The impact of the CAP green box on productivity in FADN European Regions

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Abstract

Facing the opinion about the ambiguous impact of decoupled subsidies on productivity, the article aims to check whether there are some CAP programmes contributing to the 'greening' trend, which have a positive impact on productivity in FADN regions. A two-stage panel analysis was carried out in the years 2007–2012: in the first stage clusters of regions with significantly different farming were identified; in the second the impact of particular CAP mechanisms on productivity was determined. It is concluded that, depending on the sustainability of farming, there are some CAP 'green' programmes which have a positive influence on productivity.

Keywords: CAP, green box subsidies, sustainability, agriculture, productivity

1. Introduction

Agricultural economics faces the dilemma how to reduce the effectiveness of the post-industrial development model in favour of an improvement in the sustainable quality of life [Wojtyna 2008; Zegar 2012]. Agricultural policy should therefore take into account the complementarity of the traditional and new aims of agriculture [Czyżewski, Stępień 2014; Wilkin 2008]. In the authors' view, however, the significant structural differences between regions, which have been noted by many authors [Giannakis, Bruggeman 2014], mean that it is not possible to apply one, universal model of agricultural support over the whole EU. One can assume that various models of farming are reflected in the structure of subsidies acquired by specific EU regions.

The question of what effect CAP subsidies have on the productivity of farms in the European Union has been studied by many authors, but it has not yet been definitively answered [Olley, Pakes 1996, Hennessy 1998, Ciaian, Swinnen 2009, Rizov et al. 2013, Banga 2014]. Generally subsidies, which change competition conditions and turn into the support of incomes rather than production are supposed to rather lower productivity. These studies show that before the decoupling reform (Luxembourg 2003) subsidies had a positive impact on production, while having a negative impact on productivity. Conclusions concerning the period since that reform remain rather ambiguous, although they tend to show that a negative effect is found less often (in terms of the influence of subsidies on the level of the total factor productivity or average productivity) or not at all (in terms of the influence on the rate of growth of TFP) [Rizov et al. 2013]. The cited paper by M. Rizov, J. Pokrivcak and P. Ciain is the most comprehensive study in this field, and also reviews the results of other researchers. The problem, however, is that it remains inconclusive in regard to the period since the decoupling reform, and that it concerns only the EU15 countries. In the cited study, the correlation coefficients proved to be statistically insignificant for 11 of the 15 countries regarding the relationship between TFP growth and subsidies [Rizov et al. 2013]. Rashmi Banga made an extensive study on the effect of "Green Box" (GB) subsidies on the technical efficiency of agriculture in various countries of the world, including the EU26, concluding that total factor productivity growth in EU agriculture is 3.7% per annum without GB subsidies, but that it increased to 8.3% per annum due to GB subsidies in 1995–2007 [Banga 2014]. We believe, however, that it is rather unjustified to ascribe this growth in productivity to pro-environmental subsidies and action taken to further sustainable development, because not all GB tools are of that nature (they include also investment support), and

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moreover there are large regional differences in support models, while average measures of productivity growth in the EU may be strongly affected by countries and regions with little use of GB support. Hence there is a need to continue research in this field focusing on the influence of specific programmes rather than on agricultural policy as a whole. It is worth taking into account the period since the decoupling reform and the new member countries of the EU28 in the cross-sectional regional perspective. We believe that this problem requires a slightly different approach to the evaluation of the effect of subsidies than was applied in the works cited above. Firstly, subsidies for agriculture in the EU should be considered as not so much an econometric problem but as one of political economy. Secondly, the productivity of resources in agriculture can be affected not by the amount of subsidies, but also by their structure, which differs more at regional than national level. In this view, the structure of subsidies treated holistically as the proxy for structural differences becomes a qualitative rather than a quantitative predictor.

We shall attempt to fill the aforementioned gaps by means of a two-stage study. In the first stage the goal is to identify clusters of EUFADN regions which differ significantly in terms of farming models. For this purpose the structure of acquired CAP funds was used as the proxy for structural differences. In the second stage, panel regression models were estimated for the clusters identified, in order to find out which CAP "green programmes" have a significant impact on productivity. The spatial analysis was carried out based on data from EUFADN for the 2007–2012 financial perspective; it covered all FADN regions in the EU28, focusing on representative farms for the regions (131 units representing 4,919,580 farms in 2012), and considered average indices of productivity of intermediate consumption.

2. The problem of capturing structural differences

It is an open secret that decisions on the sizes of CAP support envelopes for the whole European Union and for individual countries are influenced by political rather than economic considerations. This is particularly visible in the case of the new EU13 member countries, where there is a majority of small, semi-subsistence family farms [Davidova et al. 2013]. A basic criterion used in determination of the amount and structure of support under Pillars I and II of the CAP is the need to reach the largest possible number of farms, as these represent potential voters, regardless of the fact that they account for a relatively small total area of agricultural land and only a small percentage of total output. The microeconomic models of productivity usually do not take into account the political criteria for subsidies allocation, which in our view determines the process, and in this way they influence productivity in agriculture. The econometric methods of addressing structural differences on the microeconomic level somehow fail to fulfil those criteria for several reasons:

1) The assumptions of the microeconomic models are adopted implicitly, so they are not set out and discussed. This applies, for example, to the problem of how price effects are captured, which is generally encountered by researchers working with FADN data. The FADN database does not contain data on transaction prices, but only nominal values. Another problem corresponds to the assumption on which a production function is built, namely that "conditional on staying in production, the farm has to decide about its inputs, labour and materials use and investment" [Rizov et al. 2013, Olley, Pakes 1996] – but what about land? Semi-subsistence farms land remains in production for own needs regardless of market conditions, and the decision on purchasing or sale of land is not based on the criterion of profitability of production.
2) The assumptions are not tested to determine whether they correspond to reality (few remember about Popper's principles concerning the falsification of theories, which indicate the need to test auxiliary assumptions [Gezelter 2009, Popper 1959]). For example, the condition of the sale value of the farm maximisation is unrealistic for a semi-subsistence farm, which tends to "optimise" income, i.e. to make it sufficient, while satisfying the household's own food needs. Apart from

that, farm labour (own labour in the case of a small farm) is not a function of subsidies or one about which decisions are always made during the current period. Labour resources in small farms remain constant irrespective of agricultural policy or market conditions, and are determined more by demographic processes.

3) The efficiency of these models in terms of production results is low, since the conclusions resulting from the huge amount of research work are ambiguous and hard to implement in practice.
4) The models do not take into account the political criteria for subsidies allocation, which in our view determine the process and in this way they influence factor productivity in agriculture.

With reference to the last point, our approach has two stages. If it is assumed that the criterion for determination of the structure of national CAP envelopes is maximisation of the number of beneficiaries, the structure will initially be matched to the structure and dominant types of production in a given country, and more importantly – its regions. "Initially" means negotiating a given CAP financial perspective and determining the structure of Pillars I and II within the permissible limits of flexibility at national level. With regard to the period covered by this study, this refers to 2007, as the start of the 2007–2013 financial perspective. Nonetheless, the determined support structure (amounts allocated to individual programmes) secondarily shapes the agrarian structures in a given country and region, by forcing them to adapt to the criteria presented to beneficiaries of the various programmes (when subsidy applications are submitted). In this way the subsidies structure as a whole also exerts an influence on factor productivity. We still believe, however, that it is the support model treated holistically that exerts this influence, not the amounts of the subsidies, because the model of CAP Pillars I and II has been defined as a whole through a political process. Many microeconomic models treat subsidies as taxes with a reversed sign, which in this case is not a completely valid approach. The structure of CAP Pillars I and II, determined by politicians and being a derivative of the agrarian structures in a particular country, is a qualitative variable which affects factor productivity in three ways.

1) Indirectly, through fulfilment of the criteria of CAP programmes relating to agricultural practices and the structure of production (impact on technical and financial productivity). According to [Baumol 1990, Alston, James 2002] this impact is negative, because subsidies distort the production structure of recipient farms, leading to allocative inefficiency if recipients invest in subsidy-seeking activities which are relatively less productive. Recipients may not be eager to seek cost-improving methods.
2) Indirectly, through subsidisation of investment and technology (impact on technical productivity). The impact can be positive due to investment-induced productivity gains, but also negative while subsidies give an incentive to change the capital–labour ratio, which can lead to over-investment.
3) Directly, through influence on financial productivity and incomes (positive impact). Research carried out in Poland indicates that the dominant target function of the agricultural producer is the maximisation of returns in conditions of substitutability between economic rent, having its source in efficiency of production, and political rent, whose size results from the agricultural policy applied in the region in question. An agricultural producer replaces an income source which is for him/her more costly and demanding, with a cheaper source which does not require so much input. In the light of the concept of rational and adaptive expectations, improving the efficiency of use of production factors subject to given price relations is always harder than waiting for support [Bezat-Jarzębowska, Rembisz 2013, pp. 36–39].

3. Research methodology

Having the above considerations in mind, we propose a relatively simple statistical procedure based on assumptions which will not give rise to doubts of the kind discussed above. In the first stage, the goal was to identify areas in the EU28 having similar agricultural support models. For this purpose an agglomerative cluster analysis was carried out (using Ward's method) covering 131 representative

farms for all EUFADN[2] regions (representing 4,919,580 farms in 2012), according to the criterion of percentage contributions to the different "boxes" of subsidies, i.e. for the following grouping variables:

X1 – value of payments for public goods belonging to the title "green box" (assumed as the sum of set-aside and agri-environmental payments, support for less favoured areas, and other subsidies under rural support programmes;);
X2 – value of crop and animal production subsidies (the sum of other subsidies for crop and livestock production plus the balance of subsidies and penalties for milk production, subsidies for other cattle production and subsidies for sheep and goat production);
X3 – value of single farm payments and area payments (might be classified as the component of "green box");
X4 – value of subsidies for indirect consumption;
X5 – values of investment subsidies.

The variables X1–X5 were taken as average values across a six-year reference period (2007–2012), as well as for each year separately. The estimated cluster sets were quite similar in each year, because national structures of subsidies are mostly defined at the beginning of the programming period when the programmes of CAP Pillars I and II begin. However, we chose the clustering result from the last year of the analysis, because it reflects adjustments in agrarian structures over the entire programming period and gave the best results for disjointness tests. The disjointness of clusters is the most important criterion from the point of view of the hypothesis put forward at the outset. It was tested by evaluating the significance of the differences between the average contributions of types of subsidy to the political rent in the obtained clusters. The assumption of homogeneity of variance of variables between the groups of regions was evaluated using Levene's test and the Brown–Forsythe test. The hypothesis of homogeneity of variance in comparable groups was rejected for individual variables (X1–X4) with the exception of the variable expressing the contribution of subsidies for indirect consumption. Hence the significance of the differences between the means of samples (clusters) was evaluated using the non-parametric Mann–Withney U test [Stanisz 2006, p. 247]. It was confirmed that the clusters (isolated at a level of approximately 50% of the maximum distance) differ significantly in terms of the structure of budgetary subsidies for agriculture.

In the second stage, we computed a panel regression for each of the clusters A, B and C. A log-linear model was applied, as follows:

$$\ln TP_{it} = \gamma' SUB_{it} + \beta' X_i + u \qquad (1)$$

where: TP_{it} denotes for average technical productivity excluding subsidies: total output (SE131 FADN code) / total intermediate consumption (SE275) in the region i and year t; the vector of coefficients for the respective subsidies (the FADN codes include: SE406 SE407 SE612 SE613 SE616 SE617 SE618 SE619 SE621 SE622 SE623 SE699 SE625 SE626 SE631 SE632 SE640 SE650); β the vector of coefficients for years dummy variables; u random term

[2] The Farm Accountancy Data Network (FADN) is an instrument for evaluating the income of agricultural holdings and the impacts of the Common Agricultural Policy. The services responsible in the European Union for the operation of the FADN collect every year accountancy data from a representative sample of the agricultural holdings in the member countries. Derived from national surveys, the FADN is the only source of microeconomic data that is harmonised, i.e. the bookkeeping principles are the same in all countries. Holdings are selected to take part in the survey on the basis of sampling plans established at the level of each region in the Union. The survey does not cover all the agricultural holdings in the Union but only those which due to their size could be considered commercial. Currently, the annual sample covers approximately 80.000 holdings. They represent a population of about 5.000.000 farms in the EU, which covers approximately 90% of the total utilised agricultural area (UAA) and account for about 90% of the total agricultural production [see more EUFADN http://ec.europa.eu /agriculture/rica/concept_en.cfm#lacd, accessed 14.06.2016)

Next we computed ordinary least squares (OLS) base models (together with dummy variables for years). In case of rejection of the hypothesis of applicability of this approach (based on the Breusch–Pagan test) we estimated panel models with fixed (FE) and random effects (RE). In these models, we introduced the variables step by step, checking whether the model was stable and whether the addition of a further variable caused changes in the signs of the other regression coefficients (backward stepwise regression which allowed us to eliminate insignificant variables). The differences in final set of variables enabled us to give an explanation to the research problem. The effect of the time factor was also shown in the panel models, provided that it might be significant in capturing the impact of CAP on productivity in the years 2007-2012 in clusters B and C. The evaluation of which of these models (FE or RE) was appropriate was made on the basis of Hausman and Welch tests. The final models were computed taking account of the Beck–Katz robust standard errors (PCSE) for cluster A and Arellano robust standard errors (HAC) for clusters B and C. In the results section we present, for each cluster, a final panel model with robust standard errors, along with the marginal effects for individual years.

4. Results

The analysis identified three clusters of regions with different farming models according to the support structure. (Figure 1). In the most numerous group of regions (cluster A) a "moderately sustainable" model operated, in which support for agriculture was provided primarily through single farm and area payments (these contributed more than 59% of the subsidies). At the same time farms in those regions derived significant economic benefits from the supply of public goods – the contribution of agri-environmental payments, set-aside payments, support for less favoured areas and other subsidies under rural support programmes to the political rent of representative farms in those regions was close to 17%. In the regions in the next largest cluster (B), the contribution of single farm and area payments to the political rent was markedly higher than in the other clusters, at close to 80%. The contributions from other types of budgetary support, including payments for public goods, were relatively small. Cluster B clearly reflected to the greatest degree a model in which support for production has been almost entirely replaced by direct support for farms, and which can be described as weakly sustainable. The third, and least numerous group of regions (cluster C) contained parts of the EU28 having a model that combines different mechanisms for the support of farms. Payments for crop and animal production, as well as single farm and area payments, made contributions of no more than 30% to the political rent. Cluster C also had the highest contributions for the aforementioned payments for public goods (approx. 33%) and investment subsidies box (almost 10%) compared with the other groups of regions. It is therefore seen that over most of the area of EU in 2012 there functioned a model (A or C) in which support for agricultural production was being replaced by direct payments (area and single farm payments) and payments for public goods (Figure 1).

In most regions of the old EU member countries, however, model B operates, oriented exclusively towards direct payments, which are treated as a substitute for production support and produce a relatively weak stimulus for sustainable development, whereas in the countries of Central and Eastern Europe model A applies, providing an opportunity for placing a value on public goods produced by agriculture. This is confirmed by the spatial analysis of Giannakis and Kutkowska, in which it was observed, among other things, that direct support primarily reaches farms in intensive farming areas [Giannakis, Bruggeman 2014]. It was also noted that the regression, resulting from modulation, in area payments for farms with larger areas in the new member countries will cause changes in production in favour of methods that are more friendly to the environment and assist sustainable development [Kutkowska, Berbeka 2012, pp. 266–267]. This is no doubt determined by fears of a fall in factor productivity in agriculture in case of a possible change in the support structure.

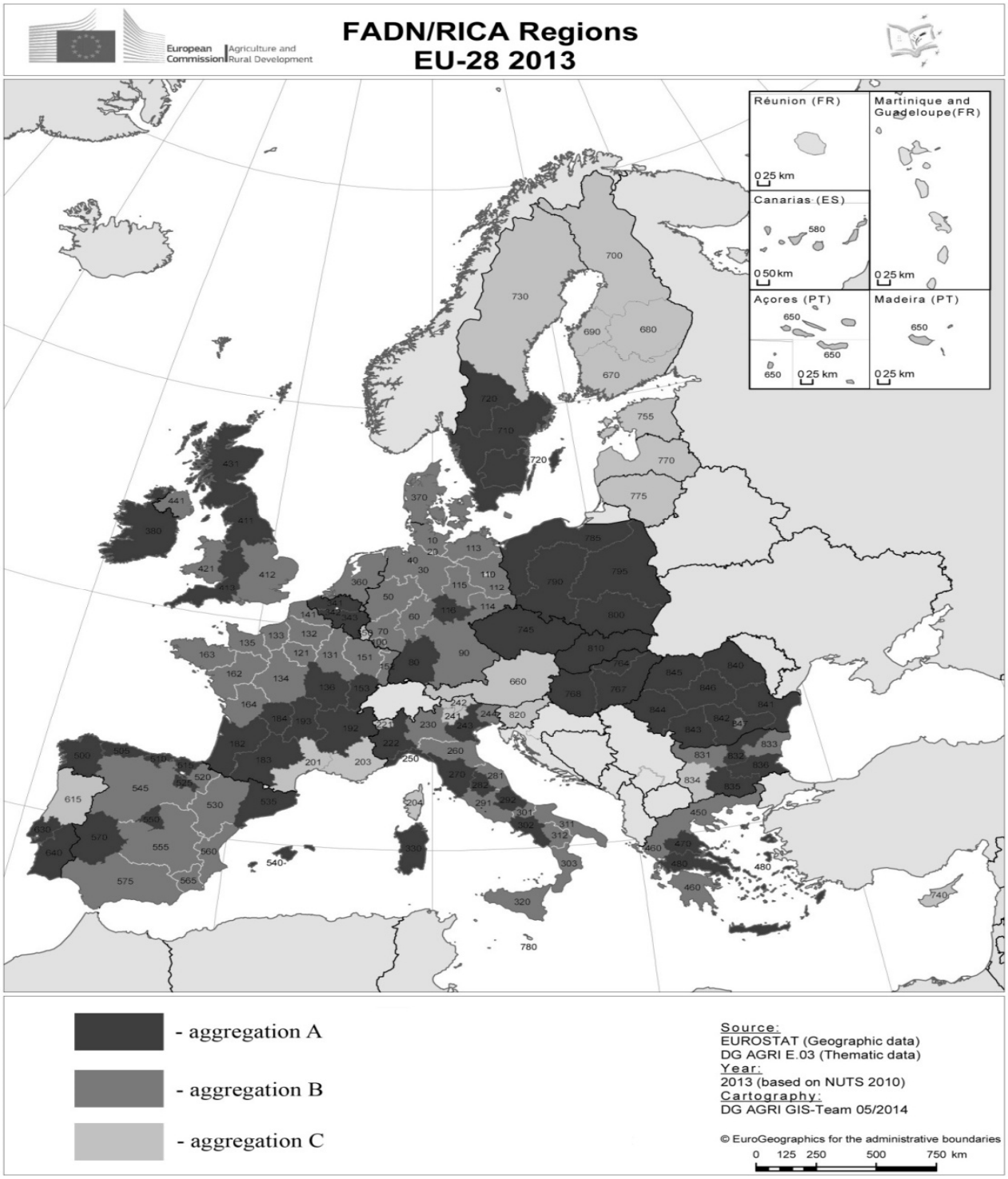

Figure 1. Clusters of EU28 regions in 2012 according to the CAP support model.

Source: own analysis based on EUFADN data

In a small group of regions there was found to be a strongly sustainable support model combining various forms of assistance to farms (cluster C). Subsidisation for the supply of public goods was accompanied there by high subsidies for agricultural production and significant direct support (single farm payments). This group included most of the island regions of the EU, the northern part of Europe consisting of the Finnish regions and the Län i Norra region in Sweden, and the regions of Lithuania, Latvia and Estonia. This cluster also contained a few regions in southern and central Europe, mainly mountainous (Figure 1). In summary, it was found that the groups of EU28 regions generated by the cluster analysis differed significantly in terms of the structure of budgetary subsidies to agriculture,

and that only models A and C were to a greater or lesser extent aligned with the development priorities of the European agricultural model emphasised in the new financial perspective of 2014–2020.

In the second stage of the study the aim was to assess which CAP programmes have a positive impact on productivity in regions from the different agrarian structures and to find out whether there are any green subsidies among them. In each case, the fixed effects model was found to be appropriate. All of the models fit fairly well: the LSDV R2 value ranges from 0.90 to 0.94, and within-R2 from 0.20 to 0.40. Some variables were excluded due to excessive collinearity. All variables in the three models are statistically significant (p-values do not exceed 0.1, except for Single farm payment in cluster A and B for which p = 0.11 in A and 0.12 in B and two variables in cluster C for which p = 0.13).

For cluster A (moderately sustainable model of agriculture support) the model explains more than 90% of the variation in productivity of intermediate consumption, taking account of individual country effects (LSDV R2 = 0.903102) which are constant over time (but vary in space). The within-group R2 explains 20% of the intragroup ('within') variation. We should recall that we are analysing a stack of time series (the years 2007–2012 for each region), hence "within-R2" attributes variation in productivity of intermediate consumption to explanatory variables which vary over time. Their variation over time is seen in cluster A to have had no statistical significance.

Table 1 Panel regression for the cluster A (fixed-effects, using 357 observations, included 60 cross-sectional units, dependent variable: log-productivity of intermediate consumption, Beck-Katz standard errors)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	0.552186	0.0511908	10.7868	<0.0001	***
Economic size	0.00115674	0.00063528	1.8208	0.0737	*
Subsidies on investments	−8.97732e-06	5.12817e-06	−1.7506	0.0852	*
Setaside premiums	−0.000848691	0.000401887	−2.1118	0.0390	**
Other crop subsidies	3.48189e-05	7.3805e-06	4.7177	<0.0001	***
Subsidies other cattle	−2.29505e-05	1.01412e-05	−2.2631	0.0273	**
Subsidies sheep&goats	9.07244e-05	3.80155e-05	2.3865	0.0202	**
Other livestock subsidies	−4.76956e-05	8.95212e-06	−5.3279	<0.0001	***
Environmental subsidies	2.49441e-05	5.42378e-06	4.5990	<0.0001	***
LFA subsidies	−3.10549e-05	1.33202e-05	−2.3314	0.0232	**
Other subsidies	−9.69108e-06	5.04416e-06	−1.9212	0.0595	*
Subsidies on intermediate consumption	−2.81006e-05	1.38462e-05	−2.0295	0.0469	**
Single Farm payment	−7.45402e-06	4.57004e-06	−1.6311	0.1082	
Single Area payment	−1.02835e-05	4.7033e-06	−2.1864	0.0328	**
Additional aid	0.00037333	0.000133433	2.7979	0.0069	***
Support_Art68	3.5304e-05	1.39287e-05	2.5346	0.0139	**
LSDV R-squared 0.903102; Within R-squared 0.201075					

Source: own study based on EUFADN data

In cluster A, with the moderately sustainable model of agriculture support which operated in most of the EU-13 regions and the mountainous French regions, the majority of CAP subsidies had a negative effect on the dependent variable as expected. It is interesting that this model confirms the thesis present in the literature that farms from new member states spend a large part of decoupled payments

on consumption or on various unsuccessful investment projects, which is shown by the negative impact of single area payments on productivity (we recall that the productivity measure used here excludes any subsidies). A quite surprising thing is the negative impact of "subsidies on investment". It happens that farms buy new assets without conducting a profitability analysis. Although there is evidence in the literature on over-investment in equipment [Szeptycki 1996, Kowalski and Szeląg-Sikora 2006, Rizov et al, 2013, Grzelak 2014] in new member states, we believe that the increase in productivity due to the investment needs more time. The exceptions, with a positive impact on productivity, are as follows:

- subsidies for sheep and goat production, which, apart from subsidies for breeding sheep and goats, include subsidies for products made from goat's and sheep's milk, as well as specific support for the production of sheep and goats. This mechanism is crucial to maintain a certain level of production in mountainous regions and regions with a predominance of extensive grazing stock production. Therefore, subsidies for products made from goat's and sheep's milk may affect also the productivity of intermediate consumption in a positive way;
- other crop subsidies, covering subsidies for field crops, horticulture and perennial plantations, apart from set-aside subsidies, compensatory and decoupled payments may be understood as a residue of direct payments, but it should be noted that the coefficient is rather low – 100 EUR, other crop subsidies will cause an increase in productivity of intermediate consumption by 0.00348%;
- environmental subsidies, which is also quite a surprising finding. We assume that in mountain regions and in regions with a predominance of extensive production, especially in the new member states, the environmental criteria have already been reached, so they make it possible to acquire new funds for development without bearing additional costs. Therefore they might positively influence the productivity of intermediate consumption; Moreover, in the literature the conventional perception about environmental protection claims that it imposes additional costs on firms, which may reduce their global competitiveness with negative effects on growth and employment. But, at the same time, more stringent environmental policies can stimulate innovations that may over-compensate for the costs of complying with these policies [Porter and Van der Linde 1995]. This confirms analysis of De Santis and Lasinio [2015] which says that the gradual strategic reorientation of environmental policies in the EU in favor of economic incentives has been more effective in stimulating productivity and innovation than in setting explicit directives about pollution control levels;
- special support granted pursuant to Art. 68 of Regulation (EC) No 73/2009, within which Member States may grant specific support to farmers in respect of: specific types of farming which are important for the protection or enhancement of the environment, improving the quality of agricultural products, improving the marketing of agricultural products, specific agricultural activities entailing additional agri-environment benefits; and in areas subject to restructuring or the development of programmes in order to prevent the abandonment of land or addressed to specific disadvantages for farmers in those areas. This may be granted in the form of contributions to crop insurance, animals and plants, and by mutual funds for animal and plant diseases and environmental incidents in accordance with the conditions set out in Article. 71. This support is intended to cover the additional costs that were actually incurred and income foregone in order to achieve a particular purpose, and as regards improving the marketing of agricultural products, it meets the criteria set out in Article. 2 - 5 of Council Regulation (EC) No 3/2008 of 17 December 2007 on information and promotional actions for agricultural products in the internal market and in third countries. Therefore, the mechanism had a positive impact on both – reducing costs and increasing revenues;
- additional aid, which is an additional amount of aid resulting from the modulation of direct payments. As it was mentioned before, production support, apart from having a positive impact

on production, did have a negative impact on productivity before the decoupling reform, so it might be concluded that the modulation led to a change in this phenomenon.

As for cluster A, also for cluster B (weakly sustainable model of agriculture support) the appropriate model was that with fixed effects (cf. Table 2). The model explains more than 94% of the variation in productivity of intermediate consumption, taking account of individual country effects (LSDV R2 = 0. 944601). The within-group R2 explains 40% of the intragroup ('within') variation (twofold more than in cluster A). The variation of the dependent variable over time has in this case strong statistical significance. The impact of time was negative in the whole period (referring to 2006) (cf. Table 2).

Table 2 Panel regression for cluster B (Fixed-effects, using 294 observations, Included 49 cross-sectional units, dependent variable: log-productivity of intermediate consumption, Robust HAC standard errors)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	0.931524	0.0839827	11.0919	<0.0001	***
Payments to dairy outgoers	0.000231715	0.000119086	1.9458	0.0575	*
Setaside premiums	−0.000676872	0.000120662	−5.6096	<0.0001	***
Other crop subsidies	−4.81729e-05	2.63026e-05	−1.8315	0.0732	*
Subsidies other cattle	−3.68319e-05	1.84421e-05	−1.9972	0.0515	*
LFA subsidies	−1.26174e-05	6.74698e-06	−1.8701	0.0676	*
Single Farm payment	−3.7522e-06	2.37638e-06	−1.5790	0.1209	
Single Area payment	4.80934e-05	1.65638e-05	2.9035	0.0056	***
Additional aid	−0.000597601	0.000204699	−2.9194	0.0053	***
dt_2 (time dummy variable ref.2007)	−0.0711015	0.014209	−5.0040	<0.0001	***
dt_3	−0.223094	0.0504853	−4.4190	<0.0001	***
dt_4	−0.194809	0.0444979	−4.3779	<0.0001	***
dt_5	−0.221163	0.0442124	−5.0023	<0.0001	***
dt_6	−0.23388	0.042717	−5.4751	<0.0001	***
LSDV R-squared 0.944601; Within R-squared 0.402253					

Source: own study based on EUFADN data

As in cluster A, also in this case of weakly sustainable support, the negative impact of CAP subsidies on productivity dominated. The model confirmed the observations of the negative impact of the Single Farm payment which is likely to act as a destimulant for improving productivity, preserving the historical support model. Only two variables had a positive impact on the productivity of intermediate consumption, and these were:

- payments to dairy outgoers, which can be explained as an improvement in productivity by reducing costs of production by turning from cost intensive animal production to less cost absorbing crop production. According to the model, 1,000 EUR spent on payments to dairy outgoers led to an improvement in productivity by 0,23%,
- single area payments, which presumably are used in the regions of new member states in this cluster (cf. figure 1) as investment funds improving competitiveness of production. The positive impact of decoupling on productivity is mentioned in the literature by some authors due to the following mechanisms [Serra et al., 2006; Weber and Key, 2012]. Firstly, they change the risk preferences of farmers leading them to make more productive investment decisions [Hennessy, 1998], secondly, direct payments might increase access to borrowed capital for credit constrained farmers by increasing land values and available collateral [Goodwin et al., 2003; Roberts et al., 2003], thirdly, decoupled payments may lead farmers to reallocate labor from off-farm

employment to on-farm activities due to the nonpecuniary benefits that they derive from the latter [Ahern et al., 2005; Key and Roberts, 2009]. This may lead to higher levels of agricultural output and productivity [Kazukauskas et al 2014].

The model for cluster C (strongly sustainable model of agriculture support) also explains more than 94% of the variation in productivity of intermediate consumption, taking into account individual country effects (LSDV R2 = 0. 944276). The within-group R2 explains almost 40% of the intragroup ('within') variation. As it was in cluster B, the time factor plays a significant role: the impact of respective years was negative over the whole period (referring to 2006), and a negative tendency can be observed there (cf. Table 3).

Table 3 Regression results for cluster C (Fixed-effects, using 138 observations, included 23 cross-sectional units, time-series length = 6, dependent variable: log_productivity of intermediate consumption, Robust (HAC) standard errors)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	0.438462	0.0783623	5.5953	<0.0001	***
Subsidies on investments	−3.20247e-05	1.12936e-05	−2.8357	0.0096	***
Set-aside premiums	−0.00414695	0.00195916	−2.1167	0.0458	**
Environmental subsidies	−5.42784e-05	3.44221e-05	−1.5768	0.1291	
LFA subsidies	8.90297e-05	5.13534e-05	1.7337	0.0970	*
Single Area payment	4.25656e-05	1.96353e-05	2.1678	0.0413	**
Additional aid	−0.000327124	0.000208785	−1.5668	0.1314	
dt_2 (time dummy variable ref. 2007)	−0.0734276	0.0340674	−2.1554	0.0423	**
dt_3	−0.14195	0.0438113	−3.2400	0.0038	***
dt_4	−0.123363	0.0440283	−2.8019	0.0104	**
dt_5	−0.151302	0.0512326	−2.9532	0.0073	***
dt_6	−0.16012	0.0448902	−3.5669	0.0017	***
LSDV R-squared 0.944276; Within R-squared 0.398523					

Source: own study based on EUFADN data

In cluster C, covering regions with a strongly sustainable (green) model of agricultural support, only six variables proved to be statistically significant (two of them were on the threshold of significance with a p -value of 0.13). Four programmes negatively affected productivity, as expected. However LFA subsidies and Single Area payments surprisingly had a positive impact on productivity in this cluster. Single area payments seem to improve competitiveness, as stated above. The LFA is commonly the largest programme financed within the CAP and it is perceived as a not very effective one in Central-Eastern European countries. [Gorton et al. 2009].Many studies suggest that the LFA scheme appears more effective in reducing land abandonment or in promoting continued land use in intermediate rural and predominantly agricultural regions (where the share of population living in rural areas is between 15-50% and more than 50% of the rural population works in agriculture) [**Zawalińska** et al, 2013] which is to some extent in line with our findings (cf. Figure 1).

5. Conclusion

In the article, we evaluated both the structural effect and the individual influence of the respective CAP schemes on the average productivity of intermediate consumption. Three clusters of regions in the EU28 countries were identified, differing significantly in terms of the structure of CAP schemes. In the most numerous group, of the EU28 regions, the moderately sustainable model A operated, primarily combining direct support with payments for public goods. The second most numerously

represented was the weakly sustainable model B, in which support consisted chiefly of single farm and area payments. The smallest group of regions featured a highly sustainable model, combining various forms of support for farms at similar levels (both through direct and production subsidies, and through payments for the supply of public goods and to a lesser degree the subsidisation of investment). The analysis confirmed that an agricultural support model which reflects structural farming differences is a significant factor in determining the productivity of intermediate consumption over the whole of the studied period. The direction of the influence of studied schemes depends on the sustainability level of farming in the respective regions. Hence, for example, the Single payments might have a positive influence on productivity only in the old member countries included in the most sustainable model, while the Environmental subsidies positively contributed to productivity only in cluster A (and negatively in cluster C. Although there is evidence for a negative general impact of CAP subsidies on productivity, in each cluster we can observe CAP programmes which positively affected the productivity of intermediate consumption. Cluster A (moderately sustainable model of farming), which encompasses the majority of new member states, was characterised by the highest number of such schemes.

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