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Inequalities in Agricultural Subsidies in European Union

Abstract. The paper constitutes an attempt at comparison of subsidies level in relation to utilised agricultural area, labour force and value of production throughout EU-25 member states in years 2005 – 2013. The main objective of the paper was assessment of the level of inequalities in agricultural subsidies in European Union and evaluation of their potential trends. Using FADN data aggregated at country level the Gini coefficient was calculated for mentioned dimensions of subsidies level. Additionally sigma and beta convergence analysis were carried out for subsidies and productivity levels. The general conclusion from performed analysis was that famers in EU-10N should now perceive the subsidies level throughout EU quite fair in contrast to 2005, it is especially true in case subsidies per utilised agricultural area with drop of Gini coefficient from 0.23 to 0.15, that is by 35%. On the other hand the productivity levels are converging on much slower pace than subsidies level, for both measures of productivity the beta coefficients in convergence analysis where negative but not significant at standard 5% significance level.

Key words: agricultural subsidies, Gini coefficient, beta convergence, CAP

Introduction

The objectives of Common Agricultural Policy (CAP) have been changing from promoting increase of productivity in aim to provide food self-sufficiency 1962 to protection of environment in 2013. But for farmers CAP always meant additional money to support their income. Therefore farmers in new member states EU-10N, which joined the EU in 2004 were in the same time afraid of competition in enlarged market and hoping for the same conditions as farmers in EU-15. But in the first years after joining EU the subsidies level in EU-10N was much lower the in EU-15, starting at 25% of the EU-15 2004 level (Kelch and Normile, 2004), it was a cause for much complaining about unfair treatment of farmers in the "old" and "new" member states.

Comparison of famers income across EU member states seems to confirm that absolute level of income for the average farm greatly differ. But, according to (Hill and Bradley, 2015) report the main reason for that is the size of average farm and sometimes production type. When comparing farms of the same size of the profile of production performance is similar throughout the EU and quite often better in EU-10N. Also (Baráth and Fertő, 2016) confirm convergence of total factor productivity (TFP) in the EU, for both σ and β convergence. For years 2004 – 2013 the highest annual growth rate in TFP was observed for Finland, Poland and Latvia, while the lowest for Germany, Luxemburg and Belgium.

Probably at least some part of mentioned increase of farms performance in EU-10N in recent years could be result of changes in subsidies level. The inequalities of agricultural subsidies between countries could be tackled in various ways, in (Samman, 2005) the Gini coefficient was applied to measure concentration of agricultural subsidies for France, Great

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Britain, the European Union and the United States in traditional way, that is comparing number of farm with amount of subsidies they receive. While this is formally correct in case of subsidies obtained results are actually in direct relation to inequalities of farms size. The more thorough analysis of mentioned inequalities requires comparison of subsidies at least in relation to utilised agricultural area, labour force and value of production.

This paper aims at assessment of the level of inequalities in agricultural subsidies in European Union and evaluation of their potential trends.

Data

This analysis uses data from the Farm Accountancy Data Network (FADN). Samples from years 2005 – 2013 were aggregated at country level. Although, the data for FADN is collected according to the same methodology across all EU member states the minimal economic size of a "commercial" farm is different in specific countries, starting from 2000 EUR of standard output in Bulgaria and Romania, by 4000 EUR in most EU10 countries up to 25000 EUR in most West Europe countries (plus Slovakia), to accommodate for the different farm structures across EU.

Observations of the following variables were selected for each member state:

X_1 – number of farms (SYS02);

X_2 – average total utilised agricultural area of holding (SE02) [ha];

X_3 – average total output (SE131) [EUR];

X_4 – average total labour (SE425D) [AWU[2]];

X_5 – average balance of subsidies and taxes (SE600) [EUR].

Table 1. Average levels of observed variables for EU 25

Year	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
2005	4044350	35.60	60734	1.66	10971	1972	34857	325	6408	18.55
2006	4064130	36.03	63226	1.63	12029	1982	36492	367	7069	20.56
2007	3858580	36.82	73494	1.65	12159	2314	41593	369	7006	17.53
2008	3816520	37.35	74173	1.65	12708	2279	42077	386	7364	18.69
2009	3660790	38.71	69122	1.64	13183	2017	38961	370	7573	21.49
2010	3704000	38.60	76799	1.61	13711	2184	43560	387	8077	20.73
2011	3703580	38.70	83219	1.61	13596	2313	47116	374	7986	18.75
2012	3782980	38.77	88238	1.60	13185	2439	49929	357	7712	17.10
2013	3770140	39.41	88232	1.58	13217	2384	50139	354	7785	17.44

Source: own calculations, based on FADN data.

Using the mentioned above variables five following variables used as a measures of productivity and subsidies level were calculated:

X_6 – average total output per total utilised agricultural area (X_3/ X_2) [EUR/ha];

X_7 – average total output per AWU (X_3/ X_4) [EUR/AWU];

[2] AWU – annual work unit = full-time person equivalent.

X_8 – average balance of subsidies and taxes per total utilised agricultural area (X_5/ X_2) [EUR/ha];

X_9 – average balance of subsidies and taxes per AWU (X_5/ X_4) [EUR/AWU];

X_{10} – average balance of subsidies and taxes per total output (X_5/ X_3) [%].

During analysed time period 3 countries joined EU, that is Bulgaria, Romania and Croatia. Those countries were excluded from the analysis to avoid concealing of possible trends. The number of farms (X_1) and average values for all other variables of remaining 25 member states are presented in table 1. Through observed 9 years on average farms in EU become significantly bigger, that is total utilised agricultural area of holding increased by 11% and value of total output by 45%. At the same time total number of AWU decreased by 11% and average level of subsidies per hectare increased by 9%.

Methods

To evaluate the level of inequalities in agricultural subsidies following statistical measures were employed:

coefficient of variation: $c_v = \frac{s}{\overline{y}}$, where s stands for estimator of standard deviation and $\overline{y}$ for average.

Gini coefficient: $G = 1 - \sum_{i=1}^{k} (x_i - x_{i-1})(y_i + y_{i-1})$, where x_i – accumulated share of the values used as a denominator[3] and y_i – accumulated share of the values used as a numerator for the i country. Before calculation of Gini coefficient countries were arranged in ascending order according to quotient of shares used as nominator and denominator.

The evaluation of potential trends in subsidies inequality across EU member states the values of mentioned statistics were calculated for each year and additionally σ and β convergence was assessed. To estimate σ convergence estimator of standard deviation was calculated for each year. For and β convergence the modification of the original Baumol was used:

$$\frac{1}{T}\log\left(\frac{y_{i,T}}{y_{i,0}}\right) = \alpha + \beta\log\left(y_{i,0}\right) + \varepsilon_i,^{4} \qquad (1)$$

[3] Originally Gini coefficient was used for assessment of income inequalities where the x_i – was accumulated share of the population number and y_i – was accumulated share of total income. Consequently, the values used for the denominator calculation were just households numbers, and the values used for the numerator calculation were incomes.

[4] The formulation used in formula (1) is typical to standard notation for linear models. However, in literate on the subject of convergence it is quite common to find slightly different formulation for example in (Young et al.,

where: $y_{i,0}$ – value of subsidy in member state *i*, starting year of analysed period and $y_{i,T}$ – value of subsidy in member state *i*, ending year of analysed period, T – period length, α – intercept and β – regression coefficient. If the increase in subsidy is proportionally higher in member states with lower initial level of subsidies $\beta<0$ should be observed.

All calculations were performed in R, a statistical computing environment (R Core Team, 2016).

Results

Comparison of subsidies per total utilised agricultural area presented in figure 1. suggests, that the differences between countries are very high for both considered years. Nevertheless in 2013 the differences seem smaller, especially observing the level of subsidies in countries which joined EU in 2004.

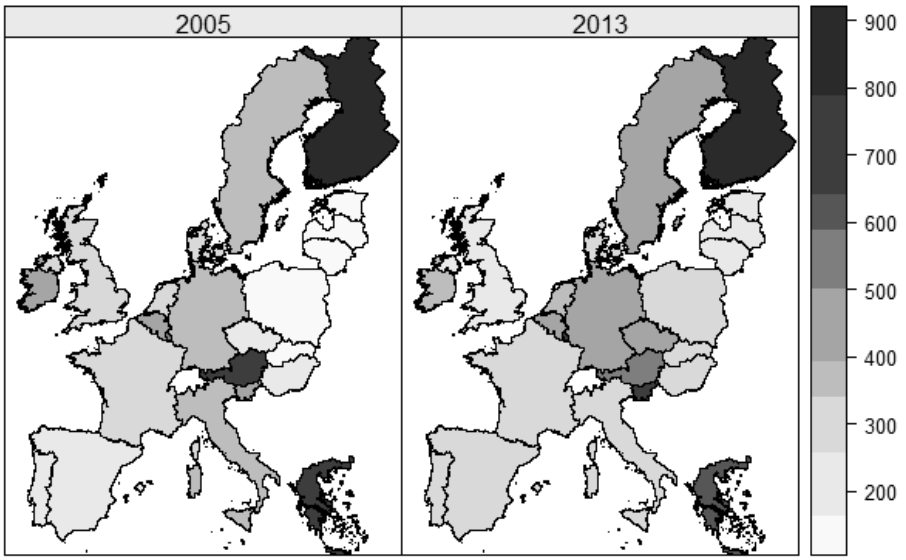

Fig. 1. Subsidies per total utilised agricultural area [EUR/ha]

Source: own calculations, based on FADN data.

On the other hand subsidies per total output presented in figure 2. show relatively high uniformity even in year 2005, except Finland, Ireland and Austria. And, what interesting, the countries which joined EU in 2004 display higher levels than Germany, France or Italy.

2008) following equation can be found: $\log\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = \alpha - \beta \log\left(y_{i,t-1}\right) + u_i$. The main difference, besides using for estimation data from to consecutive years, is the minus sign before beta. Because of that in this formulation positive values of beta support convergence, while in the formulation used in this paper it negative beta.

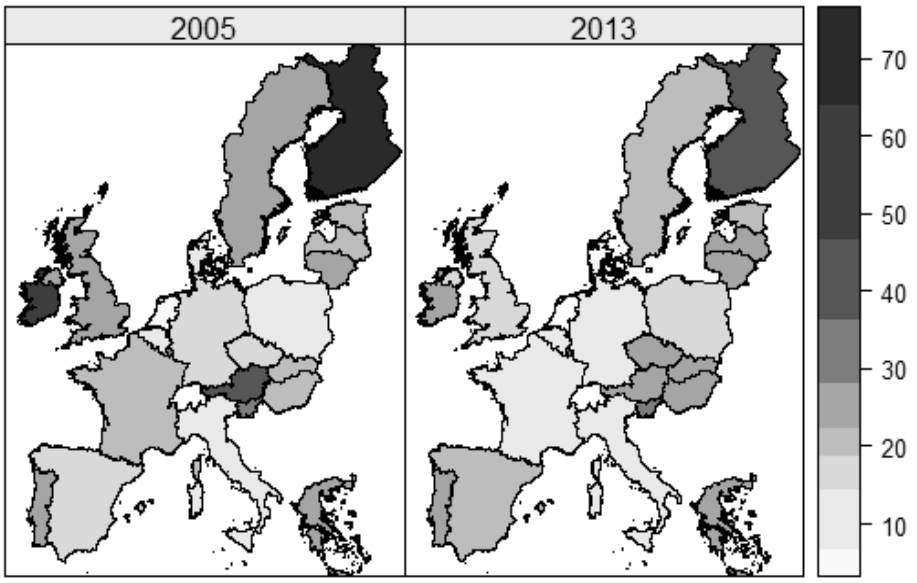

Fig. 2. Subsidies per total output [%]

Source: own calculations, based on FADN data.

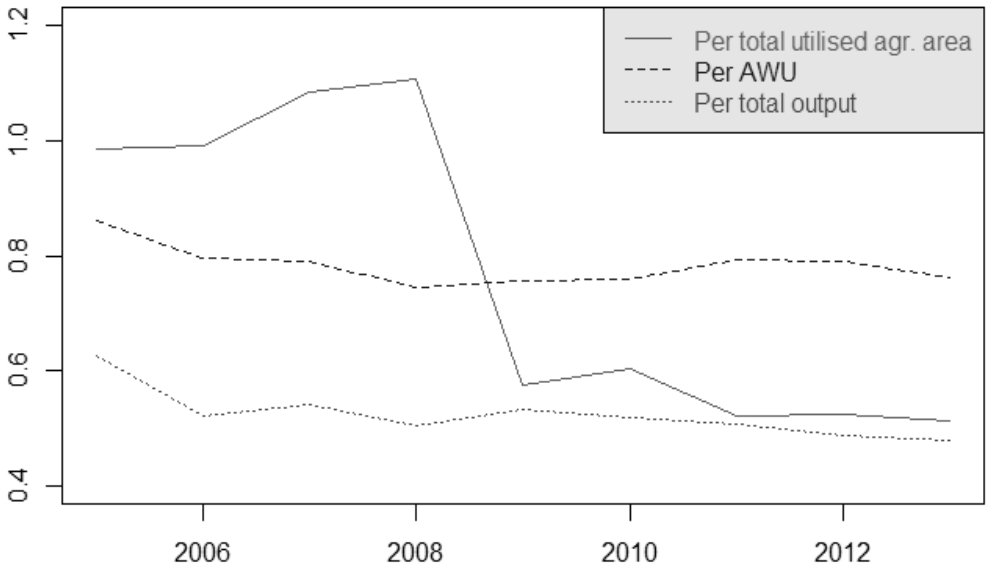

Fig. 3. Coefficient of variation of subsidies per total utilised agr. area, AWU and total output

Source: own calculations, based on FADN data.

Assessment of inequalities in the level of subsidies has been performed separately for the three variables, in which the nominal of level subsidies were divided, respectively by total utilised agricultural area, number of AWU and by total output. As could be expected all three variables show different level of inequality. Results for coefficient of variation presented in the figure 3 confirm, that for the whole period 2005–2013 subsidies per total output have the smallest variation, while for total utilised agricultural area the variability decreased to similar level only since year 2009. The variability of subsides level per AWU showed very small decrease and in year 2013 was still close 0.8.

The result showed in the figure 3. concerned variability of subsidies. It could be argued that in case of high uniformity of subsidies levels measures of variability should be low. Still, the traditional measure of inequalities is popular Gini coefficient. The calculation of it values for three variables representing different formulation of subsidies level allowed comparison of subsidies concentration in relation to utilised agricultural area, labour force and production. Surprisingly the lowest concentration was observed entire time for the utilised agricultural area. Such high difference between rankings produced by variation coefficient and Gini coefficient can be caused by some extreme values of observed variables with very low share in the sum of the denominator values. For example in 2005 subsidies per utilised agricultural area was close to 2200 EUR/ha on Malta when average for whole EU25 was just 325 EUR/ha, during the following years the subsidies for Malta were equal in EUR/ha: 2439, 2790, 3121, 1170, 1380, 1047, 1082, 1055. Consequently those extreme values greatly affected values of variation coefficient. In calculation of Gini coefficient the share of both subsidies and utilised agricultural area is taken into account. Those shares for Malta were in 2005 respectively: 0.0049% and 0.0347%, thus influencing value of Gini coefficient very little in contrast to variation coefficient where all observations had the same weight.

Summarizing the result for Gini coefficient, the inequalities of subsidies level across EU25 during years 2005–2013 were decreasing, with the deepest lessening of 35% observed for subsidies in relation to utilised agricultural area.

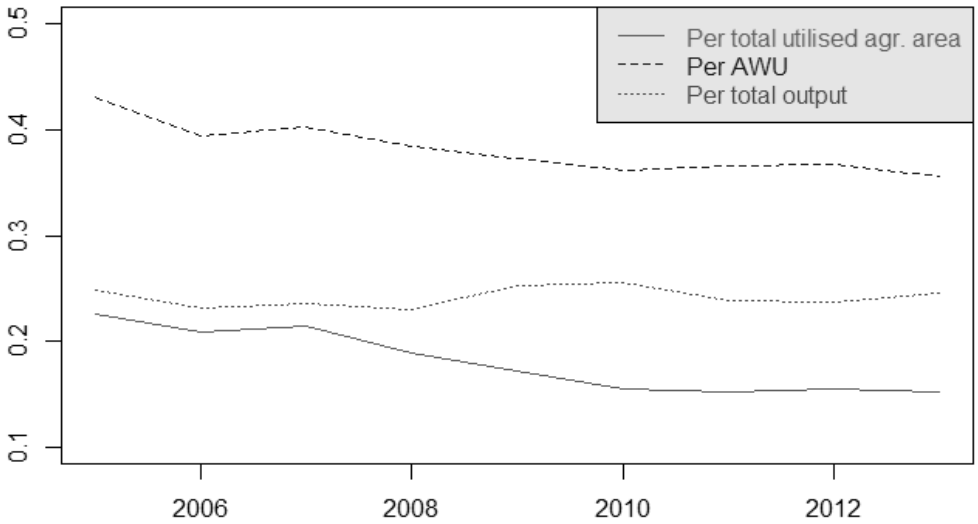

Fig. 4. Gini coefficient of subsidies per total utilised agricultural area, AWU and total output

Source: own calculations, based on FADN data

To compare trends in inequalities of subsidies level with changes in productivity tables 2 and 3 contain results for 5 variables, additional variables X_6 and X_7 are connected to productivity. Both measures of productivity show that during 9 analysed years there was practically no change in divergence level measured by variation coefficient. Conversely, subsidies level shows quite strong convergence. It is especially true for subsidies per hectare of utilised agricultural area where variation coefficient in year 2013 is almost twice lower than in 2005.

Table 2. Variation coefficients of productivity and subsidies level for EU 25

Year	X_6	X_7	X_8	X_9	X_{10}
2005	1.163	0.831	0.985	0.861	0.626
2006	1.189	0.858	0.991	0.796	0.520
2007	1.091	0.808	1.086	0.791	0.542
2008	1.140	0.801	1.108	0.745	0.504
2009	1.107	0.823	0.576	0.757	0.532
2010	1.130	0.862	0.604	0.759	0.519
2011	1.052	0.856	0.520	0.794	0.507
2012	1.111	0.853	0.524	0.790	0.488
2013	1.160	0.845	0.513	0.763	0.478

Source: own calculations, based on FADN data.

The negative values of β presented in table 3 indicate existence of β convergence for all variables. On the other hand the p-values show that at 5% significance level only subsidies per utilised agricultural area and per labour force size are significant. Furthermore only determination coefficient for X_8 has actually high value supporting claim of strong β convergence only for subsidies per utilised agricultural area.

Table 3. Estimated β convergence of productivity and subsidies level for EU 25

Year	X_6	X_7	X_8	X_9	X_{10}
β	-0.0081	-0.0113	-0.0518	-0.0311	-0.0177
p-value	0.1004423	0.1168155	0.0000003	0.0147030	0.2329500
R^2	11.3	10.35	68.98	23.23	6.13

Source: own calculations, based on FADN data.

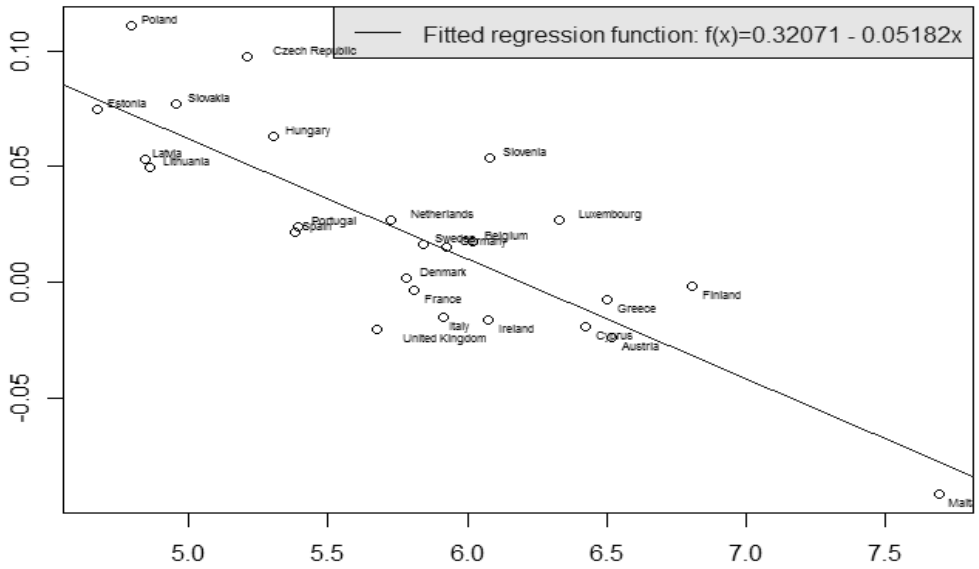

Fig. 5. Estimated β convergence model for subsidies per total utilised agr. area

Source: own calculations, based on FADN data.

Detailed data presented at Figure 5 prove, that relatively the highest increase of subsidies per total utilised agriculture area happens in Poland and other countries, which joined EU in 2004, except for Cyprus and Malta. In 2005, Poland was second to last in the level of subsidies per hectare, with lower level only Estonia, in 2013 Poland was 8 from the end, and among the countries with a lower level of subsidy was for the example the United Kingdom.

Conclusions

The comparisons of subsidies level across member states of the EU-25 in relation to utilised agricultural area, labour force and value of production show, that while for all those measures of subsidies level the reduction of inequalities level could be observed, the real decrease occurred in case of subsidies per utilised agricultural area. With drop of Gini coefficient from 0.23 to 0.15. The reason for the strongest reduction in this case could be attributed to two causes. First of them 2003 reform of the CAP, which introduced direct payments decoupled from current production, with implementation in 2005-07 at the discretion of its member states. The second reason was accession agreement for EU-10N new member states according to it single farm payments in the accession year 2004 for EU-10N started at 25% of the EU-15, with 5% increase each year until the new members receive 100% of EU payments (Cochrane, 2004).

For subsidies per labour force size the reduction of Gini coefficient was similar in absolute terms from 0.43 to 0.36, but in relative terms it was respectively: 35% and 16%. In case of subsidies per production value the changes were minimal, the reduction of Gini

coefficient from 0.25 to 0.245. Possibly the reason for this lack of inequalities reduction was change of productivity level proportional to change in subsidies per hectare.

The conclusions form analysis of Gini coefficient were confirmed by analysis of β convergence, where beta coefficient was not significant in case of subsidies per production value and strong relation with R^2 equal 69% in case of subsidies per utilised agricultural area.

Overall conclusion from performed analysis suggest, that although famers in EU-10N should now perceive the subsidies level throughout EU quite fair, in terms of subsidies per utilised agricultural area, in contrast to 2005 the productivity levels are converging on much slower pace.

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