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The Regional Allocation of EU Producer Support: How Natural Conditions and Farm Structure Matter*

by

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Natural Conditions in Agriculture and the Regional Distribution of EU Producer Support*

by

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Abstract

The redistributive implications of the Common Agricultural Policy (CAP) of the European Union (EU) have regained a strong interest in recent years since economic and social cohesion has become a major goal of European policy. The empirical evidence is surprisingly diverse and ranges from a clearly positive to a clearly negative regional redistributive impact of the CAP. Therefore, the objectives of this paper are threefold. First, the interregional allocation of EU producer support under the CAP is measured at the NUTS III-level in the period 1986-2002 for 26 regions of the German Bundesland Hesse. Second, the role of the measurement concept for the magnitude and distribution of the regional transfers is elaborated. Third, the interregional allocation of EU producer support is explained by natural conditions and farm structure variables within a quantitative analysis. A major result is that the interregional allocation of producer support is unequal, depends on the measure of protection used and is affected by a number of variables characterizing farm structure and natural conditions.

1 Introduction

There is a substantial degree of uncertainty with regard to the redistributive effects of agricultural policy in industrialized countries. At least two aspects are responsible for this uncertainty. Firstly, it is often unclear whether agricultural policies aim at redistribution at all. If income distribution is an objective of agricultural policy, the redistributive goal is in many cases undefined or at least imprecise [OECD (a)]. Secondly, even if the income distribution objective is defined, agricultural policies in industrialized countries are often diverse and the net effect on any redistributive goal is mostly hidden. Even with the annual information on producer support estimates (*PSE*s) provided by the OECD (a), detailed redistributive effects within agriculture are typically lacking whereas aggregate national figures on support are available.

The focus of this contribution is on the regional impact of agricultural policies, in particular of the Common Agricultural Policy (CAP) of the European Union (EU). In the first place, the question arises how effects of the CAP may differ interregionally. If we refer to income transfers due to the CAP, these may be different according to the measure of transfers used. Absolute transfers are depending on the size of a region: Ceteris paribus, regions with a larger agricultural sector will receive more transfers from price support than regions with a smaller sector. Additionally, the levels of support vary by commodity and, thus, the regional distribution of transfers depends on the commodity composition of the region's agricultural area. The consequential redistributive effects of the CAP can be regarded as a byproduct of the major policy instruments behind the uniform regulation of individual EU agricultural markets.

Although representing side-effects of the agricultural policy instruments, regional redistribution is very relevant for policy evaluation. In general and for agricultural policy, regional policy objectives have been formulated for the EU. In Art. 2 of the Treaty of Rome, already the task of the Community "to promote throughout the Community a harmonious, balanced and sustainable development of economic activities … and convergence of economic performance" was formulated. With the process of EU enlargements and increasing disparities within the EU, economic and social cohesion has become a major issue of European policy [EUROPEAN COMMISSION (2004)]. Income convergence is one aspect of cohesion. Additional evidence for the importance of regional redistributive objectives can be found in agricultural and regional development policy. The existence of the European Regional Development Fund and its redistributive objectives indicate that European policies aim at equity goals and at reducing the income differences between prosperous and backward regions. In the Agenda 2000, rural development has become the second pillar of the CAP besides the major agricultural policy instruments, i.e. market support, direct transfers, quotas, export subsidies, and tariffs. It is consistent with the increasing role of redistributive goals that the regional impacts of the CAP regained considerable interest. After the major and early RICAP study on the implications of the CAP for regional development [COMMISSION OF THE EUROPEAN COMMUNITY (1981)], surprisingly few analyses had dealt with the topic in the 1980s and 1990s. In the last few years, however, quite a number of studies appeared which are related to the redistributive implications of the CAP or, more generally, to its impacts on economic and social cohesion within the EU (EUROPEAN COMMISSION 2001; TARDITI/ZANIAS 2001; ZANIAS 2002; WALKENHORST 2003; ANDERS/HARSCHE/HERRMANN/SALHOFER 2004; ESPON 2004; HANSEN/HARSCHE 2005).

It is the objective of this paper to measure the regional distribution of EU producer support for the regions in one German Bundesland over time. The case study is related to 26 regions at the NUTS-III level (Landkreise) of Hesse in the period 1986-2002. Furthermore, determinants of the magnitude and development of the interregional transfers will be elaborated.

The paper is organized as follows. The literature on the regional transfers under the CAP and its determinants is surveyed in Section 2. Then, details of the methodology and data are presented in Section 3. The empirical evidence on the regional distribution of support is outlined in Section 4. In Section 5, we examine how the distribution is affected by differential natural conditions, farm structures and economic development of the regions. We discuss briefly some marked differences of these results from those of the related literature in Section 6. Results are summarized and conclusions are drawn in Section 7.

2 Literature Review on the Regional Distribution of EU Producer Support and its Determinants

Regional development goals and the principle of economic and social cohesion have become increasingly visible in the activities of the EUROPEAN COMMISSION and also in recent policy changes in the EU. In the third report on economic and social cohesion, the EUROPEAN COMMISSION (2004) stresses the role of structural and regional policies given the fact that "large socio-economic disparities persist between Member States and between regions" and that the enlargement to 25 Member States " represents a challenge without precedent" for the EU. In this context, proposals for regional policies after 2006 are made in the third report.

Agricultural policy is also increasingly seen in the context of economic and social cohesion. In the Agenda 2000, e.g., rural development has become the second pillar of the CAP besides the major agricultural policy instruments, i.e. market support and direct transfers. In the literature, too, a regained interest in the regional effects of the CAP and of rural development policy has taken place during the last few years. In a comprehensive study by the EUROPEAN COMMISSION (2001), implications of the CAP for economic and social cohesion were analyzed. It was investigated for the NUTS-I level in the years 1989, 1994 and 1996 how transfers from the CAP are distributed in the EU across farm types and regions. One main result is that agricultural policy favoured large and productive farms. This finding is valid for the years before and after the move from market support towards direct transfers. With regard to regions, transfers per capita due to the CAP and per-capita income in the regions are correlated negatively. Transfers from consumers and transfers to farmers are both covered by the definition of transfer used in the EUROPEAN COMMISSION study. The major policy conclusions from the study is that the CAP tends to redistributive income from high- to low-income regions within the EU and, thus, contributes to convergence. It could not be determined on the basis of the selected years whether this redistributive impact became stronger over time.

With a similar methodology, TARDITI/ZANIAS (2001) confirm positive effects of agricultural price policies in terms of income redistribution at the NUTS-I and NUTS-II levels: "On average, the agricultural price support transfers income from richer urbanized and industrialized regions towards poorer regions where agriculture accounts for a larger share of the regional GDP" (TARDITI/ZANIAS 2001, p. 213). Despite this positive effect on regional policy goals, TARDITI/ZANIAS stress the negative effects on resource allocation and competition arising from the EU price policy as well as undesirable redistributive implications between consumers, producers and taxpayers and within the agricultural sector. As a net effect, they conclude that EU price policy is detrimental for European cohesion. ZANIAS (2001) computes redistributive implications of the CAP at the NUTS-0 level, i.e. for member countries, and provides a simulation of full decoupling and re-nationalization.

Other studies show more ambiguous results on the CAP's redistributive impacts. ANDERS/HARSCHE/HERRMANN/SALHOFER (2004) show for selected German regions that CAP producer support flows more to poorer regions when the PSE per hectare is utilized but not when the PSE per farm or the relative PSE are considered. WALKENHORST (2003) illustrates for Switzerland that transfers are concentrated in the more prosperous farm regions.

A further major work on the issue is the ESPON (2004) Project 2.1.3 study on the territorial impact of CAP and Rural Development Policy. The ESPON programme in general “aims at a better balance and polycentric development of the European territory seen from the national, regional and local points of view" [ESPON (2004), p. 38]. Within this programme, the Project 2.1.3 study had the overall objective of "deepening the understanding of the EU's Common Agricultural Policy and Rural Development Policy (CAP/RDP)" (ibid., p. 39). The approach was very broad: Empirical analyses have been carried out over the period 1990 to 2000 at the NUTS-III level and they cover the EU 15 as well as neighbouring and accession states. Various types of regions relevant for the cohesion objective have been used: a rural area typology, a less favoured area typology, an urban-rural area typology and a cluster typology. The major result of the ESPON study is a very negative one: "… in aggregate the CAP works against the … objectives of economic and social cohesion. Moreover, in terms of polycentricity at the EU level, Pillar 1 of the CAP appears to favour core areas more than it assists the periphery of Europe, and at a local level CAP favours the more accessible areas" (ibid., p. 13).

The analysis shows with 1999 data that Pillar 1 support, i.e. the value of market price support and direct income transfers, per hectare agricultural land is positively correlated with per-capita income and population change and negatively with the unemployment rate in the region. When support is measured per agricultural worker unit, the correlation coefficients with unemployment rates and population change still have the same sign but they are correlated negatively with GDP per capita. The authors conclude from this that the distribution of Pillar 1 support is inconsistent with economic or social cohesion objectives of the EU (ibid., p. 89). By distinguishing the two components of Pillar 1 support, differential effects are revealed for market price support and direct income payments. Direct payments are significantly higher (per hectare or per agricultural worker) in regions with a lower GDP per capita, higher unemployment rates and a declining population. Thus, these transfers are consistent with cohesion objectives. The dominating market price support, however, is not: Higher support per hectare is found where GDP per capita and population changes are above average and where unemployment rates are below average.

Remarkable in the ESPON study are at least two other results: (i) Surprisingly, Pillar 2 support was also found to rather benefit "richer regions with lower unemployment rates and high population growth" (ibid., p. 116). (ii) When other factors are introduced within a regression analysis, like farm size, commodity mix and production intensity in the regions, the influence of GDP per capita on the support becomes insignificant in all cases.

We share with the ESPON project and some of the other cited studies the objective to gain a more detailed knowledge of the regional impacts of the CAP. Although the ESPON study goes beyond ours in the sense that more European regions are covered and more convergence indicators are incorporated, we integrate some other important issues that are not dealt with elsewhere: Firstly, the quantitative analysis of interregional differences in support in the ESPON study refers to the year 1999. Our study covers for the NUTS-III level of one federal state of Germany, Hesse, time series of agricultural protection from 1986 to 2002. By this, regional protection levels can be analyzed over time under the influence of changes in the CAP. Additionally, more recent data are utilized here than in the ESPON study and all other cited studies. Secondly, like in the ESPON study and unlike all earlier cited studies, it is our goal to explain the interregional allocation of support by its determinants. It is tested whether natural conditions for agricultural production, structural characteristics of agriculture as well as regional economic conditions affect the level and - in addition to the ESPON study - changes in support.

3 Methodology

For the measurement of agricultural protection at the regional level (NUTS-III), the application of the OECD´s Producer Support Estimate (PSE) concept has been suggested elsewhere

[ANDERS/HARSCHE/HERRMANN/SALHOFER (2004)] and we follow this approach. In particular, different disaggregate PSE measures are derived based on the definition of the aggregate absolute PSE measure, defined as:

(1) $PSE = MPS + PP = (P_p - P_r)Q - L + PP,$

where *MPS* is market price support, and *PP* are payments based on different production, input and income related criteria (OECD 1999). P_p and P_r are the regional domestic producer price and reference world market price at the border in local currency. *Q* is quantity supplied and L are price levies.

In order to derive regional PSE measures we follow a top-down approach. The OECD's Unit *PSE* data are utilized by multiplying it with the quantity produced in a specific region. Consequently, no additional data have to be collected for P_p, P_r, *L*, and *PP* at the regional level. A bottom-up approach would give more exact results of the regional level of support. However, its application becomes difficult for the analyzed NUTS-III level since necessary information is not be available or inconsistent across regions.

The Unit *PSE* (*UPSE*) for product *i* is defined as

(2) $UPSE_i = PSE_i / Q_i .$

To derive the *PSE* for a specific region *j*

(3) $PSE^j = \sum_{i=1}^{n} \left(UPSE_i Q_i \right)$

with i = 1,…n; j = 1,…,m. Based on equation (3) *PSE*s are calculated for m=26 NUTS-III regions of Hesse[1] including n=11 different products[2]. Overall, about 70% of total agricultural output of Hesse is represented.

In accordance with the OECD we regionalize three relative *PSE* measures: *PSE* per farm (*FPSE*), per hectare (*APSE*) and the percentage *PSE* (%*PSE*):

$$(4)\quad FPSE^{j} = \frac{PSE^{j}}{F^{j}},$$

$$(5)\quad APSE^{j} = \frac{PSE^{j}}{A^{j}},$$

$$(6)\quad \%PSE^{j} = \frac{PSE^{j}}{\sum_{i} P_{p_i} Q_i^{j} PP},$$

where F^j is the number of farms in region j, and A^j is the area of cultivated land in hectares in region j. The *%PSE* gives the percentage of total revenues (including direct payments) induced by transfers from consumers and taxpayers.

In the following analysis, the regional income transfers are captured as time series for 26 Hessian regions in the period 1986-2002. All € values of income transfers are deflated with the German consumer price index (1995 = 100).

A particular extension of the regional *PSE* methodology in this paper is that we decompose the growth or decline in producer support per farm, *FPSE*, in the change due to the CAP and

[1] The names of the 26 regions analyzed in this study are Darmstadt (DA), Frankfurt/Main (FFM), Offenbach (OF), Wiesbaden (WI), Bergstrasse (BERG), Darmstadt-Dieburg (DADIE), Groß-Gerau (GG), Hochtaunuskreis (HTK), Main-Kinzig-Kreis (MKK), Main-Taunus-Kreis (MTK), Odenwald (OD), Offenbach-Landkreis (OFL), Rheingau-Taunus-Kreis (RTK), Wetterau (WE), Giessen (GI), Lahn-Dill-Kreis (LDK), Limburg-Weilburg (LM), Marburg-Biedenkopf (MB), Vogelsberg (VB), Kassel (KS), Fulda (FD), Hersfeld-Rotenburg (HR), Kassel-Landkreis (KSL), Schwalm-Eder-Kreis (SEK), Waldeck-Frankenberg (WF) and Werra-Meissner-Kreis (WM).

[2] The products chosen are: wheat, rye, barley, cabs, rapeseeds, sugar, potatoes, milk, beef, pigmeat, sheepmeat.

due to to structural change – i.e. changes in the average farm size. For the decomposition, we redefine producer support per farm in region j and period t as

$$(7)\quad FPSE_t^j = \frac{PSE_t^j}{\overline{F}^j}\frac{\overline{F}^j}{F_t^j},$$

where $\overline{F}^j$ characterizes average farm size in hectares in region j over time. $PSE_t^j / \overline{F}^j$ measures producer support per farm in region j in period t, computed with the average number of farms in region j in the period 1986-2002. This term captures only policy changes as structural change is excluded. $\overline{F}^j / F_t^j$ relates the average number of farms in region j to the number of farms in region j for period t. This terms measures structural change: A decreasing number of farms raises this ratio. After total differentiation and when indices for regions and time are omitted for convenience, the absolute change in producer support per farm can be decomposed as follows:

$$(8)\quad \Delta FPSE = \Delta(PSE/\overline{F})\cdot(\overline{F}/F) + \Delta(\overline{F}/F)\cdot(PSE/\overline{F})$$

It is possible in (8) to interpret the overall change of producer support per farm in region j as the sum of a policy-induced and a structural-change component. The first term on the right-hand side measures the policy-induced change in producer support per farm: Changing transfers, caused by price support or direct payments, are related to a given farm size. The second term on the right-hand side measures that part of the overall growth rate in producer support per farm which is due to structural change. A decline in the number of farms, i.e. a rising average farm size, leads to a positive value of this term and, hence, to an increase of the overall producer support per farm.

4 Empirical Evidence on the Regional Distribution of EU Support

4.1 Differential Regional Support Levels Due to the CAP

Table 1 presents some major empirical findings on the level of producer support and its interregional and intertemporal variation. In general, 607 Mio. € have been transferred annually to producers via price support and direct transfers for the whole Bundesland Hesse. There is, however, a rather diverse pattern of farm structure and natural conditions. Thus, a strong interregional variation in support per farm (*FPSE*) and per hectare (*APSE*) occurs, whereas support relative to producer revenues (%*PSE*) does not vary much interregionally. The interregional coefficient of variation for *FPSE* is as high as 29.3%. As expected, the absolute amount of producer support differs widely between the regions given the wide variation of the size of the agricultural sector – the interregional coefficient of variation of *PSE* is above 80%. It is remarkable that the coefficient of variation of *FPSE* is high, too, namely with 29%.

Table 1: The Level of Producer Support and Its Interregional and Intertemporal Variation, 1986-2002

Level and Variation of Support	Measures of Protection			
	PSE (Mill. €)	*FPSE* (€)	*APSE* (€)	*%PSE* (%)
Support for ...				
average of regions:	23.4	13,971	697.6	45.1
favoured regions [a)]:	23.6	19,828	783.0	43.5
disfavoured regions [a)]:	29.9	13,530	780.6	47.0
Coefficient of variation(%):				
Interregional	85.7	29.3	18.1	6.2
Intertemporal	18.5	13.0	23.2	9.6

[a)] The medians of the five most favoured (disfavoured) regions are computed. The indicator for a favoured or disfavoured region is soil quality.

Source: Authors' computations.

It is interesting from the interregional allocation's point of view whether favoured agricultural regions get more or less support than disfavoured agricultural regions. In order to address this question, we compare the five most favoured agricultural regions with the five most disfavoured agricultural regions, excluding[3] the purely urban regions of Hesse[4]. In this context, a favoured (disfavoured) region is one that is characterized by better (worse) agricultural conditions as indicated by a soil quality index ("Bodenpunkte").

It can be seen from Table 1 that favoured agricultural regions get clearly more support in terms of support per farm, but less relative to total revenues (%*PSE*). Favoured regions tend to capture a higher share of their revenues on markets and a lower one by governmental support. In terms of support per hectare, both the most favoured and disfavoured regions ranked above the average *APSE*. This is due to the fact that the excluded urban areas are those which gain an *APSE* that is well below the average of Hesse[5].

Table 1 additionally illustrates how the interregional and intertemporal variation of producer support differs. The result depends strongly on the utilized measures of support. The intertemporal variation of support for the average of regions was clearly lower than the interregional variation of support in the period 1986-2002 for *PSE* and *FPSE*. The intertemporal variation is higher, however, than the interregional variation for *APSE* and %*PSE*. A similar result holds true for undeflated transfers in almost all individual regions in the period 1986-99 [ANDERS/ HARSCHE/HERRMANN/SALHOFER (2004)]. This implies that total transfers under the CAP led to a relatively stable pattern of support over time.

[3] The urban regions are excluded as there are strong effects from the non-agricultural sector on agricultural activities in urban areas independent of soil quality. Based on this decision, the five most favoured agricultural regions are: WE, DADIE, GG, KSL and LM. The five most disfavoured regions are: FD, WM, VB, HR and LDK. For the abbreviations, see note 1. If we had included the urban areas, WI, FFM and MTK would have been among the most favoured agricultural regions and KS among the least favoured agricultural regions based upon average soil quality of agricultural land.

[4] The urban regions FFM, OF, and WI, e.g., received an average producer support per hectare of 676, 468, and 646 € respectively. This is well below the Hessian average in the period 1986-2002 of 786 €.

[5] The urban regions FFM, OF und WI, e.g., received an average absolute producer support per hectare of 676, 468 and 646 Euro respectively. This is well below the Hessian average in the period 1986-2002 of 786 Euro.

4.2 *The Influence of the Measure of Protection on the Computed Levels of Producer Support*

In an analysis on the interregional allocation of producer support, it is important to know whether the distribution is independent of the measure of protection chosen. If the measure of protection does not matter, conclusions on the regional distribution of transfers could be generalized. It would not be necessary to decide upon one indicator that captures the politicians' redistributive goal best.

In Table 2, the average producer support in all 26 regions in the period 1986-2002 was utilized according to all four measures of regional protection – *PSE, FPSE*, *APSE* and *%PSE*. A correlation analysis was then performed on the basis of the mean support levels and is shown in the Appendices.

Table 2: The Correlation between Various Measures of Protection, 1986-2002

	PSE **(Mill. €)**	***FPSE*** **(€)**	***APSE*** **(€)**	***%PSE*** **(%)**
PSE **(Mill. €)**	1			
FPSE **(€)**	0.574**	1		
APSE **(€)**	0.834***	0.720***	1	
%PSE **(%)**	0.064	- 0.193	0.107	1

*** (**) Statistically significant at the 99.9%-(99%-) level.

Source: Authors' computations.

It is apparent from Table 2 that the measure of protection does strongly affect the results on the regional implications of the CAP. This is not so much the case for *PSE*, *FPSE* and *APSE*; those are positively correlated among each other. Thus, regions which receive higher (lower) producer support according to *PSE*, also tend to get a higher (lower) *APSE* or *FPSE* due to the CAP. The correlation is highest between *PSE* and *APSE,* followed by *APSE* and *FPSE*. The correlation is somewhat lower, but still statistically significant, between *PSE* and *FPSE*. The correlations are incomplete, however, and the regional redistributive effects of the CAP due to *PSE*, *FPSE* and *APSE* should be distinguished.

A very important finding is that %*PSE* is totally uncorrelated with all other measures. If European decision-makers in agricultural policy are interested in targeted redistributive effects of their policies, they have to define clearly whether they are interested in %*PSE* on the hand or *APSE* or *FPSE* as indicators of producer support. One consequence of the findings of Table 2 is that a set of policies might have an impact on one indicator which is completely different from that on another indicator.

4.3 Growth and Decline in Regional Support Levels Due to the CAP

Producer support due to the CAP might have changed over time with regard to the level as well as the structure of transfers. There were a number of policy changes in the period under consideration: the 1988 budget and production stabilizers, the agricultural reform of 1992, the GATT decisions on the liberalization of agricultural trade, and the first elements of the Agenda 2000. Along with these changes, a move from price support towards direct financial transfers took place at least for some product market orders. In order to test for changes in support, linear trend functions were estimated for the Hesse-wide producer support in the period 1986-2002. Changes in support due to price support, direct transfers and both major policy instruments (defined as the CAP) were computed separately. The regression coefficients of these functions are presented in Table 3.

Table 3: Annual Changes in Producer Support Under the CAP, All 26 Regions, 1986-2002

Growth of ...	Changes in ...		
	CAP	Price support	Direct transfers
PSE (Mill. €)	-18.699***	-29.771***	11.0716***
FPSE (€)	291.97**	-225.541*	517.51***
APSE (€)	-23.69***	-38.28***	+14.53***
%PSE (%)	0.001	-1.212***	+1.214***

***, **, * Statistically significant at the 99.9%-, 99%-, 95%-level.

Source: Authors' computations.

Table 3 reveals that *%PSE* did not follow any significant trend when price support and direct transfers are considered jointly. However, *FPSE* increased across all regions by 292 € per farm annually and *PSE* as well as *APSE* declined significantly in real times. Behind these differential growth pattern in real producer support are uniform patterns for the two policy areas. All indicators of producer support diminished due to a decrease in price support and were raised significantly by direct transfers. Apparently, direct transfers largely compensated for the lower price in terms of relative producer support so that *%PSE* did not alter much over time.

The decline in real producer support due to price support overcompensated the growth in real producer support due to direct transfers for *PSE* and *APSE* and, thus, the overall decline in these two variables.

The reverse held true for *FPSE* which rose significantly due to the dominating growth of direct transfers as opposed to the decline of price support per farm. However, we supposed that this result might be due to a growing average farm size. Structural change affected almost all regions in the period under consideration. The question arises in Table 3 to which extent the change in *FPSE* and APSE are caused by changes in policy or by structural change in agriculture. We controlled for structural change in additional analyses on the basis of the decomposition in equations (7) and (8).

Table 4 reveals that this distinction is extremely important for the interpretation of changes in *FPSE* over time. It refers to the aggregate view of all 26 Hessian regions. The average annual growth of *FPSE*, $\overline{FPSE}$ (=$PSE/\overline{F}$) and ($\overline{F}/F$) are shown as is the relative importance of policy-induced change and structural change for the average annual growth of producer support per farm according to equation (8).

Whereas the uncorrected *FPSE* indicates an increase in CAP support per farm over time, this is not the case for $\overline{FPSE}$ that corrects for structural change. Apparently, the influence of structural change is very strong. The policy-induced producer support per farm ($\overline{FPSE}$) in real terms did significantly decrease over time when the impacts of the CAP are aggregated. A significant change of producer support per farm is also shown for both measures when the CAP is disaggregated – with a positive sign for direct transfers and a negative sign for price support. However, the magnitude of change is strongly different for *FPSE* and $\overline{FPSE}$. If we control for structural change, producer support per farm has decreased annually by 731 € due to lower price support. If the effect of structural change and policy are jointly considered, the average annual decrease of producer support is only 226 € per farm. On the other hand, the average annual growth of producer support due to direct transfer is 272 € per farm when $\overline{FPSE}$ is utilized, but 518 € per farm for *FPSE*.

Table 4: Policy-induced and Structural Change and their Importance for the Annual Change of Producer Support per Farm, All 26 Regions, 1986-2002

Policy	Average Annual Change of Producer Support per Farm and Its Components		
	$\frac{\Delta(PSE/F)}{\Delta t}$ (€)	$\frac{\Delta(PSE/\overline{F})}{\Delta t}$ (€)	$\frac{\Delta(\overline{F}/F)}{\Delta t}$
CAP	291.67**	-459.17***	0.052***
Price support	-225.54*	-731.05***	0.052***
Direct transfers	+517.51***	+271.87***	0.052***
Policy	**Percentage Contribution to Change in *FPSE* (%)**		
	Policy-induced and structural change	Policy-induced change	Structural change
CAP	100.0	-157.4	57.4
Price support	100.0	-324.1	224.1
Direct transfers	100.0	52.5	47.5

***, **, * Statistically significant at the 99.9%-, 99%-, 95%-level. Computations based on equation (8) and its components.

Source: Authors' computations.

We can summarize from the decomposition in the lower part of Table 4 that structural change crucially affects the growth of *FPSE*. It contributes about 57% to the growth of *FPSE* when only direct transfers are considered. With regard to price support, the strongly negative and dominating effect of policy on the change of *FPSE* is moderated by the strong structural change in the 26 regions.

Similar computations were performed for the producer support per hectare. It can be concluded that a correction for structural change is not necessary as there is no significant trend in total agricultural land of the 26 regions. Therefore, the growth of *APSE* and $\overline{APSE}$ (=$APSE/\bar{A}$) are more or less identical.

Table 4 captures the aggregate effect of EU policy and structural change for all 26 regions. A more disaggregate view is presented in Table 5 where favoured and disfavoured regions are again distinguished. Structural change in agriculture was high and about the same in favoured and disfavoured regions.

Table 5: Policy-induced and Structural Change of Producer Support per Farm in Favoured and Disfavoured Agricultural Regions of Hesse, 1986-2002 [a)]

Regions	**Average Annual Change of $\Delta\ \overline{FPSE}$ due to ...**			$\Delta\left(\overline{F} / F\right)$
	CAP (€)	**Price support (€)**	**Direct transfer (€)**	
Favoured regions:				
WE	-706.7***	-1165.4***	458.7***	0.058***
GG	-792.4***	-1149***	356.7***	0.051***
DADIE	-825.8***	-1178.4***	352.6***	0.043***
KSL	-705.1***	-1015.3***	310.0***	0.054***
LM	-659.3***	-1113.1***	453.9***	0.047***
Median	-706.7	-1149.1	356.7	0.051
Disfavoured regions:				
FD	-256.1***	-508.4***	243.0***	0.047***
HR	-390.7	-593.4***	202.7***	0.068***
WM	-495.4***	-775.5***	280.1***	0.057***
VB	-459.7***	-747.2***	387.5***	0.058***
LDK	-291.7***	-415.7***	124.0	0.056***
Median	-390.7	-593.4	243.0	0.057

*** (**, *. [*]) Statistically significant at the 99.9%- (99%-, 95%- 90%-) level. – a) The computations are based on equation (7) and utilize the regression coefficients of linear trend functions for the absolute changes of the components.

Source: Authors' computations.

However, it is a remarkable result that the policy impacts on the change of $\overline{FPSE}$ are crucially different. The favoured agricultural regions realize a clearly higher decrease of annual real income transfer due to price support. Although the annual increase of income transfers due to direct transfers was also higher than for disfavoured regions, it does not compensate for the negative change in price support. Therefore, a median loss in producer support per farm by 706.7 € occurred annually for the favoured agricultural regions. For the disfavoured agricultural regions, the losses by decreasing price support were higher than the additional direct transfers, too. However, the resulting average annual loss of real income transfers was clearly lower in the disfavoured than in the favoured agricultural regions.

4.4 Did Regional Income Transfers Due to the CAP Become More or Less Equitable over Time?

It was mentioned already that there is a strong interregional variation of producer support due to the CAP in the period 1986-2002. Hence, the question arises whether this interregional variation of transfers changed under the influence of the changes of the CAP during the 1980s and 1990s.

In order to analyze the question, interregional variation of support was measured across all 26 regions – for each year and each measure of support. Then, the growth in those coefficients of variation was estimated by regression analysis and the results are shown in Table 6.

Table 6: How the Interregional Distribution of Producer Support Changed over Time, 1986-2002[a)]

Change in interregional variation of ...	**Due to changes in ...**		
	CAP	**Price support**	**Direct transfers**
PSE	0.395***	0.824***	-0.268**
FPSE	0.482***	0.993***	-0.137
$\overline{FPSE}$	0.150*	0.781***	-0.595**
APSE	0.437***	1.526***	-0.861**
%PSE	-0.145	1.346***	-0.899*

*** (**, *, [*]) Statistically significant at the 99.9%-(99%-,95%-, 90%-) level. – a) The interregional distribution of support is measured by the coefficient of variation across all 26 regions. Changes are computed here as the regression coefficients of linear trend equations of those coefficients of variations in the individual years.

Source: Authors' computations.

For no measure of support, the interregional variation declined significantly when the overall impact of the CAP is analyzed in real terms. It even increased for *PSE, FPSE*, $\overline{FPSE}$ and *APSE*. This implies that the interregional distribution of the absolute *PSE* and *PSE* per hectare became more unequal due to the CAP. Support per farm became less equal, too, independent of whether we correct for structural change or not.

With regard to the policy areas, one pattern is remarkably stable: Price support made transfers more unequal across regions, and direct transfers made them more equal. All regression coefficients for the interregional variation are statistically significant when only price support or direct transfers are covered and when we correct for structural change when transfers per farm are computed.

It has to be borne in mind that we cannot draw an immediate policy lesson from these findings: When transfers become more unequal over time, this can be positive or negative from a redistributive point of view. The highest transfers may be concentrated more on the poorest or the richest regions over time. We will come back to this assessment by a joint analysis of findings in Table 6 and 8.

5 Determinants of the Regional Distribution of Support Under the CAP

Up to now, the regional distribution of producer support was analyzed with indicators of descriptive statistics, growth rates and growth decomposition methods. In the following, it will be investigated additionally whether the regional distribution of support and its characteristics can be explained by differential agricultural conditions and – to some extent – economic characteristics of the region.

Agricultural conditions, like soil quality or climate, are often regarded as factors influencing the long-run specialization in agriculture which are less important in explaining short-run changes in planned production. Therefore, the average regional support in the period 1986-2002 or the average change in support during the same period were utilized as dependent variables. Economic variables like the price wedge between domestic and world prices are excluded from the explanation of average support. This price wedge will differ from year to year but is taken as constant across regions. Therefore, the economic variable "price wedge" will rather explain variations of support over time than across the 26 regions at a given period of time.

Agricultural conditions as determinants of support were measured as follows. An index of soil quality (SOIL), "Bodenpunkte", was introduced first as our major indicator of whether a region is agriculturally favoured or disfavoured. This index measures the yield potential of the soil from zero to 100. Moreover, climatic variables were introduced as mean precipitation levels in January and May ($PRECIP_{JAN}$; $PRECIP_{MAY}$) or as mean temperature in °Celsius in the same two months ($TEMP_{JAN}$; $TEMP_{JUL}$). An important relationship is that an increasing precipitation in May and a rising temperature in July favours crop yields and, thus, producer support coupled to crop production. Average size per farm (*A/F*) is computed by dividing total agricultural area in hectares (*A*) by the number of farms (*F*) and is used as indicator of agricultural production structure in the regions. As the dependent variables are defined as average support or a growth rate of support for the period 1986 to 2002, mean values are also computed for 1986-2002 for these agricultural and climatic variables. Additionally, it is expected that support differs in rural and urban areas even when soil quality is identical. THUENEN's theory suggests that market-oriented production dominates close to the urban centres. This suggests a lower dependence of governmental support than in remote areas. Two different dummy variables are introduced which are unity in the urban centres and zero in all other cases. URBAN 1 is a narrower definition which captures the major centres DA, FFM, OF, and KS. URBAN 2 is broader and includes WI, MTK, and OFL additionally. Moreover, it was tested whether the regional distribution of support and its changes are affected by per-capita income (Y^C) of the regions when we already control for differences in agricultural conditions and farm structure.

The data are from the following sources. PSE information is taken from OECD (c). Data on agricultural structure are available from HESSISCHES STATISTISCHES LANDESAMT (a) and on regional per-capita income from HESSISCHES STATISTISCHES LANDESAMT (b). Climatic variables are from DEUTSCHER WETTERDIENST and additional price information for the computation of %PSE is from EUROSTAT.

What are the reasons for the interregional distribution of producer support shown above? A selection of regression estimates is presented in Tables 7 and 8. The distribution of producer support across regions is explained in Table 7; determinants of the average annual change in producer support are elaborated in Table 8.

Apart from the design of policy instruments, the distribution of transfers is strongly related to farm structure and the natural conditions of agricultural production in the regions. First, the size distribution of farms drives the absolute amount of producer support a region receives. The more agricultural land is available, the higher is the absolute transfer – this influence is very strong and is mainly responsible for an $\overline{R}^2$ of 0.99 for *PSE*.

Second, about 86% of the interregional variation of the producer support per farm is explained by farm structure, natural conditions and economic development of the region. The level of *FPSE* was significantly higher in regions with a larger average farm size, better soils and a lower average temperature in January. Moreover, it was lower in the urban centres than in the non-urban areas and, besides all these variables, support per farm was higher in regions with a lower per-capita income.

Table 7: How Natural Conditions, Farm Structure and Per-Capita Income Affect the Level of Regional Product Support Under the CAP, 26 Regions, Average 1986-2002[a)]

Independent Variables	**Dependent Variables**			
	***PSE* (Mill. €)**	***FPSE* (€)**	***APSE* (€)**	***%PSE* (%)**
Constant	-21.8231** (-2.99)	8,509.55** (2.89)	92.9558 (0.36)	42.8502*** (8.83)
A	0.8624*** (29.58)			
F			72.4747** (3.94)	
A/F		692.173*** (9.81)		-0.1883[*] (-1.86)
SOIL	0.0944[*] (1.75)	103.727* (2.37)	5.0443* (2.65)	
$TEMP_{JAN}$	-2.0308** (-2.99)	-1,135.57** (-2.97)		
$TEMP_{JUL}$	1.2351** (3.63)			
$PREC_{JAN}$				0.0828** (3.10)
$PREC_{MAY}$			5.4430* (2.76)	
URBAN 1		-2,555.84* (-2.69)	-103.559* (-2.16)	
Y^C	$-0.2244 \cdot 10^{-3}$ (-0.74)	-0.7656*** (-4.37)	$-0.2913 \cdot 10^{-2}$ (-0.28)	$0.7243 \cdot 10^{-3}$ (0.29)
$\bar{R}^2$	0.99	0.86	0.69	0.34
F	522.23***	31.09***	12.30***	5.22***

a) All variables are explained in the text. As the average real values for 1986-2002 are taken into account for all 26 regions, *n* is 26 in all cases. ***, **, *, [*] indicates statistical significance at the 99.9%-, 99%-, 95%- and 90%-level respectively.

Source: Authors' computations.

Third, about 70% of the interregional variation of producer support per hectare can be explained by natural conditions, farm structure, and economic development of the region. Soil quality remains statistically significant when producer support per hectare is analyzed. Favoured regions in terms of soil quality received a higher *APSE* than disfavoured regions. Additionally, support per hectare rises as expected with an increasing precipitation in May – i.e. with rising crop yields – and is higher in rural than in urban regions. The latter relationship suggests that THUENEN's hypothesis is valid with market-oriented production being more concentrated in the urban areas. Apart from these determinants, per-capita income does not affect the regional allocation of producer support.

Fourth, it is striking that the variation of %PSE across regions cannot be explained as well as that of *FPSE* and *APSE* by natural conditions and farm structure in the regions. The $\overline{R}^2$ in the equation shown in Table 7 is 0.34. Apart from a significant influence of one of the precipitation variables, only A/F is weakly statistically significant. Apparently, producers in regions with a larger average farm size are less dependent on producer support than their counterparts in region with a smaller farm size. There is no separate influence of per-capita income on the distribution of %PSE.

Table 8 reveals that farm structure and natural conditions for agriculture affect the change in producer support over time, too, but to a lesser extent. In general, the average annual changes of PSE and FPSE can be explained better by natural conditions and farm structure than those of APSE and %PSE. The corrected coefficients of determination are 0.94 and 0.68 for the first two equations and clearly less for the other two.

It is remarkable that the growth of %PSE was higher in disfavoured agricultural regions - measured by soil quality - than in favoured agricultural regions. The effect of SOIL on changes in all other measures of producer support was insignificant. In urban regions, measured by URBAN 1, the changes in PSE per farm were more negative than in rural regions.

Average annual changes in *FPSE* (*APSE*) decreased (increased) with a rising per-capita income. These results are most interesting when assessed in combination with Table 4. Table 4 had indicated a diverging trend in regional producer support on the basis of both *FPSE* and *APSE*. The income coefficients in Table 8 suggest additionally that income distribution targets have been fulfilled more (less) over time when *FPSE* (*APSE*) is utilized as measure of interregional income distribution.

Table 8: How Natural Conditions, Farm Structure and Per-Capita Income Affect the Average Annual Change of Regional Producer Support Under the CAP, 26 Regions, Average 1986-2002[a)]

Independent Variables	Dependent Variables			
	Δ PSE (Mill. €)	*Δ FPSE* (€)	*Δ APSE* (€)	*Δ %PSE* (Percentage points)
Constant	0.4406 (0.93)	1494.38** (3.47)	-49.6012*** (-4.26)	-0.0694 (-0.21)
A	-0.0217*** (-10.79)			
F			3.1764** (2.97)	
A/F		8.5577 (1.31)		
SOIL	-0.0125** (-3.40)	4.5778 (1.15)	-0.1245 (-1.14)	$-0.6473 \cdot 10^{-2}$* (-2.26)
$TEMP_{JAN}$		-117.065** (-3.17)	1.6909 (1.48)	
$PREC_{MAY}$	$-0.3297 \cdot 10^{-2}$ (-0.87)	-9.3306* (-2.21)		$0.4226 \cdot 10^{-2}$ (1.34)
URBAN 1		-335.662** (-3.70)		
URBAN 2	0.1904[*] (2.08)			
Y^C	$0.1519 \cdot 10^{-4}$ (0.77)	-0.0646** (-3.77)	$0.1595 \cdot 10^{-2}$* (2.66)	$0.8763 \cdot 10^{-5}$ (0.65)
$\bar{R}^2$	0.94	0.68	0.25	0.16
F	74.48***	9.75***	3.11*	2.56[*]

a) All variables are explained in the text. As the average real values for 1986-2002 are taken into account for all 26 regions, *n* is 26 in all cases. ***, **, *, [*] indicates statistical significance at the 99.9%-, 99%-, 95%- and 90%-level respectively.

Source: Authors' computations.

6 Comparison with other Studies

It is interesting to compare our results with those of other recent studies which are supposed to measure regional redistributive effects of the CAP, in particular with EUROPEAN COMMISSION (2001) and TARDITI/ZANIAS (2001). These studies use the PSE database, too, but their focus is different. Both studies go beyond ours in so far as redistributive impacts on consumers and budget revenues are incorporated, whereas we concentrate on the regional redistribution of producer support. Our study, however, goes beyond these two studies as it covers a longer time pattern of support whereas the EU study is based on three years – 1989, 1994 and 1996 – and TARDITI/ZANIAS on two years – 1991 and 1994. This implies that broader changes in the CAP from the mid-1980s to 2002 are included, not only years before and after the 1992 reform. Moreover, an explanatory approach is taken here as the distribution of support is related to natural and agricultural conditions in the respective regions.

There are some similarities in results, but also some marked differences. TARDITI/ZANIAS (2001, p. 213) conclude that, "on average, the agricultural price support transfers income from richer urbanized and industrialized regions towards poorer regions where agriculture accounts for a larger share of the regional GDP". Our results do not generally confirm this redistributive impact but allow more differentiated conclusion. Whether redistribution occurs toward poorer regions, is dependent of the measure of support. Furthermore, it matters whether causality is modelled or not. An existing correlation between producer support and per-capita income does not necessarily mean that differences in per-capita income cause producer support when natural conditions and farm structure are incorporated as additional determinants of support.

There is only a uniform result for %PSE which does not confirm the results by TARDITI/ZANIAS: Per-capita income does not matter – neither in correlation nor regression analysis – for the regional allocation of producer support. The findings by the European Commission and TARDITI/ZANIAS are confirmed when the regional support as measured by PSE and APSE is correlated with regional per-capita income. Apparently, regional producer support in absolute amount and per hectare are concentrated in poorer regions. The regional distribution of FPSE, however, is not significantly correlated with per-capita income. All these findings are very similar for total CAP transfers, market price support and direct transfers.

When we consider natural conditions and farm structure additionally, regional per-capita income does not significantly affect regional producer support according to PSE, APSE and %PSE. FPSE, however, rises when regional per-capita income declines. Thus, multiple regression analysis reveals that poor regions benefit more from the CAP's producer support only when producer support per farm is considered.

Additionally, our results show that soil quality, precipitation and farms structure determine producer support.

Apparently, our results are clearly more differentiated than those of the European Commission and TARDITI/ZANIAS. Analogously, they deviate from the ESPON study as that study unambiguously deduces a redistributive impact toward richer regions.

Our results clarify one further point which remained open in EUROPEAN COMMISSSION (2001). No clear signs could be elaborated there on how the distribution of CAP benefits changed. We can clearly answer this question for the period 1986-2002: Producer support declined in real terms due to the CAP, and the interregional distribution of *PSE, FPSE* and *APSE* became significantly more uneven. Regression results additionally show that the hectare was lower than in low-income regions. According to all measures of support, price support made producer support more disparate, and direct transfers worked in the opposite direction.

7 Summary and Conclusions

The following major conclusions can be drawn from the presented analysis:

1. A uniform CAP does affect the regions very differently. This result is valid according to all four measures of producer support. Some regions are clearly more favoured than others.

2. Recent reforms of the CAP have significantly reduced the real level of agricultural support in the Bundesland Hessen according to all measures of support. The effects of direct payments could not compensate for the opposite effects of price support.
3. The interregional variation of support increased according to all PSE measures. In one case, for APSE, disparities in per-capita income across regions became stronger over time.
4. We saw that the measurement concept matters. If there is a regional redistributive goal in the CAP, the policy target has to be defined very precisely. In particular, a certain interregional allocation of absolute support will lead to an arbitrary interregional distribution of relative support.
5. The distribution of support across regions is strongly determined by farm structure and natural conditions. Soil quality and average farm size in the regions and the fact that a region is urban affected regional producer support in the period 1986-2002.

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Appendix 1: Selected Correlations between PSE Measures and Indicators of Natural Conditions, Farm Structure and Regional Development[a)]

***PSE* Measure**	**Indicators of Natural Conditons, Farm Structure and Regional Development**		
	SOIL	*A/F*	Y^c
PSE	-0.2908	0.1053	-0.5931**
FPSE	0.1050	0.8133***	-0.2953
APSE	-0.1190	0.2037	-0.5026**
%PSE	-0.3001	-0.4002*	-0.0402
MPS	-0.2996	0.0981	-0.5894**
FMPS	0.0654	0.7803***	-0.2931
AMPS	-0.1340	0.2245	-0.4484*
%MPS	-0.2588	-0.0018	-0.1334
PP	-0.2659	0.1192	-0.5903**
FPP	0.1693	0.7664***	-0.2586
APP	-0.0285	0.0626	-0.4433*
%PP	0.0189	-0.4147*	0.1290

[a)] The PSE measures are defined and computed as explained in Section 2, the variables SOIL, Y^c and (A/F) in Section 4. Each correlation is based on average values of the time period 1986-2002 for each region, i.e. 26 observations. *** (**, *, [*]) statistically significant at the 99.9%- (99%-, 95%- and 90%)-level.

Source: Authors' computations.

Appendix 2: Correlation between *PSE* Measures[a)]

***PSE* Measure**	***PSE***	***FPsE***	***APsE***	***%PSE***	***MPS***	***FMPS***	***AMPS***	***%MPS***	***PP***	***FPP***	***APP***	***%PP***
PSE	1.00											
FPSE	0.57**	1.00										
APSE	0.83**	0.72***	1.00									
%PSE	0.06	-0.19	0.11	1.00								
MPS	1.00***	0.57**	0.84***	0.09	1.00							
AMPS	0.75***	0.70***	0.96***	0.15	0.77***	0.77***	1.00					
%MPS	0.32	0.28	0.53**	0.65***	0.37[*]	0.42*	0.69***	1.00				
PP	0.99***	0.57**	0.81***	-0.01	0.97***	0.53**	0.69***	0.22	1.00			
FPP	0.52**	0.91***	0.58**	-0.26	0.49*	0.80***	0.46*	-0.04	0.58**	1.00		
APP	0.71***	0.48*	0.68***	-0.06	0.68***	0.35[*]	0.47*	0.14	0.79***	0.67***	1.00	
%PP	-0.35[*]	-0.56**	-0.57**	0.21	-0.38[*]	-0.69***	-0.72***	-0.61***	-0.27	-0.22	0.11	1.00

[a)] The PSE measures are defined and computed as explained in Section 2. Each correlation is based on average values of the time period 1986-2002 for each region, i.e. 26 observations. *** (**, *, [*]) statistically significant at the 99.9%- (99%-, 95%- and 90%)-level.

Source: Authors' computations.

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