The distributional effects of agricultural policy reforms in Switzerland

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Abstract: This paper analyses the effects of Swiss agricultural policy reforms and the effects of farm income, off-farm income and direct payments on the distribution of the farm household income. To this end, the farm-level income records from the FADN data for the period 1990–2009 are used to calculate Gini coefficients and Gini elasticities. Bootstrap sampling procedures are applied to test for significant differences of the estimated parameters over time. The Gini coefficients estimated in our analysis show that the household income inequality in Swiss agriculture only slightly increased from 0.21 to 0.24, but the farm income inequality strongly increased from 0.27 to 0.38 in the considered period. We find furthermore that increasing off-farm incomes and direct payments would decrease the household income inequality. Especially direct payments that support farmers producing under adverse production conditions in the hill and mountain regions have found to be well targeted and thus contribute to the reductions in income inequality in agriculture.

Key words: agricultural policy reform, direct payments, Gini coefficient, income inequality

In the agricultural and rural policy making, the levels and the distribution of farmers' incomes are of a particular importance. Thus, many countries have typically framed the income objectives of agricultural policies in terms of the distribution or equity (OECD 1998; Moreddu 2011). Along these lines, agricultural policy instruments such as the price support and direct payments have an effect on the farmers' income and income distribution. In particular, most direct payment instruments within agricultural policy have at least partially shifted the objective of income redistribution towards the neediest parts of the farming population (Mann 2005). In most European countries, the importance of direct payments for incomes of farm households increased considerable over time while market supports were heavily reduced within the last decades due to policy reforms.

However, the analysis of the effects of different income sources on the income distribution within the farm population as well as the dynamics in these relationships observed over time has received little attention so far. Particularly, the research about the impact of specific direct payment programmes on income inequality is scarce. The existing studies of the distributional effects of policy changes in European agriculture show mixed results. For instance, Keeney (2000) found that due to an increasing share of support payments in the total farm income, Irish farm income inequality decreased between 1991 and 1996 (pre- to post-MacSharry reform). Whereas the programmes that target farmers in less favoured areas reduced

income inequality, the per hectare arable payments increased it. By comparing the pre-support with the post-support Scottish farm income, Allanson (2005) shows that the measures of the MacSharry reform progressively support farmers with the negative or low pre-support incomes. Schmid et al. (2006) show that the less-favoured area payments have had only a minor effect on the absolute income inequality in Austria, but that direct payments and agri-environmental payments increased the absolute income inequality. Results of von Witzke and Noleppa (2007) show that direct payments significantly contribute to income inequality in German agriculture.

Based on this background, the goal of this paper is to measure the effect of Swiss agricultural policy reforms on the distribution of income within the farm population. Switzerland serves as a good case study for European countries to analyse the effects of the changing farm-level supports on the income distribution. Swiss agricultural policy faced a dramatic shift from the market-based support to direct payments and most of the direct payment instruments available to Swiss farmers are very similar to those applied or thought to be introduced by the European Union (cp. section 2 and see e.g. Mann 2003). Regarding the specific case of Switzerland, there exist studies that deal with income distribution within the Swiss population at large (e.g. Gerfin 1994; Zürcher 2004; Engler 2010), but there is little research dealing with the impact of various income sources on the overall income inequality (e.g. Flückiger and Silber 1995).

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Most importantly, income inequality in Swiss agriculture has not been addressed so far.

Besides the specific contribution for the Swiss case, our analysis expands the existing studies also from the methodological points of view. To our knowledge, this is the first paper that uses the farm-level data over a range of twenty years (including two main reform steps) to measure the effects of different direct payment programmes on the income distribution. Furthermore, we use bootstrap procedures to test for significant differences over time. To account for the real income situation of farmers, we expand the farm-income perspective and analyse the effect of policy changes with regard to the total household income, including farm income and off-farm income[1]. In the first step, the effect of agricultural policy reforms on the distribution of household income is analysed. In the second step, a more specific analysis is undertaken to measure the effect of eleven direct payment programmes on the household income distribution, including the general and ecological payments as well as the animal welfare payments and the payments that support farmers producing under adverse production conditions. Thus, marginal effects how specific direct payments contribute to income inequality in agriculture are estimated. The results may be used by the policy makers to examine numerically the distributional effects of the past and proposed policy changes.

This paper is structured as follows. In section 2, the main developments of Swiss agricultural policy between 1990 and 2009 are briefly described. The data and methods used in this paper are presented in the 3rd section. In the 4th section, the marginal effects of agricultural policy reforms and single direct payment programmes on the household income distribution are explored. Furthermore, we analyse how the changes in the importance and distribution of different income sources affect the changes in the household income distribution. The analyses investigate the hypothesis that the changes in income inequality can be attributed to the agricultural policy reforms. Section 5 summarizes and discusses the results.

DIRECT PAYMENTS AND THE AGRICULTURAL POLICY REFORMS IN SWITZERLAND

Roughly two main steps within the reform process of Swiss agricultural policy can be distinguished, the first being in 1992 and the second in 1999. With each reform step, the market support was reduced and the farm-level based subsidies were introduced as compensation. Pre-reform subsidies that were already available to the farmers prior to 1992 included the payments provided per farm household. Furthermore, the area-based and animal-head based payments were given to farmers producing under adverse production conditions mainly in the hill and mountain regions of Switzerland. The policy goal followed by these payments was the support of farmers that were not able to earn an appropriate income from marketable goods. The support in the frame of farm household payments ended in the late 1990s. With the first policy reform in 1992, decoupled direct payments were introduced without geographical restrictions. Area-based and animal unit based payments were introduced for all farmers. Furthermore, farmers could voluntarily apply to agri-environmental schemes that aim at promoting the environmental-friendly production systems. These agri-environmental schemes included payments for the extensive crop production and ecological compensation areas.

With the next reform cycle starting in 1999, a new direct payment system was introduced dividing support payments into the general and the ecological direct payments. The general direct payments were based on a cross-compliance approach. Thus, farmers had to comply with the baseline criteria regarding the environmental and animal friendly production, with the most restrictive being the set-aside of seven percent of their farmland as the ecological compensatory area (Mann 2003). As previously, farmers could apply voluntarily to the ecological direct payment programmes.

Since 1999, no considerable changes in the direct payment system were made. One exception is the introduction of a new performance-oriented ecological direct payment programme in 2001, aiming at enhancing and increasing the biodiversity on cultural land. Currently, the general direct payments constitute most of the financial support (79% in 2009 (FOA 2010)) and include the animal unit and area-based payments to farmers within all regions and the additional payments for farmers producing under adverse production conditions in the hilly and mountainous regions. Ecological direct payments include the payments for the extensive crop production, the ecological compensation areas and the eco-quality. Furthermore, two animal welfare programmes are available[2].

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[1]See Hill (1999) for detailed discussions on the issue of income measures for the agricultural community.

[2]For more details on the direct payment system in Switzerland, see e.g. Curry and Stucki (1997), Mann (2003) and El Benni and Lehmann (2010).

Beside direct payments, the production of oil seeds, legumes, fibre crops, potato seed, cereals and fodder plants are supported by the arable payments. While these payments were adapted over the last two decades, they are paid with the aim to enrich the crop rotation and for the food security reasons. This support measure falls under the aforementioned cross compliance conditions as well.

METHOD AND DATA

Gini decomposition by income source

The Gini coefficient of inequality is a commonly used measure in the income inequality research (Flückiger and Silber 1995). For non-negative incomes, the Gini coefficient measures the relative income inequality and ranges between 0 and 1. The Gini coefficient equals 0 if the household income is totally equally distributed, and it increases the more unequal the income distribution becomes. To estimate the Gini coefficient G, the household income Y is assumed to be a random variable, distributed with the mean μ over the farm population. With $F(Y)$ denoting the cumulative distribution function of the household income and cov(.) the covariance, Stuart (1954) shows that the Gini coefficient of relative income inequality can be written as follows:

$$G = 2\mathrm{cov}\frac{[Y, F(Y)]}{\mu} \tag{1}$$

To measure the effect of different income sources on the aggregated income inequality, the Gini decomposition approach of Fei et al. (1978) and Pyatt et al. (1980) extended by Lerman and Yitzhaki (1985) is applied. Using this method, the total household income is defined as the sum of incomes from k different sources Y_k with $F(Y_k)$ denoting the cumulative distribution function of the income source under consideration. The decomposed Gini coefficient can be written as follows:

$$G = \sum_{k=1}^{K} \left(\frac{\mathrm{cov}[y_k, F(Y)]}{\mathrm{cov}[y_k, F(Y_k)]} \times \frac{2\mathrm{cov}[y_k, F(Y_k)]}{\mu_k} \times \frac{\mu_k}{\mu} \right) \tag{2}$$

$$G = \sum_{k=1}^{K} R_k G_k S_k \tag{2a}$$

The Gini correlation R_k ranges between -1 and $+1$ and it is defined as the covariance between the kth component income and the cumulative distribution of total income, divided by the covariance between the kth component income with its own cumulative distribution (Pyatt et al. 1980). If the income of the kth income

source increases (decreases) with increasing the total income, R_k is positive (negative), and if R_k equals 0 the income source is a constant not contributing to the total income inequality. G_k is the Gini coefficient of the kth income source, showing how the income from the specific income source is distributed within the population. The share of the kth income source on total income is given by S_k. R_k times G_k yields the concentration ratio or the Pseudo-Gini coefficient C_k, which measures how the income from each source is transferred across the population ranked with respect to the level of the total income received:

$$C_k = \frac{\mathrm{cov}[y_k, F(Y)]}{\mathrm{cov}[y_k, F(Y_k)]} \times \frac{2\mathrm{cov}[Y_k, F(Y_k)]}{\mu_k} = \frac{2\mathrm{cov}[y_k, F(Y)]}{\mu_k} \tag{3}$$

The concentration ratio is 0 if all income groups receive an equal amount of income of the given income component (Pyatt et al. 1980); it is negative if the income from a specific source accrues mainly to the households in the lower tail of the distribution of the total income; and it is positive, if the richer households receive a large proportion of the income from the specific income component. The concentration ratio that is larger than the Gini coefficient of the aggregate income proves that the income component in question has had an unequalising effect on the observed aggregate income distribution (Keeney 2000).

The marginal effects of different income sources on income inequality

To measure the effect of a specific income component on the aggregated income inequality, the Gini elasticity is calculated as proposed by Lerman and Yithzaki (1985). The Gini elasticity gives information on how the income distribution would change with a marginal percentage change in the mean income of the specific income component. By assuming that the ratio between the total income distribution and the income source remains undisturbed, the rate of change of the Gini coefficient is derived as follows:

$$\eta_k = \frac{\mu_k}{G} \times \frac{dG}{d\mu_k} = \frac{1}{G}\left[\frac{\mu_k}{\mu}(C_k - G)\right] \tag{4}$$

The income source elasticity η_k is greater (lower) than 1 if the amounts received under the specific policy programme (income component) raise more (less) than proportionally to the total household income. In case of unit elasticity, the distribution of income from a particular income source is proportional to the distribution of the total income, and thus, the

concentration coefficient and the Gini coefficients coincide (Podder 1995; Keeney 2000)[3].

In order to test if changes of the Gini coefficients, the Pseudo-Gini coefficients and the Gini elasticities over time are statistically significant, we use the non-parametric bootstrap (see DiCiccio and Efron 1996, for details). To this end, the above described point estimates are estimated for 1000 data replicates that are generated by sampling with the replacement from each of the initial datasets. Thus, the estimation procedure[4] is replicated for the 1000 newly generated datasets. This leads to 1000 estimates for the Gini coefficients, the Gini elasticities and the Pseudo-Ginis for each year, which are used to construct 95% confidence intervals by discarding the 2.5% smallest and largest point estimates, respectively. These confidence intervals are used to test for significant differences between different years, though we are aware that the tests based on overlapping confidence intervals are a very conservative way of hypothesis testing (Schenker and Gentleman 2001). All statistical analyses are conducted with the statistical language and environment R (R Development Core Team 2011).

Causes of the change in income inequality

To analyse if changes in the share or changes in the distribution of the different income sources are the driving force for the overall inequality changes over time, the approach of Podder and Chatterjee (2002) is used. Therefore, the change of the Gini coefficient over time ΔG is divided into a share effect (SE) and a concentration effect (CE):

$$\Delta G_t \approx SE + CE \tag{5}$$

The change in the aggregated Gini coefficient from the period $t - 1$ to the period t is given by $\Delta G_t = G_t - G_{t-1}$. Changes in the Gini coefficient can be attributed to a change in the share of the kth income component in the total income $\Delta S_{k,t} = S_{k,t} - S_{k,t-1}$ between the period $t - 1$ and t and to the change in the concentration coefficient $\Delta C_{k,t} = C_{k,t} - C_{k,t-1}$ over

the same period. Hence, the changes in the share of a specific income component as well as the changes in the distribution of an income component over the range of the total income affect the change of the Gini coefficient. The difference between two time periods can be measured with respect to the base period or with respect to the terminal period, which would lead to a different result. Therefore, Podder and Chatterjee (2002) suggest the following approximation of the share and the concentration effect:

$$SE = \sum_{k=1}^{K} \frac{C_{k,t} + C_{k,t-1}}{2} \times \Delta S_{k,t} \tag{6}$$

$$CE = \sum_{k=1}^{K} \frac{S_{k,t} + S_{k,t-1}}{2} \times \Delta C_{k,t} \tag{7}$$

According to Eq. 6, the share effect SE of all income components is approximated by the sum of the changes in the shares of the different income components from one year to another weighted by their average changes in the concentration coefficient over the same time period (and vice versa for the concentration effect as shown in Eq. 7).

Data

The farm-level income data of the Swiss National Farm accounting Network (FADN) over the period 1990 to 2009 are used. The total household income is defined as the gross household income minus the total production costs, labour costs and interest on debt and land and it is decomposed into the off-farm income, the farm income, and the income from (different) direct payments. For the analyses, the sample of the FADN farm households is weighted based on the farm size, the farm production system, and region[5]. Since the dataset contains some extreme values, the 2.5% households at the top and the bottom end of the total household income distribution were excluded from the analysis. The final dataset includes in average 3460 farm operations per year, representing (after weighting) a farm population of the average 52 180 farms per year.

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[3]In the presence of negative incomes, the Gini coefficient here presented may exceed unity and the estimates of the elasticities are analytically correct but biased upwards (Boisvert and Ranney 1990). Even if methods exist to estimate here presented Gini coefficients that account for negative incomes (Chen et al. 1982), these coefficients cannot be decomposed by here presented income source (Boisvert and Ranney 1990) and their interpretation is difficult (van de Ven 2001). Hence, by using the here presented here presented Gini decomposition approach, the marginal effects of different income components on income inequality can be biased upwards. Nevertheless, the qualitative policy implications remain by choosing this approach (Boisvert and Ranney 1990).

[4]This also includes trimming and weighting for each dataset.

[5]The weights used are provided together with the FADN data. The methodology of the sample selection and the details of weighting are presented in the FAT (2000).

RESULTS

This section presents the results of the Gini decomposition for the total household income. In the first step, the effects of the off-farm income, the farm income and direct payments (in general) on the household income inequality are estimated. Second, we analyse if the changes in the share or in the distribution of the different income components led to the changes in the Gini coefficient of the total household income.

In addition, we measure the effects of single direct payments schemes on the Gini coefficient of household income and its changes over time.

The effect of agricultural policy reforms on the total household income inequality

The contribution of farm income, off-farm income and direct payments to the household income inequality

In this section, we investigate how the agricultural policy reforms, i.e. the change from market support to direct payments, had affected the distribution of household income within the Swiss farm popula-

tion. Table 1 shows the share of the total household income, the farm and off-farm income, and the income from direct payments by the selected total household income decile for the years 1990, 1995, 2001 and 2009. More precisely, the farms were ranked by decile according to their total household income level. The mean of each income decile was divided by the sum of the total household income, i.e. the sector household income. The same was done for all other income sources. For instance, the mean direct payment income in the first household income decile was divided by the sum of all direct payment given to the sector. The years were chosen to represent the pre-reform (1990), the first reform (1995), the second reform (2001) and the current (2009) situation.

The share of the total sector household income received by households in the 10th decile (i.e. the households with the highest incomes) is about 18%, while the share received by the 1st decile (i.e. the households with the lowest incomes) is about 5%. Farms with higher household incomes generate more of the sectors' off-farm income than the farmers in the lower household income decile. Also, the farm income is mainly generated by farmers in the highest income decile. In 1990, about 19% of the sectors farm income was generated by the 10th income decile, and only 4.5% by the first income decile. In 2009,

Table 1. Income shares of different income sources by deciles of total household income

Year	Income (source)	Total household income deciles					Mean (CHF)	Sample size (pop. size)
		1st	3rd	5th	8th	10th		
1990	Household income	4.8	7.2	8.9	12.2	18.0	78 918	
	Off-farm income	6.2	8.7	9.0	10.0	14.0	13 579	4 086 (60 318)
	Farm income	4.5	6.8	8.9	12.6	18.9	65 339	
	Direct payments	12.9	11.4	10.8	8.5	7.3	10 873	
1995	Household income	3.8	7.0	9.0	12.6	17.9	62 313	
	Off-farm income	4.6	7.7	10.7	12.0	14.8	16 706	4 324 (57 786)
	Farm income	3.5	6.8	8.4	12.9	19.1	45 607	
	Direct payments	9.4	9.6	9.9	9.9	10.9	28 775	
2001	Household income	4.1	7.1	9.0	12.5	17.8	69 885	
	Off-farm income	6.0	6.8	9.4	12.0	13.4	18 532	2 909 (50 613)
	Farm income	3.5	7.2	8.8	12.7	19.5	51 353	
	Direct payments	9.1	9.2	9.6	10.7	11.8	42 819	
2009	Household income	3.7	6.8	9.0	12.6	18.5	85 416	
	Off-farm income	5.2	8.4	10.4	12.0	13.0	26 354	3 199 (45 520)
	Farm income	3.1	6.2	7.9	12.9	21.0	59 062	
	Direct payments	8.0	9.2	9.6	11.1	12.1	57 753	

Note, that the shares within the table do not add to 100% because only some of the deciles are presented.

the 10th household income decile generated 21% of the sectors' farm income and the first income decile generated only 3%.

The distribution of income from direct payments over the total household income deciles (4th row in each subsection of Table 1) reveals some interesting changes over time. In 1990, households in the lowest income decile received about 13% of the total governmental farm-level support, while farmers in the highest income decile received only 7% of the total support. In contrast, farmers in the first household income decile received only 8% of the total governmental support in 2009, while farmers in the highest decile received 12% of the total support. Thus, direct payments were re-distributed across the farm population.

Figure 1 shows the decomposition results for the total household income inequality calculated according to the equations 1 to 4. Figure 1b shows that direct payments became a very important income source for farmers after the agricultural policy reform in 1992. Since 2001, direct payments are even higher than the farm income. Hence, part of the direct payments is used by farmers to cover the costs of production. Also

the importance of the off-farm income increased over time, making up about 33% of the total household income in 2009.

The Gini coefficients (Figure 1a) show that the farm income is less equally distributed than the household income. It shows, furthermore, that the farm income inequality strongly increased (the Gini coefficient was 0.27 in 1990 and 0.38 in 2009) while the household income inequality only slightly increased over time (the Gini coefficient was 0.21 in 1990 and 0.24 in 2009). In general, the off-farm income is the most unequally distributed income source, even if inequality decreased over the here considered time period. This might be explained by the differences in the off-farm employment opportunities in e.g. different regions and different needs of farmers to earn money off the farm. With the first agricultural policy reform in 1992, the area-based direct payments were introduced and were made available to all farmers without geographical restrictions. This led to a wide spread of the farm-level support within the Swiss farm population and decreased the Gini coefficient considerably (from 0.43 in 1990 to 0.29 in 2009).
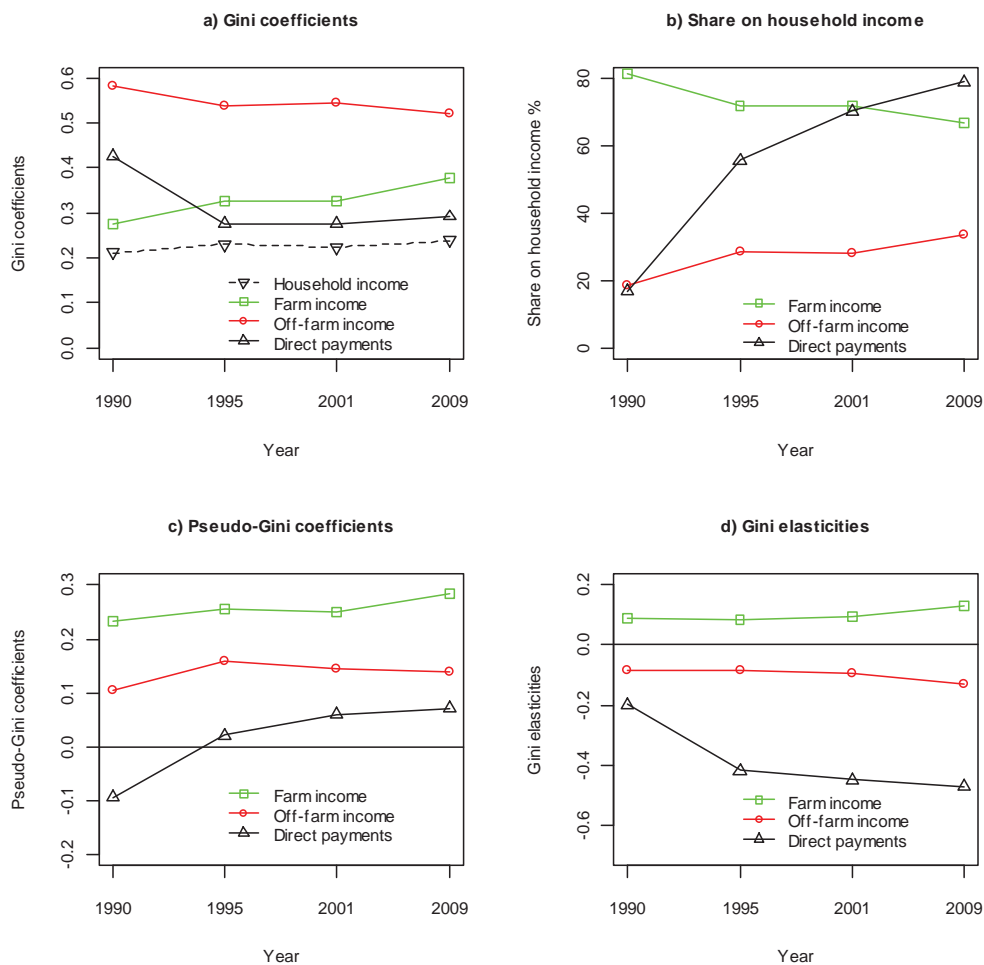

Figure 1. The Gini decomposition results for the total household income by off-farm income, farm income, and direct payments over the period 1990 to 2009

The results of the Pseudo-Gini coefficients (i.e. concentration coefficients) in Figure 1c show that the farm income is mainly generated by farmers with – in average – higher household incomes. The same is true for the off-farm income, however, to a lower extent. It shows that both, the farm and off-farm income, are important for the farmers to generate high household incomes. As already suggested by the decile analysis, direct payments supported especially farmers with lower household incomes in 1990 (i.e. most of the direct payments provided to the agricultural sector are given to low-income farmers). However, after the agricultural policy reform in 1992, the direct payments support is mainly provided to farmers with higher household incomes[6].

The marginal effects of the different income components on the total income inequality are shown by the Gini elasticities presented in Figure 1d. It shows that

Table 2. Sources of change in total household income inequality

Row		1990–1995	1995–2001	2001–2009
1	ΔG household income	**0.0183**	−0.0074	**0.0164**
2	ΔS off-farm income	0.0960	−0.0029	0.0434
3	ΔC off-farm income	0.0548	−0.0144	−0.0060
4	ΔS farm income	−0.0960	0.0029	−0.0434
5	ΔC farm income	0.0219	−0.0053	0.0331
8	ΔS direct payments	0.3240	0.1509	0.0634
9	ΔC direct payments	**0.1143**	**0.0380**	0.0123
10	SE off-farm income	0.0126	−0.0004	0.0061
11	CE off-farm income	0.0121	−0.0038	−0.0017
12	$SE + CE$ off-farm income	0.0247	−0.0043	0.0044
13	SE farm income	−0.0235	0.0007	−0.0116
14	CE farm income	0.0171	−0.0039	0.0236
15	$SE + CE$ farm income	−0.0064	−0.0031	0.0120
16	SE direct payments	−0.0117	0.0061	0.0041
17	CE direct payments	0.0343	0.0204	0.0079
18	$SE + CE$ direct payments	0.0226	0.0265	0.0120

ΔG, ΔS, ΔC denote the change in the Gini coefficient of total household income, and the change in the share and concentration of each income component respectively. *SE* and *CE* are calculated according to Eq. 6 and 7. Significant changes are indicated in bold. Significance tests are based on the 95% confidence intervals of the 1000 bootstrap samples.

the increase of the off-farm income and the income from direct payments would decrease the income inequality. For instance, the increase in direct payments of 1% would have reduced the Gini coefficient by 0.22% in 1990 and even by 0.47% in 2009. Hence, direct payments have become less redistributive in the absolute perspective, but due to their increased importance, they have contributed increasingly to balancing the income distribution among farmers. The positive Gini elasticities for the farm income can be explained by the remaining share of the farm income, namely the income from marketable goods.

The effects of the farm income, the off-farm income and direct payments on the household income inequality changes

The subsequent section is devoted to the question if changes in the share or the concentration of the off-farm and farm income led to a change in the Gini coefficient of the total household income. Also the results for direct payments in general are presented.

Table 2 shows a small but significant increase in the household income inequality from the pre-reform year 1990 to the post-reform year 1995 and between 2001 and 2009. In contrast, a slight but insignificant decrease of the income inequality can be observed between 1995 and 2001 (row 1 of Table 2).

The sum of the share and the concentration effect (row 12 and 15 respectively) shows that the off-farm income contributed to the income inequality increases between 1990 and 1995, while the decrease in the importance of the farm income alone would have reduced the overall income inequality (i.e. the negative share effect (row13) overcompensates the positive concentration effect (row14)). Between 1995 and 2001, the decrease in the concentration of the farm and off-farm income decreased the Gini coefficient of the total household income. In contrast, between 2001 and 2009 the off-farm income led to the income inequality increases because of its increasing importance for the household income (row 10 to 12), and the farm income increased the income inequality because of its increased concentration to farmers in the upper tail of the income distribution (row 13 to 15).

Table 2, furthermore, shows the effect of changes in the share and concentration of direct payments (which are part of the farm income) on the Gini coefficient of the total household income. It shows that direct payments by themselves would have increased the

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[6]Direct payments continued to support incomes in all deciles, but the relative shares and concentrations across the deciles shifted in favour of higher-income farmers.

household income inequality over all time periods considered. However, the changes in the remaining part of the farm income (i.e. income from marketable goods) more than compensated the inequality increasing effects of direct payments between 1990 and 2001. This was not the case in the subsequent time period (2001–2009) where the sum of the share and the concentration effect of direct payments equals that of the farm income (row 18 and 15 respectively).

The effect of different direct payments on the household income inequality

The decomposition of the household income inequality by the single direct payment programmes

Figure 2 shows the shares of the different direct payment programmes in the total household income for the years 1990, 1995, 2001 and 2009. It shows that a number of different support programmes were developed over time. Note that all abbreviations for the direct payment programmes are explained below Figure 2. In the pre-reform period, the roughage animal payments for farmers in the hill and mountain regions (*RAUhill*) and the arable payments (*Arable*) were the most important support programmes at farm-level. However, market prices were high and single payments made up only between 6% and 2% of the total household income. With the agricultural policy reform in 1992, the market support was reduced and the area-based payments (*Area*) became the most important direct payment programme, making up about 16% of the total household income in 1995. In addition, the payments for the ecological compensation area (*Eco*), the extensive crop production (*Extenso*) and for the integrated production (the latter is included in the category *Rest* in Figure 2) were introduced for which farmers could voluntarily apply (e.g. Finger 2010). However, these payments made up only 11% of the total household income,
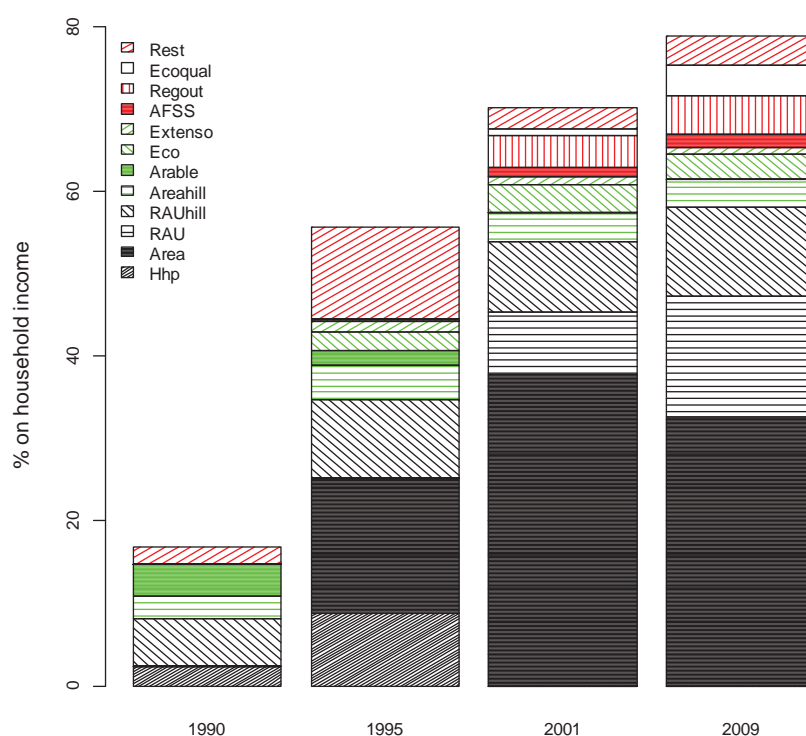

Figure 2. The share of different direct payments in the total household income

Hhp. = Farm household payments (CHF/farm household), Arable = Arable payments (CHF/ha crop land), Area = Area-based payments (CHF/ha), Areahill = Additional area-based payments for farmers producing in the hilly and mountainous regions (CHF/ha), RAU = Roughage animal unit based payments (CHF/roughage animal unit), RAUhill = Additional roughage animal unit based payments for farmers producing in the hilly and mountainous regions (CHF per roughage animal unit), AFSS = Particularly animal-friendly stabling systems (per animal unit), Regout = livestock with regular outdoor exercise (per animal unit), Eco = Ecological compensation area (CHF/ha), Extenso = Extensive crop production (CHF/ha), Ecoqual. = Eco-quality (CHF/ha), Rest = includes all other payments that are not analysed separately in this paper either because the support through these payments start and/or end outside the considered years or because the number of observations was too low

compared to all other direct payment programmes that contribute with 45%.

With the second policy reform step in 1999, the household payments and the support for the integrated production were abandoned but the production requirements of the integrated production programme became obligatory to receive the general direct payments (see also section 2). Furthermore, the animal unit based payments without geographical restrictions (*RAU*) were introduced as well as two animal welfare programmes (*Regout, AFSS*) and a programme that aims at supporting the ecological quality of the farm land (*Ecoqual*). The importance of the general direct payments for the household income increased to 59% in 2001 (with the area-based payments being the most important with 38% of the total household income) while the ecological direct payments still contribute with 11% to the total household income (see Figure 2).

Since the second reform step in 1999, only small changes were made to the direct payments system. The area-based direct payments were slightly decreased which resulted in a decreasing share of these payments in the total household income. In contrast,

the animal unit based payments were made available to milking cows (which was not the case before) and the eco-quality payments were increased. In 2009, the general direct payments made up about 64% and the ecological direct payments 15% of the household income (see Figure 2).

Figure 3a shows the concentration coefficients and the Gini elasticities for different direct payments for the four considered years. It shows that the farm household payments (*Hhp*), the payments given to farmers producing under adverse production conditions (*Areahill, RAUhill*) support mainly the low-income farmers (i.e. have negative Gini concentration coefficients). Hence, these payments seem to be well targeted, as especially those farmers are supported by these programmes that are not able to generate an appropriate income from marketable goods because of the adverse production conditions they face.

In contrast, all other direct payments support mainly the farmers with the higher income levels (i.e. have positive Gini concentration coefficients). This is especially true for the animal welfare programme *AFSS,* which requires the farmer to construct
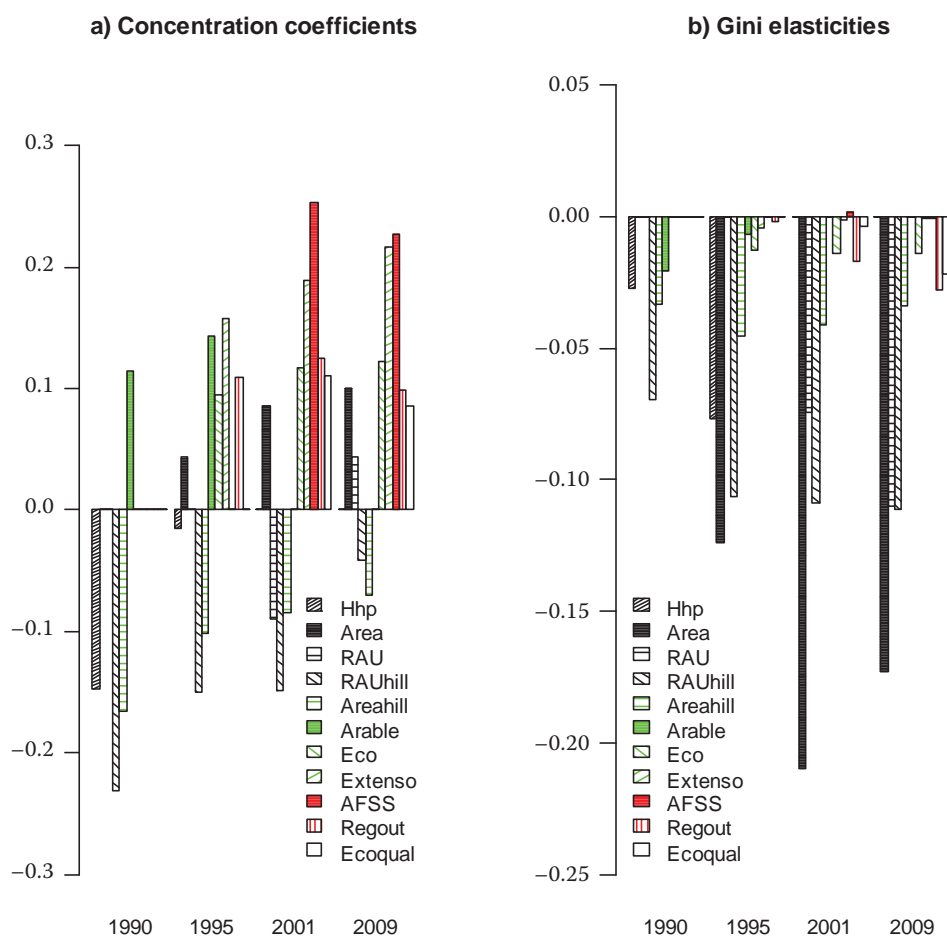

Figure 3. Concentration coefficients and the Gini elasticities of different direct payment programmes

a particularly animal-friendly stabling system. The result suggests that those farmers that generate the highest incomes are also those who are able to invest in the new stabling systems that are required to receive the additional direct payments. However, the concentration coefficients for each of the direct payment programmes are in general much lower than the Gini coefficient of the total household income. This implies that every of the direct payments help to decrease the household income inequality. This is also shown by the results of the Gini elasticities, depicted in Figure 3b. For instance, the increase of the area-based payments (*Area*) of 1% would have

decreased the household income inequality by 0.17% in 2009. The increase in the animal unit based payments by 1% would have decreased the overall Gini coefficient by 0.11%. In contrast, the increase of support for the welfare and ecological programmes would hardly affect the income distribution of the household income.

The effect of different direct payments on changes in the household income inequality

Table 3 shows how the changes in the share and concentration of the different direct payments pro-

Table 3. The effect of different direct payments on changes in household income inequality

Line		1990–1995	1995–2001	2001–2009	Line		1990–1995	1995–2001	2001–2009
1	ΔG farm income	**0.0183**	−0.0074	**0.0164**					
Farm household payments (CHF/farm household)					**Animal-friendly stabling systems (CHF/AU[b])**				
2	ΔS	**0.0520**	–	–	20	ΔS	–	–	**0.0040**
3	ΔC	**0.1160**	–	–	21	ΔC	–	–	−0.0554
4	$SE + CE$	0.0013	–	–	22	$SE + CE$	–	–	0.0002
Arable payments (CHF/ha crop land)					**Livestock with regular outdoor exercise (CHF/AU[b])**				
5	ΔS	**−0.0207**	–	–	23	ΔS	–	**0.0331**	**0.0053**
6	ΔC	0.0218	–	–	24	ΔC	–	0.0183	−0.0476
7	$SE + CE$	−0.0029	–	–	25	$SE + CE$	–	0.0047	−0.0013
Area-based payments(CHF/ha)					**Ecological compensation area (CHF/ha)**				
8	ΔS	–	**0.2012**	**−0.0536**	26	ΔS	–	**0.0100**	−0.0024
9	ΔC	–	**0.0475**	0.0057	27	ΔC	–	0.0212	0.0006
10	$SE + CE$	–	0.0274	−0.0039	28	$SE + CE$	–	0.0017	0.0003
Area-based payments; hill (CHF/ha)					**Extensive crop production (CHF/ha)**				
11	ΔS	**0.0095**	−0.0028	**−0.0041**	29	ΔS	–	**−0.0031**	**−0.0018**
12	ΔC	0.0349	0.0231	0.0057	30	ΔC	–	0.0304	0.0186
13	$SE + CE$	−0.0002	0.0010	0.0005	31	$SE + CE$	–	−0.0003	−0.0003
Animal unit based payments (CHF/RAU*)					**Ecoquality (CHF/ha)**				
14	ΔS	–	–	**0.0628**	32	ΔS	–	–	**0.0236**
15	ΔC	–	–	**0.1179**	33	ΔC	–	–	−0.0641
16	$SE + CE$	–	–	0.0092	34	$SE + CE$	–	–	0.0010
Animal unit based payments; hill (CHF/RAU[a])									
17	ΔS	**0.0257**	−0.0041	**0.0202**					
18	ΔC	**0.0538**	0.0030	**0.0932**					
19	$SE + CE$	−0.0017	0.0008	0.0049					

[a]RAU = roughage animal unit; [b]AU = animal unit; ΔG, ΔS, ΔC denote the change in the Gini coefficient of total household income, and the change in the share and concentration of each income component respectively. *SE* and *CE* are calculated according to eq. 7 and 8. Bold numbers denote significant differences at the 95% level, which have been derived with the bootstrap analysis

grammes affected the changes in the Gini coefficient of the total household income[7]. Between 1990 and 1995, the changes in the farm household payments (rows 2–4 in Table 3), which were mainly caused by the increase in the concentration effect, contributed to the income inequality increases. In contrast, the decreasing share of the arable payments (rows 5–6) would have led to a reduction in the Gini coefficient over time. Even though the share and the concentration of the area- and animal-unit based payments for the hill and mountain regions increased (rows 11–13 and 17–19), these payments strongly supported farmers with low household incomes and therefore they would have reduced the overall Gini coefficient.

Between 1995 and 2001, most direct payment programmes positively contributed to the changes in the household income inequality. Significant increases in the share of the different payments on the household income can be observed for most of the programmes, while the changes in the concentration (i.e. Pseudo-Ginis) were only significant in the case of the area-based payments. In total, the increasing shares (i.e. share effect) of the here considered programmes would have increased the Gini coefficient of the total household income (which did not change significantly over this time period due to the shifts in the concentration and the shares of the other income components). Between 2001 and 2009, the changes in the area-based payments (rows 8–10), the ecological compensation area payments (rows 26–28) and the payments for the extensive crop production (rows 29–31) would have reduced the household income inequality. For these programmes, the negative share effect was stronger than the positive concentration effect. In contrast, all other direct payments programmes increased the household income inequality. For instance, in the case of the eco-quality payments (rows 32–34), the increasing share more than compensated the decrease in the concentration. In contrast, in the case of the animal unit based payments (in the valley as well as hill regions), the concentration effect was much stronger.

The disaggregated analysis shows that most of the direct payments affect the income inequality because of the changes in their share in household income. However, in the case of the animal-unit based payments, also the increase in the concentration to farmers with higher incomes leads to the overall income inequality increases.

SUMMARY AND DISCUSSION

Our analysis showed that the total household income inequality in Swiss agriculture only slightly increased between 1990 and 2009, but a strong increase in the farm income inequality could be observed in this period. Hence, the strong reliance on direct payments which Swiss farms have developed over the last 20 years has not led to a significant change in the sectoral inequality altogether. However, the change from the market support to the decoupled direct payments increased the number of farmers earning negative market incomes which led to an increase in the farm income inequality. The difference between the household income and the farm income inequality furthermore shows that the off-farm income plays an important role in balancing the income distribution among farmers.

Compared to other countries, however, the farm income within the Swiss farm population is still rather equally distributed with the Gini coefficients ranging between 0.27 and 0.38. In contrast, the Gini coefficients of between 0.63 and 0.55 were found for Ireland (Keeney 2000), and the Gini coefficient of 0.54 was found for Germany (von Witzke and Noleppa 2007). This result can be explained by the homogenous structure of Swiss agriculture that is based on small family farms with a similar capital intensity (cp. Finger and El Benni 2011). Even though the structural change took place within the last two decades, no large and highly efficient farm operations were developed. The average farm size is about 17 hectare and 97% of all farms have 50 ha or less (FOA 2010).

Over the last two decades, the goals and measures of Swiss agricultural policy changed. These changes are reflected in the effects of direct payments on the household income inequality (i.e. the results of the Gini decomposition). In the pre-reform period, the main goal of direct payments was to support farmers that were disadvantaged by adverse production conditions and did not earn an appropriate income, even though the market support led to very high price levels. Hence, direct payments were not equally distributed and were given to farmers with low incomes. With the agricultural policy reform in 1992, market support was reduced and direct payments aimed at compensating all farmers for income losses they face due to the price decreases. As a result of

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[7]Note, that not all direct payments could be included in the analysis due to the low number of observations for some of these programs or because the programs were available only outside the considered years. For instance, the integrated production payments were available to farmers from 1993 to 1999 and they are therefore not considered for the analysis of the years 1990, 1995 and 2001. Therefore, the share and concentration effects of the single payments analysed do not sum to the changes in the Gini coefficient of the total household income.

the reform, direct payments became more equally distributed across farmers, but they were since also more concentrated on the farmers in the upper tail of the income distribution (see also Mann 2006). Hence, the new agricultural policy, which was based on the area payments, conserved the distributional effects of the former (market support oriented) policy at least to a certain extent. As in the case with the market support, also the support through direct payments advantaged the high income farmers (i.e. input factors such as land enable farmers to produce more output but they also determine the amount of direct payments the farmers receive). However, even if the high-income farmers receive more direct payments than the low-income farmers, the direct farm-level support has still an equalizing effect on the income distribution (see also Keeney 2000; Mishra et al. 2009). Hence, the equalizing effect of direct payments can be attributed to the fact that the incomes in the lower tail of the income distribution can be maintained at a certain level.

Regarding the causes of the change of the household income inequality between the pre-reform year 1990 and the post-reform year 1995, our analysis shows that the off-farm income was the main contributor to the inequality increases. In contrast, changes in the share and the concentration of farm income hardly affected the Gini coefficient of the total household income over this time period. This implies that direct payments could compensate farmers for the foregone market profits without affecting the income distribution. In contrast, the household income inequality increases between 2001 and 2009 can mainly be attributed to the changes in farm income. Hence, even if the direct payments make up a considerable amount of the household income, they cannot avoid the income inequality increases. In addition, the income from direct payments exceeds the farm income which shows that direct payments are used to cover production costs and cannot compensate for the income losses anymore. This suggests that the income from farmers in the lower tail of the income distribution further decreases which opens the income gap across the farm population. Hence, a structural change is needed to enable farmers earning an appropriate income from farming. Furthermore, direct payments cannot be used to decrease the income inequality but the off-farm income might be a better strategy to balance the income between farmers.

The decomposition of the Gini coefficient by the single direct payment programmes reveals the inequality reducing effect from each of the direct payment programmes considered. This is especially true for the general direct payments that make up a high share

in the household income. In contrast, the increase of income from the animal welfare payments and the ecological direct payments would hardly affect the distribution of farm income.

The disaggregated analysis over time shows that the changes in the share (i.e. the share of a specific direct payment programme in the household income) are the primary reason why a single direct payment programme contributes to the household income inequality. However, this seems to be rather the case for the area-based payments than for the animal-unit based payments, for which also the changes in the concentration contributed to the income inequality changes in the past. In general, the contribution of the general direct payments to the inequality changes is higher than the contribution of the ecological direct payments. This, however, is the result of the low importance of these payments for the household income and may change if the agricultural policy opts to increase the support for the environmental friendly production.

REFERENCES

Allanson P. (2005): The Impact of Farm Income Support on Absolute Inequality. Paper for the 94th EAAE Seminar, 9–10 April 2005, Ashford, UK.

Boisvert R.N., Ranney C. (1990): Accounting for the importance of non-farm income on farm family income inequality in New York. Northeastern Journal of Agricultural Economics, *19*: 1–11.

Chen C.-N., Tsaur T., Rhai T.S. (1982): The Gini coefficient and negative income. Oxford Economic Papers, *36*: 473–476.

Curry N., Stucki E. (1997): Swiss agricultural policy and the environment: an example for the rest of Europe to follow? Journal of Environmental Planning and Management, *40*: 465–482.

DiCiccio T.J., Efron B. (1996): Bootstrap confidence intervals. Statistical Science, *11*: 189–212.

El Benni N., Lehmann B. (2010): Swiss agricultural policy reform: landscape changes in consequence of national agricultural policy and international competition pressure. In: Primdahl J., Swaffield S. (eds.): Globalisation and Agricultural Landscapes – Change Patterns and Policy trends in Developed Countries. Cambridge University Press, Cambridge, pp. 73–94.

Engler M. (2010): Redistribution in Switzerland: Social Cohesion or Simple Smoothing of Lifetime Incomes? Discussion Paper No. 2010-02, Department of Economics, University of St. Gallen.

FAT (2000): Neue Methodik für die Zentrale Auswertung von Buchhaltungsdaten an der FAT. Eidgenössische

Forschungsanstalt für Agrarwirtschaft und Landtechnik (FAT), Tänikon.

Fei J.C.H., Ranis G., Kuo S.W.Y. (1978): Growth and the family distribution of income by factor components. The Quarterly Journal of Economics, 92: 17–53.

Finger R. (2010): Evidence of slowing yield growth – the example of Swiss cereal yields. Food Policy, *35*: 175–182.

Finger R., El Benni N. (2011): Spatial analysis of income inequality in agriculture. Economics Bulletin, *31*: 2138–2150.

Flückiger Y., Silber J. (1995): Income inequality decomposition by income source and the breakdown of inequality differences between two population subgroups. Swiss Journal of Economics and Statistics, *131*: 599–615.

FOA (2010): Agricultural report 2010. Swiss Federal Office of Agriculture, Bern, Switzerland.

Gerfin M. (1994): Income distribution, income inequality and life cycle effects – a nonparametric analysis for Switzerland. Swiss Journal of Economics and Statistics, *130*: 509–522.

Hill B. (1999): Farm household incomes: perceptions and statistics. Journal of Rural Studies, *15*: 345–358.

Keeney M. (2000): The distributional impact of direct payments on Irish farm incomes. Journal of Agricultural Economics, *51*: 252–263.

Lerman R.I., Yitzhaki S. (1985): Income inequality effects by income source: a new approach and applications to the United States. The Review of Economics and Statistics, *67*: 151–156.

Mann S. (2003): Doing it the Swiss way. EuroChoices, *2*: 32–35.

Mann S. (2005): Implicit social policy in agriculture. Social Policy and Society, *4*: 271–281.

Mann S. (2006): Direktzahlungen aus sozialpolitischer Perspektive am Beispiel der Schweizer Landwirtschaft. Zeitschrift für Agrarpolitik und Landwirtschaft, *84*: 116–127.

Mishra A., El-Osta H., Gillespie J.M. (2009): Effect of agricultural policy on regional income inequality among farm households. Journal of Policy Modeling, *31*: 325–340.

Moreddu C. (2011): Distribution of Support and Income in Agriculture. OECD Food, Agriculture and Fisheries Working Papers, No. 46, OECD Publishing, Paris.

OECD (1998): Agriculture in a Changing World: Which Policies for Tomorrow? Organisation for Economic Co-operation and Development (OECD), Paris.

Podder N. (1995): On the relationship between the Gini coefficient and income elasticity. Sankya: The Indian Journal of Statistics, *57* (Series B, Part 3): 428–432.

Podder N., Chatterjee S. (2002): Sharing the national cake in post reform New Zealand; income inequality trends in terms of income sources. Journal of Public Economics, *86*: 1–27.

Pyatt G., Chau-nan C., Fei J. (1980): The distribution of income by factor components. The Quarterly Journal of Economics, *95*: 451–473.

R Development Core Team (2011): R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available at www.R-project.org

Schmid E., Hofreither M.F., Sinabell F. (2006): Impacts of CAP Instruments on the Distribution of Farm Incomes – Results for Austria. Discussion paper DP-13-2006, Universität für Bodenkultur, Wien.

Schenker N., Gentleman J.F. (2001): On judging the significance of differences by examining the overlap between confidence intervals. The American Statistician, *55*: 182–186.

Stuart A. (1954): The correlation between variate-values and ranks in samples from a continuous distribution. British Journal of Statistical Psychology, *7*: 37–44.

Van de Ven J. (2001): Distributional Limits and the Gini Coefficient. Research Paper Number 776, January 2001, Department of Economics, University of Melbourne, Melbourne.

von Witzke H., Noleppa S. (2007): Agricultural and Trade Policy Reform and Inequality: The Distributive Effects of Direct Payments to German Farmers under the EU's New Common Agricultural Policy. Working Paper Series No. 79/2007, Institute for Agricultural Economics and Social Sciences, Humboldt-University of Berlin, Berlin.

Zürcher B.A. (2004): Income inequality and mobility: a nonparametric decomposition analysis by age for Switzerland in the 80s and 90s. Swiss Journal of Economics and Statistics, *140*: 265–292.

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