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Agricultural and Trade Policy Reform and Inequality: The Distributive Effects of Direct Payments to German Farmers under the EU's *New Common Agricultural Policy*

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Key words: Common Agricultural Policy, agricultural subsidies, income distribution, decoupled payments.

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Abstract: The Common Agricultural Policy (CAP) of the European Union has been in a process of reform since the early 1990s. As a result of reforms, agricultural market regulations have become more liberal and direct payments have been introduced which are to a large extent decoupled from production. In this paper, we analyze the effects of the direct payments to farmers on inequality of profits in German agriculture. For this purpose, we decompose measures of absolute and relative inequality in total farm profits into the partial effects of the direct payments and all other profit determinants. Key results of the analysis are that the system of direct payments under the *New CAP* accounts for about one third of the observed inequality in family farms and for almost two thirds of inequality in the large incorporated farms.

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1. Introduction

Since the early 1990s, the Common Agricultural Policy (CAP) of the European Union has been in the process of reform. In this process, the traditional farm subsidies in the form of variable import levies, export subsidies and other government market interventions increasingly have been replaced by direct payments to farmers which are to a large extent decoupled from actual production.

One key argument against the traditional CAP, which attempted to provide income support to farmers, has been that this type of policy is poorly suited to realizing this objective because of detrimental distributive effects (e.g. von Witzke, 1979; von Witzke and Schmitt, 1981). Under the traditional CAP, price support transfers from the EU to farmers were linked to production. Thus, large operations, which produced a lot and which typically secured high incomes, were the primary beneficiaries and not the small farmers for whom this policy was intended. Moreover, it is the land owners rather than the operators who reap most of the benefits of this type of policy, as agricultural producer price support tends to be capitalized to a large extent into farm land prices.

The *New CAP* lacks the explicit agricultural income support objective. Rather it is politically legitimized as compensation for positive externalities and the provision of public goods. Whatever public goods and positive externalities farmers might produce, they will be tied directly or indirectly to the size of the operation. However, it is false to conclude that the distributive effects of farm payments under the *New CAP* do not matter.

Allocation and distribution are two key economic dimensions. Allocative and distributive effects are central variables by which the performance of government policies is measured. Therefore, it is not all that surprising that the distributive implications of agricultural and trade policies in EU countries (e.g. von Witzke, 1983; 1984; Kleinhanss, 2004; Thurston, 2006), the United States (e.g. MacDonald, 2006) and elsewhere have been subject to scientific scrutiny and public debate. The European Union has apparently already felt the public unease with the distribution of farm payments under the *New CAP*, as the EU Commission has repeatedly expressed concern in this regard and contemplated imposing limitations on individual payments to farmers.

At first glance, it might appear paradoxical that the traditional CAP, which had an explicit distributive objective, was politically acceptable for the last four decades despite its inability to meet this objective with reasonable efficiency, and that the distributive consequences of the *New CAP,* which lacks an explicit distributive motivation, has become cause for political concern. This paradoxical political attitude can be resolved, however, when one takes into account that the distributive effects of the traditional CAP have not been transparent to the public because the transfers to farmers were disguised as support prices. Under the *New CAP* the magnitude of transfers to the farm economy is much more conspicuous even to the casual observer of the CAP.

In the remainder of this paper, we will, first, present a theoretical framework which is suitable for the decomposition of two commonly used measures of absolute and relative inequality into the partial contribution of inequality determining variables. Then, we will present the results of an empirical analysis of the contribution to inequality of the direct payments to farmers in Germany under the *New Common Agricultural Policy* of the European Union. As the European Commission is again contemplating imposing limitations of payments to individual farms, we will also quantify how a payment cap at € 300,000 per farm would affect profit levels and inequality. We will conclude with the discussion of some of the implications of this study's result for structural adjustment in German agriculture.

2. Theoretical framework

2.1 The measurement of inequality

Inequality has many dimensions (e.g. Sen, 1973; von Witzke, 1983). Two of them are considered here. They are absolute and relative inequality.

A commonly used measure of average relative inequality of a distribution is the Gini coefficient *(G)*. When the observations *(y)* are arranged in a monotonically non-decreasing order *G* may be defined as follows:

(1) $$G = \sum_{i=1}^{n} l_i \cdot r_i$$

(2) $$l_i = \frac{2 \cdot i - n - 1}{n - 1}$$

(3) $$r_i = \frac{y_i}{\sum_{i=1}^{n} y_i}$$

Notice that r_i in eq. (3) represents the slope of the Lorenz curve in i.

G has a number of nice and intuitively appealing properties.

- It is constant with respect to a proportional change of all observations.
- It is invariant to sample size.
- It meets the transfer axiom (a transfer from one unit of observation to a larger one acts to increase G).
- For non-negative values it is in the interval [0,1], where 0 reflects perfect equality and 1 perfect inequality.

When G is multiplied by $2 \cdot \mu$ (μ = arithmetic mean), one obtains a measure of average absolute inequality of a distribution (GA):

$$(4) \qquad GA = \frac{2}{n} \cdot \sum_{i=1}^{n} l_i \cdot y_i$$

GA is characterized by properties which are analogous to G:

- It is invariant to a change in value of the observations which is identical for all observations.
- It is invariant to sample size.
- It meets the transfer axiom.
- For non negative values it is in the interval [0,1).

2.2 Decomposing inequality

In this paper, we wish to determine the extent of overall profit inequality in German agriculture and the contribution of the distribution of direct payments to overall inequality of profits. For this purpose, the two measures of inequality discussed above will be decomposed. This allows us to quantify the contribution of the inequality of profit components to overall profit inequality.[1]

Assume that total profit (y) is the sum of two components $(x$ and $z)$. Then for any individual farm (i).

$$(5) \qquad y_i = x_i + z_i$$

When the profit vector (y) is arranged in a monotonically non-decreasing order, and the income components are arranged according to y_i, then G, as defined in eq. (1), can

[1] The following decomposition analysis is based on Rao (1969), Fei et al. (1978), Pyatt et al. (1980), Shorrocks (1982), von Witzke (1983, 1984).

be decomposed into the contribution of the distribution of profit components to overall inequality. This can easily be seen as:

$$(6) \quad \sum_{i=1}^{n} l_i \cdot r_i = \sum_{i=1}^{n} l_i \cdot r_{xi} + \sum_{i=1}^{n} l_i \cdot r_{zi}$$

$$(7) \quad r_{xi} = \frac{x_i}{\sum_{i=1}^{n} y_i}$$

$$(8) \quad r_{zi} = \frac{z_i}{\sum_{i=1}^{n} y_i}$$

The two parts of the right hand side of eq. (8) formally look like Gini coefficients of the two profit components. However, they are not true Gini coefficients, as they are not necessarily arranged in a monotonically non-decreasing order and, therefore, can assume values outside [0,1]. We will refer to them as **p**artial **p**seudo **G**ini coefficients (PPG). Thus, we obtain:

$$(9) \quad G = PPG_x + PPG_z$$

The PPG_i are the product of the relative contribution of the $i-th$ profit determinant to total profit (w_i) and the distribution of the $i-th$ profit determinant. This can easily be seen by rewriting eq. (6) as follows:

$$(10) \quad G = \sum_{i=1}^{n} l_i \cdot r_i = w_x \cdot \sum_{i=1}^{n} l_i \cdot r_{xxi} + w_z \cdot \sum_{i=1}^{n} l_i \cdot r_{zzi}$$

$$(11) \quad w_x = \frac{\sum_{i=1}^{n} x_i}{\sum_{i=1}^{n} y_i}$$

$$(12) \quad w_z = \frac{\sum_{i=1}^{n} z_i}{\sum_{i=1}^{n} y_i}$$

(13) $$r_{xxi} = \frac{x_i}{\sum_{i=1}^{n} x_i}$$

(14) $$r_{zzi} = \frac{z_i}{\sum_{i=1}^{n} z_i}$$

Two expressions on the right side of eq. (10) $\left(\sum_{i=1}^{n} l_i \cdot r_{xxi} \ and \ \sum_{i=1}^{n} \cdot r_{zzi} \right)$ formally look like Gini-coefficients of the income determining variables *x* and *z* respectively. However, they are not true Gini-coefficients, as the r_{xxi} and r_{zzi} are not necessarily arranged in a monotonically non-decreasing order. In the literature, they are often referred to as **p**seudo **f**actor **G**ini coefficients (PFG). Therefore, eq. (10) can be rewritten as follows:

(15) $$G = w_x \cdot PFG_x + w_y \cdot PFG_y$$

By analogy, GA can be decomposed:

(16) $$GA = PPGA_x + PPGA_z$$

(17) $$GA = \frac{2}{n} \cdot \sum_{i=1}^{n} l_i \cdot x_i + \frac{2}{n} \cdot \sum_{i=1}^{n} l_i \cdot z_i$$

When there are negative profits G may be outside [0,1]. When average profits are negative, G must also be negative, as evidenced by eq. (18).

(18) $$G = \frac{1}{n \cdot (n-1)} \cdot \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} \left| y_i - y_j \right|}{2 \cdot \mu}$$

The existence of negative profits may complicate the interpretation of results significantly (Amiel, et al., 1996; Allanson, 2006). As will become evident later, negative profits do occur in both farm groups analyzed here. Their impact on the results for family farms is limited. However, negative profits are of significance in the incorporated farms. In fact, average profit without the direct payments is negative in the incorporated farms.

3. Empirical analysis

3.1 Data

The data used in this analysis has been made available by the German Federal Ministry of Food, Agriculture and Consumer Protection. It is the very same data set upon which the annual report on the economic situation of German agriculture is based ("Testbetriebe") and which is reported to the EU farm data network (FADN). A total of 11,756 observations are available for 2005 for farms with a single operator and partnerships of (usually) four or fewer partners. They represent more than 250,000 farms. In the remainder of this paper these farms will be referred to as 'family farms'. In addition, there is data available for 2004/05 for 481 large incorporated farms, typically located in the East of Germany. They represent a population of 2,876 farms. The two samples can be considered to be reasonably representative of German farms. The data is grouped by agricultural accounting profit per farm before taxes. We have opted to analyze both samples separately because they cover different time periods and because the definition of accounting profit is somewhat different between the two farm types.

The cash transfers to farmers considered in this analysis include all direct payments. The bulk of these payments are (largely) decoupled transfers under the New CAP. They are based on historic production figures. The calculation of the actual individual transfers is rather complicated and cannot be discussed here (for details see BMVEL, 2005). In essence, the sum of total payments can be expected to correlate with farm size. Therefore, we expect large operations to receive more in payments from the government than do small farms.

Individual data has not been available due to government data privacy regulations. In fact, only averages are available for each group. The farm profit classes according to which the data is grouped are exhibited in Table A1 of the Appendix.

3.2 Direct payment and farm size

The individual payments for which farmers are eligible require complex calculations and detailed information on each individual farm. In fact, the calculations are very complex and the administrative cost for the calculation of individual payments and verifying the information provided by farmers is high as well. Therefore, it is sometimes argued that payments to small farms should be discontinued altogether.

However, the payments are in one way or another related to farm size, as are farm profits. As this is the case, one would expect the direct payments to contribute to profit inequality. Therefore, one or more variables which capture farm size might be good predictors of total direct payments received by farmers. One variable often used to capture farm size is the area farmed. We found that this variable is indeed an excellent predictor of the direct payments received by a farm. We ran WLS regressions with total direct payments per farm within in each profit class as the dependent variable and area used for farming as the independent variable where the number of observations per

profit class determines the weight of each observation. The results are presented in table 1.

Table 1: Explaining direct payments received per farm acreage farmed (WLS regression)

1.1 Results of the WLS regression analysis for family farms (2005)

dependent variable	total direct payments per farm (€)
independent variable	agricultural area per farm (€)
intercept [1]	1250.021 (2.509)
slope [1]	372.946 (112.336)
adjusted R^2	.999
F	12619.378

1.2 Results of the WLS regression analysis for incorporated farms (2004/05)

dependent variable	total direct payments per farm (€)
independent variable	agricultural area per farm (€)
intercept [1]	6971.894 (.200)
slope [1]	404.815 (16.782)
adjusted R^2	.949
F	281.644

[1] t-values in parenthesis

Source: Own calculations based on BMELV.

It becomes obvious from table 1 that the area farmed is an excellent predictor of the total amount of direct payments received per farm. For both family farms and for the large incorporated farms the estimates have an excellent fit and the t-values are highly significant.

A word of caution is in order, however. The estimates are based on grouped data. They reflect group averages. Thus, it is possible that some individual farm characteristics may lead to somewhat higher or lower actual individual payments than one would expect based on the estimates presented here.

3.3 The contribution of the inequality of the direct payments to overall profit inequality

The extent of relative and absolute inequality is exhibited in table 2. In order to demonstrate the effect of negative profits on overall inequality, we have calculated G and GA in two ways, setting negative profits equal to one and accounting fully for negative profits.

In general, G is fairly high. This is, however, not very surprising when annual data is used in the calculations, as profits tend to fluctuate considerably from one year to the next due to random events such as weather, plant or animal disease.

In the incorporated farms inequality is more pronounced than in the family farms. This is particularly true with regard to GA. In part, this reflects the fact that the incorporated farms are larger and thus receive more subsidies and secure higher profits.

Table 2: Average relative and absolute inequality in German farms, 2005 (family farms), 2004/05 incorporated farms

2.1: Negative profits = 0

farm type	G	GA (€)
family farms	.50271	40,313
incorporated farms	.64853	134,432

2.2 Negative profits accounted for

Farm type	G	GA (€)
Family farms	.53558	41,970
Incorporated farms	.85089	154,707

Source: Own calculation based on BMELV.

A comparison of the results in tables 2.1 and 2.2 shows that the impact of negative profits in inequality is fairly limited in the family farms but rather pronounced in the incorporated farms. The main reason for this is that in the family farms the percentage of farms with negative profits is about half of what it is in the incorporated farms.

In the decomposition of overall inequality into its partial effects we have fully accounted for negative profits, as this yields exact results. We have calculated the numbers for total profit including direct payments, direct payments only, and profit without direct payments. In the remainder of this paper we will refer to profit without direct payments as ‘market profit’. Notice that market profit is not identical to free market profit, as market profit also contains subsidies to farmers through government market interventions such as trade restrictions, domestic minimum prices, domestic production quotas and other policy instruments.

The results of the decomposition analysis are quite dramatic. In the family farms the direct payments account for about one third of total inequality while in the incorporated farms they account for almost two thirds of total inequality.

Table 3: Inequality of farm profits, direct payments, and market profits in German farms, 2005 (family farms) and 2004/05 (incorporated farms); negative profits accounted for

3.1 Relative inequality

farm type	Gini coefficient	PPG direct payments	PPG market profits
family farms	.53558	.17554	.36004
Incorporated farms	.85089	.53645	.31444

3.2 Absolute inequality (€)

farm type	GA	PPGA dir. payments	PPGA mkt. profits
family farms	41,970	13,756	28,214
incorporated farms	151,707	97,536	54,171

Source: Own calculations based on BMELV.

Notice that the results reported in table 3 underestimate the actual contribution of direct payments to overall inequality. The reason is that the inequality of annual market profits is subject to random shocks. Therefore, annual profit inequality is larger than inequality of average profits for more than one year (von Witzke, 1983). Hence, the inequality of market profits would be reduced if these shocks were accounted for.

In contrast to the PPGAs, the PPGs can be decomposed further. The results of the decomposition of the PPGs are exhibited in table 4. The interpretation of the numbers for the family farms is straightforward. The direct payments account for about 60 per cent of total profit. The rest (about 40 per cent) is market profit. The PFG of market profit is close to one. This reflects overall inequality but it also reflects the fact that almost one third of family farms would realize negative profits in the absence of the direct payments.

The interpretation of the results for the incorporated farms is complicated by the fact that the market profit in all but one profit class is negative. Therefore, the weight of the market profit is negative as is the respective PFG. As the direct payments are the key component for overall profit, its weight is rather high. Notice that the sum of both weights must be equal to one (see eqs. (11) and (12)).

Table 4: Decomposition of the Partial Pseudo Gini coefficients (PPG), family farms (2005) and incorporated farms (2004/05)

farm type	direct payments			market profit		
	PPG	w	PFG	PPG	w	PFG
family farms	.17554	.60472	.29028	.36004	.39528	.91085
incorporated farms	.53645	5.9401	.09031	.31444	-4.9401	-.06365

Source: Own calculations based on BMVEL.

3.4 Implications of payment limitations

The European Union has repeatedly considered limitations on payments to individual farms. Therefore, we have analyzed how such upper limits would affect German agriculture at present farm structure. We have analyzed the distributive effects of payment limitations in the amount of € 300,000, as this is a payment cap presently contemplated by the European Union. The results are presented in table 5. As can be seen, a payment limit of € 300,000 would have no effect at all on family farms. Notice that very large farms with single ownership or limited number of partners, which here are referred to as family farms, are not in the sample. These large operations would, of course, also be affected by the payment limitation analyzed here. Notice also that payment limitations create an incentive to split up farms into smaller units.

In the incorporated farms, both payment limitations would be binding in every profit class except one. The reason is that these farms tend to be large, and thus receive large direct payments. Tables 5 and A1 also clearly demonstrate that all incorporated farms except those few in the highest profit class would make a loss in the absence of the direct payments. Therefore, G becomes negative with payment limitation while GA declines by almost two thirds. As the payment limitation is binding for all but one profit class, their PPG and PPGA respectively is close to zero, and overall inequality is almost entirely accounted for by the inequality of market profits.

Table 5: The effect of a € 300,000 per farm payment limitation on relative and absolute inequality

5.1 Family farms

No effect in family farms.

5.2 Incorporated farms

G without payment limitation	G with limitation	PPG dir. payments with limitation	PPG market profits with limitation
.85089	-.19505	-.00416	-.19089
GA without limitation (€)	GA with limitation (€)	PPGA dir. payments (€)	PPGA market profits (€)
154,707	58,417	1,246	57,171

Source: Own calculations based on BMELV.

4. Summary and conclusions

This paper presents a methodological framework for the analysis of the determinants of economic inequality. It is applied here in order to quantify the impact of direct payments under the European Union's *New CAP* on profit inequality between German farms.

The results demonstrate that the direct payments contribute significantly to profit inequality in German agriculture. About one third of observed inequality between family farms is accounted for by direct payments, while direct payments account for almost two thirds to observed inequality between the large incorporated farms. A typical family farm secures a profit of about € 25,000 of which about € 17,000 is accounted for by direct payments. The incorporated farms typically receive a multitude of the payments made to family farms. Even the smaller incorporated farms receive government cheques of more than € 500,000. The larger operations secure direct payments from the government in excess of € 1,000,000. However, the vast majority of incorporated farms would make negative profits in the absence of direct payments.

The EU has repeatedly considered imposing limitations on direct payments made to an individual farm. In this paper, we have calculated the implications of a payment limitation per farm in the amount of € 300,000. The results suggest that smaller family farms would not be affected by such a payment limitation simply because they typically receive payments that do not exceed the limitation considered here. However, the large incorporated farms would experience a significant reduction in payments. The vast majority of these farms would make negative profits in the absence of the direct payments and, therefore, would be forced to go out of business or to restructure and become efficient.
In this context, the issue of equity has to be addressed as well. To a significant degree the *New CAP* has replaced traditional farm subsidies. Much like the traditional farm subsidies, the direct payments are closely linked to farm size. Thus, it is not surprising that direct payments are rather unequally distributed in favour of large operations. Therefore, the *New CAP* contributes significantly to inequality within agriculture.

The proponents of decoupled payments claim that this type of subsidy has no effect on factor allocation and, thus, no effect on social welfare either. This presumption is based on a very simple model of neoclassical partial equilibrium analysis in which liquidity does not matter for either production or investment decisions, in which risk and risk aversion do not exist, in which farmers do not hold expectations about future adaptations of agricultural policies, and in which factor payments in agriculture are identical to those outside of agriculture. The findings in this paper contradict this perception and they are consistent with the US experience of decoupled payments to farmers under the 1996 US Farm Bill.

As this is the case, the direct payments keep farms which are inefficient in business. Without the subsidies under the EU's *New CAP*, society would be better of and social welfare would be higher. The structural adjustments would include downsizing the labor force and a reduction in the rental price of agricultural land. In the absence of these

subsidies, the inefficient farms would go out of business, or they would have to restructure to become efficient. Essentially the same is true for payment limitations, except that the economic incentives to adjust towards more efficient farms are alleviated, and incentives are generated to avoid payment caps by splitting up (existing) farms into smaller operations.

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Appendix

Table A 1: Farm profit class, profits and number of observations per profit class

1. Family farms (2005)

profit class (thousand €)	number of farms in sample	total number of farms	profit per farm (€)	total direct payments per farm (€)
≤ 0	1,117	37,659	-9,626	11,397
0 – 5	672	23,692	2,573	11,179
5 – 10	724	21,711	7,580	12,636
10 – 15	842	22,680	12,453	13,944
15 – 20	910	22,112	17,428	15,539
20 – 30	1,696	37,193	24,948	17,220
30 – 40	1,473	27,687	34,581	21,234
40 – 50	1,058	17,752	44,802	25,830
50 – 75	1,630	25,651	60,762	31,840
75 – 100	785	10,890	85,397	37,939
100 – 125	377	4,827	110,676	47,174
125 – 150	179	2,294	135,766	47,263
150 – 200	171	1,907	170,765	74,870
200 – 300	81	826	237,862	105,844
> 300	41	453	404,499	150,207

2. Incorporated farms (2004/05)

profit class (thousand €)	number of farms in sample	total number of farms	profit per farm (€)	total direct payments per farm (€)
≤ 0	94	519	-65,162	517,570
0 – 5	34	202	2,710	416,444
5 – 10	17	94	7,409	281,623
10 – 15	16	75	12,766	608,598
15 – 20	12	104	17,129	358,964
20 – 30	27	184	24,398	335,200
30 – 40	23	151	35,152	474,244
40 – 50	22	118	44,506	623,146
50 – 75	31	205	61,602	480,161
75 – 100	37	259	86,326	452,225
100 – 125	26	141	115,600	682,668
125 – 150	29	194	139,218	622,194
150 – 200	37	189	174,345	612,657
200 – 300	44	265	249,202	585,224
300 – 500	26	152	368,832	853,600
> 500	6	24	1,271,034	1,068,592

Source: BMELV and own calculations based on BMELV.

Table A 2: Farm profit, direct payments and market profit with payment limitations (€ 300,000); incorporated farms[1]

profit class (thousand €)	total number of farms	profit per farm without direct payments (€)	total direct payments per farm (€)	*new* profit per farm (with payment limitations) (€)
≤ 0	519	-582,732	300,000	-282,732
0 – 5	202	-413,734	300,000	-113,734
5 – 10	94	-274,214	281,623	7,409
10 – 15	75	-595,832	300,000	-295,832
15 – 20	104	-341,835	300,000	-41,835
20 – 30	184	-310,802	300,000	-10,802
30 – 40	151	-439,092	300,000	-139,092
40 – 50	118	-578,640	300,000	-278,640
50 – 75	205	-418,559	300,000	-118,559
75 – 100	259	-365,899	300,000	-65,899
100 – 125	141	-567,068	300,000	-267,068
125 – 150	194	-482,976	300,000	-182,976
150 – 200	189	-438,312	300,000	-138,312
200 – 300	265	-336,022	300,000	-36,022
300 – 500	152	-484,768	300,000	-184,768
> 500	24	202,442	300,000	502,442

Source: BMELV and own calculations based on BMELV.

[1] No effect of a € 300,000 payment limitation in family farms.

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