	51028	51028	26576
		1905	*1995*	*2228*	*1447*
Index of systematic reranking	H_R	-439	-365	-260	-537
		148	*168*	*41*	*20*
Between-farm type classical HI	H_B	-2543	-3138	-1882	-943
		1329	*1365*	*1420*	*827*
Within-farm type classical HI	H_W	-7261	-6906	-7098	-3609
		613	*610*	*669*	*359*

Source: Own calculations using FAS data.
Notes: The difference in sample size between the first and other columns is partly due to the dropping of a number of observations with incomplete records on non-farm incomes. See also the notes to tables 2 and 3.

Columns 2, 3 and 4 of table 4 give additional results for Scotland based on farm, total household and *per capita* household incomes for commercial farms run by individuals and households, *i.e.* excluding corporate farms. These results must be treated with due caution given the limitations of the data both on total income and household size. Nevertheless the main findings that emerge when passing from a farm to a household definition of income are similar to those for Tuscany. First, the distribution of household incomes would have been less unequal than that of farm incomes if it had not been for the adverse consequences of horizontal inequities in the incidence of non-farm incomes. Second, the vertical stance of agricultural policy appears more progressive relative to the distribution of pre-transfer income when using the total household definition of income due to the reranking of households in the pre-transfer income distribution when non-farm incomes are taken into account. Third, the use of the total household income concept leads to an increase in measured within-type HI, reflecting the inherent limitations of agricultural support as a means to improve the overall welfare of the farming community. However, the distribution of transfers is somewhat less progressive when household income is measured on a *per capita* basis in spite of a similar positive association between household size and total income.

5. Conclusions

The main purpose of this article has been to explore the robustness of estimates of the redistributive effects of agricultural policy transfers to the use of alternative measures of income and definitions of the agricultural community. Allanson (2007) has previously provided evidence that the composition and empirical significance of classical horizontal inequities in the provision of support are insensitive to the measurement of redistributive effects in terms of changes in either absolute or relative income inequality. Allanson (2008) demonstrates the stability of estimates of the redistributive properties of agricultural policy transfers, reporting results based on farm income for full-time farms in Scotland for the years 2000/01 through 2004/05 that are broadly similar over time.

The methodology employed in the article is based on the use of population-weighted micro-level data to evaluate the impact of policy transfers on the distribution of income within the agricultural community. More specifically, the overall redistributive effect of agricultural policy transfers is measured as the difference between the absolute Gini indices of pre-transfer and post-transfer incomes. This is a measure of the change in absolute inequality, which provides a benchmark of distributional neutrality more in accord with both public and official perceptions of fairness in the distribution of farm support than one based on the concept of relative inequality. The measure may be interpreted as the monetary value per farm of the change in inequality due to the provision of support. Moreover it may be decomposed into a vertical redistribution effect and various HI components, and thus serves not only to quantify but also to characterise the redistributive effect of agricultural policy transfers.

The main set of empirical results presented in the article are based on a static analysis using individual farm records for 2002 from the Italian Agricultural Business Survey (REA) of Tuscany. These show that the impact of policy transfers was to

increase absolute income inequality within the agricultural community because the observed distribution of transfers to farms was both vertically and horizontally inequitable given the existing distribution of pre-transfer incomes. The regressive incidence of transfers implies that farms with higher pre-transfer incomes also tended to receive larger policy transfers, consistent with the general perception that the bulk of agricultural support goes to those that do not need it (OECD, 2003). Horizontal inequities largely arose due to the stochastic nature of the relationship between transfers and pre-transfer incomes at the farm type level, rather than because of either systematic discrimination between farm types due to the commodity organisation of support or systematic reranking as a result of income traps in the transfer schedule. The variation in the value of transfers received by farms of the same type with similar pre-transfer incomes points to the imperfect targeting of support under the CAP (see Allanson, 2008, for further discussion).

The article demonstrates that these findings concerning the redistributive properties of the CAP are robust to the specification of alternative measures of income and definitions of the agricultural community. First, moving from a farm to a total household measure of income tends to exacerbate post-transfer income differentials, but reduce the negative redistributive effects of agricultural policy as the regressivity of transfers is somewhat moderated by the reranking of farms in the pre-transfer income distribution when non-farm incomes are taken into account. Expressing total incomes in *per capita* terms, that is on an individual rather than a household basis, leads to a further slight reduction in the regressivity of transfers due to the positive association between household income and size. Nevertheless the increase in income differentials due to the provision of support remains substantial relative to the average level of both transfers and post-transfer incomes. Second, moving from less to more inclusive definitions of the agricultural community, by relaxing the thresholds on the size of holding or dependence on farming income, tends to decrease post-transfer income differentials due to the inclusion of a mass of smaller holdings with low incomes. The redistributive effect of agricultural policy also falls as the impact of lower average transfers is only partially offset by resultant increases in transfer regressivity, but remains negative.

The article additionally shows that to the extent that it is possible to generate comparable results for Scotland using Farm Accounts Survey data, then these tend to confirm the Tuscan findings in spite of the marked differences in both agricultural structures and average support levels between the two regions. Indeed, the only substantive difference in the results is the finding that the distribution of transfers is progressive not regressive in Scotland as a result of the chronic dependence of Scottish agriculture on support. The broad concordance in the results suggests that the findings of the study may be more generally characteristic of the redistributive properties of the CAP throughout the European Union, with the vertical stance of agricultural policy in a region primarily determined by the degree of dependency of the region's agriculture on the provision of support.

References

Allanson P. (2008) On the characterisation and measurement of the redistributive effects of agricultural policy, *Journal of Agricultural Economics* 59, 169-187.

Allanson P. (2007) Classical horizontal inequities in the provision of agricultural income support, *Review of Agricultural Economics* 29, 656-671.

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

Atkinson A.B. (1980) Horizontal equity and the distribution of the tax burden, *in: The Economics of Taxation*, Aaron H., Boskin M.J. (eds), Washington D.C., Brookings Institute, 3-18.

Atkinson A.B., Bourguignon F. (2000). Income distribution and economics, *in: Handbook of Income Distribution*, Atkinson A.B., Bourguignon F. (eds), Amsterdam, Elsevier, 1-58.

Cavalletti B., Rocchi B. (2006) Efficiency grounds and welfare effects in decoupling farm support. Insights from an AGE model of the Italian economy, *International Journal of Sustainable Development* 9(2), 106-121.

Cleveland W.S., Devlin S.J. (1988) Locally weighted regression: An approach to regression analysis by local fitting, *Journal of the American Statistical Association* 83, 596-610.

Department for Environment, Food and Rural Affairs (2002) *Farm Incomes in the United Kingdom 2000/01*, London, Her Majesty's Stationery Office (HMSO).

European Commission (2002) *Communication from the Commission to the Council and the European Parliament on the Mid-term Review of the Common Agricultural Policy*, COM(2002) 394 final, Brussels.

European Commission (2001) *Study on the Impact of Community Agricultural Policies on Economic and Social Cohesion*, Brussels, Directorate-General for Regional Policy.

European Commission (1997) *Agenda 2000: For a Stronger and Wider Europe*, COM(97) 2000, Supplement to the Bulletin of the European Union 5/97, Luxembourg, Office for Official Publications of the European Communities.

European Commission (1991) *The Development and Future of the CAP - Reflections Paper of the Commission*, COM(91) 100 final, Brussels.

European Union (2002) Consolidated versions of the Treaty on European Union and of the Treaty establishing the European Community, *Official Journal of the European Communities*, C325, 33-184.

Eurostat (2002) *Income of the Agricultural Households Sector, 2001 Report*, Theme 5, Luxembourg, Eurostat.

Eurostat (1997) *Manual on Economic Accounts for Agriculture and Forestry (Rev.1)*, Theme 5, Luxembourg, Eurostat.

Eurostat (1995) *Manual of the Total Income of Agricultural Households (Rev.1)*, Theme 5 Series E., Luxembourg, Eurostat.

Hastie T., Loader C. (1993) Local regression: Automatic kernel carpentry, *Statistical Science* 8, 120-129.

Hill B. (1999) Farm household incomes: Perceptions and statistics, *European Review of Agricultural Economics* 15, 345-358.

Hill B. (1990) In search of the Common Agricultural Policy's 'agricultural community', *Journal of Agricultural Economics* 41, 316-326.

IRPET (2004) *Economia e Politiche Rurali in Toscana, VI° Rapporto.* Florence, IRPET/ Arsia.

ISTAT (2005) I risultati economici delle aziende agricole Anno 2002, *Statistiche in Breve* 7 giugno, *www.istat.it/salastampa/comunicati/non_calendario/20050607_00/.*

Jenkins S.P., Lambert P.J. (1999) Horizontal inequity measure: a basic reassessment, *in: Handbook in Income Inequality Measurement*, Silber J. (ed.), Boston, Kluwer Academic, 535-556.

Kakwani N.C. (1977) Measurement of tax progressivity: An international comparison, *Economic Journal* 87, 71-80.

Kakwani N.C., Lambert P.J. (1999) Measuring income tax discrimination, *Review of Economics and Statistics* 81, 27-31.

Keeney M. (2000) The distributional impact of direct payments on Irish farm incomes, *Journal of Agricultural Economics* 51, 252-265.

Lam D. (1997) Demographic variables and income inequality, *in: Handbook of Population and Family Economics*, Rosenzweig M.R., Stark O. (eds), volume 1B, Amsterdam, Elsevier Science, 1015-1059.

Lerman R.I., Yitzhaki S. (1989) Improving the accuracy of estimates of Gini coefficients, *Journal of Econometrics* 42, 43-47.

Organisation for Economic Co-operation and Development (2005) *OECD Agricultural Databases*, *2005 Ed.*, Paris, OECD Publications.

Organisation for Economic Co-operation and Development (2003) *Farm Household Income: Issues and Policy Responses*, Paris, OECD Publications.

Plotnick R. (1981) A measure of horizontal equity, *Review of Economics and Statistics* 63, 283-88.

Rapanà F.M. (2006) *CAP Support of Mediterranean Commodities: Estimates Update to Year 2004*, University of Siena, Centro Interuniversitario di Politica Agro-alimentare-ambientale (CIPAS).

Roberts D, Russell N. (1996) Income distribution and the structure of production: Insights from a SAM-based model of UK agriculture, *in: Rural Economic Modelling. An Input-Output Approach*, Midmore P., Harrison-Mayfield L. (eds), Wallingford, CAB International, 53-67.

Rocchi B., Romano D. and Stefani G. (2005) Distributive impacts of alternative agricultural policies: A SAM based analysis for Italy, *Cahiers d'économie et sociologie rurales* 77, 86-112.

Rodríguez J.G., Salas R. and Perrote I. (2005) Partial horizontal inequity orderings: A non-parametric approach, *Oxford Bulletin of Economics and Statistics* 67, 347-368.

Sasieni P. (1998) An adaptive variable span running line smoother, *Stata Technical Bulletin* 41, 4-7.

Scottish Executive Environment and Rural Affairs Department (2004) *Farm Incomes in Scotland*, Edinburgh, Scottish Executive.

Sen A. (1973) *On Economic Inequality*, Oxford, Clarendon Press.

Tracy M. (ed.) (1998) *CAP Reform: The Southern Products*, Brussels, Agricultural Policy Studies.

United Nations Economic Commission for Europe (2007) *Handbook on Rural Households' Livelihood and Well-Being: Statistics on Rural Development and Agricultural Household Income*, UNECE Statistical Division, Geneva, *http://www.fao.org/statistics/rural/*.

Zanias G.P. (2002) The distribution of CAP benefits among member states and the impact of a partial re-nationalisation: A note, *Journal of Agricultural Economics* 53(1), 108-112.

Zheng B., Agresti A. (2000) Summarizing the predictive power of a generalized linear model, *Statistics in Medicine* 19, 1771-1781.