Are Support Measures and External Effects of Agriculture Linked Together?
Conceptual Notes and Empirical Evidence from the Austrian Agricultural Sector

Diskussionspapier Nr. 64-W-97

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November 1997

Institut für Wirtschaft, Politik und Recht
Universität für Bodenkultur Wien

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Are Support Measures and External Effects of Agriculture Linked Together?

Conceptual Notes and Empirical Evidence from the Austrian Agricultural Sector

Franz Sinabell *)

Abstract

Several recent agricultural policies are focused on internalising environmental costs whereas others are aimed at rewarding environmental services of agricultural producers and stimulating their provision. Such policies that might put the agricultural sector on a track of sustainable development are dominated by production stimulating policies, most notable border protection measures, however. Market distortions due to the latter policies are captured in protection measures like the PSE values published regularly by the OECD. This analysis shows that several problems arise if this measure is used when agricultural production is causing external effects. In the empirical part a slightly modified regionalised version of the PSE is used to show that product specific support is likely to cause environmental damage and that there are good reasons not to believe that payments intended to compensate farmers for the provision of public goods actually reach that goal in Austria.

1 Introduction

Virtually any government in industrial countries intervenes in agricultural markets. Besides arguing for a "fair" level of income, comparable to that outside the agricultural sector, numerous other reasons for agricultural support have been brought forward. According to WINTERS (1987, 291) agricultural policies have been put into effect in industrialised countries in order to

- promote agricultural efficiency and the optimal utilisation of production factors;
- provide a local supply for domestic food processors;
- ensure 'reasonable' prices for consumers;
- ease the farm sector's speed and the costs of adjustment to external factors;
- pay due regard to the social structure of agriculture;

Disregarding arguments raised from a welfare economics perspective to reach some of these goals in an efficient way by opening protected markets to foreign trade and

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subsidising the factor labour in the vulnerable sector (BAGHWATI/SRINIVASAN, 1969), governments tried to reach these goals with various kinds of intervention. These included above world price level minimum prices, subsidies, tariffs and quota on trade, as well as direct payments for producers. Besides the fact that some of these instruments are in direct conflict with many of the national goals of economic policy, they caused trade conflicts which have been settled temporarily with in the Agreement on Agriculture during the Uruguay Round (see e.g. SCHWAR, 1995).

One set of arguments for government intervention in agricultural markets which only recently entered the discussion in high income countries, is to compensate farmers for the provision of public goods, to reduce negative external effects linked to agricultural production and to promote sustainable agricultural practices (see e.g. HOFREITHER/VOGEL, 1995). Since most of the older policy aims are still on the agenda (this is at least true for Austria; PUWEIN, 1994) policy makers are confronted with the problem to reach a larger number of goals with a more restricted set of instruments.

The question if liberalising trade of agricultural commodities will be in conflict with the principles of sustainable development is difficult to resolve. Trade models lead to the conclusion that there will be positive welfare effects and increase economic growth. Growth, however, might stimulate the depletion of natural resources (a number of contrasting arguments are brought forward by DALY, 1994 and BHAGWATHI, 1994). Therefore many authors propose to enter a structured discussion to reach agreements where environmental and trade concerns are dealt with in an integrated way (e.g. ESTY, 1994, STEININGER, 1994, GARDNER, 1995).

This study wants to contribute to such a discussion by examining if indicators that are used to measure the openness of the agricultural sector to foreign trade and external effects of agricultural production can be analysed within a uniform conceptual framework. The analysis shows that this in fact is possible, if environmental costs and benefits of production can be valued in monetary terms. In case such evaluation results are not available it is proposed to use environmental indicators as proxies for social damages.

Empirical estimates based on data from Austria indicate that product specific regional transfers to the agricultural sector are interrelated with indicators of environmental damage. Such a relationship cannot be found with respect to positively valued services of agriculture: the distribution of transfers shows quite a different pattern than environmental benefits from countryside stewardship practices. We suppose that such evidence gives policy makers valuable information on how to allocate support to regions where positively valued environmental services of farmers are provided and on how to modify existing support schemes in regions where environmental damage can be observed.

2 Indicators of sustainability and protection coefficients

Liberalising agricultural markets will eventually lead to a reduction of input subsidies and to agricultural commodity prices which are close to world market prices. Both these consequences are seen essential for a tight integration of agricultural and environmental policies (OECD, 1993). The argumentation is based on the assumption that production stimulating policies like price support schemes potentially lead to detrimental environmental effects. MAIER and STEENBLICK explain this position as follows:

> *"Over the long run, moving agriculture onto a sustainable path and maintaining it there will require a mix of persuasion, financial incentives and disincentives, and other instruments as appropriate. In order to get the mix right, governments will have to work closely with farmers and farming associations, providing access to education and training and creating the right conditions for the adoption of more environmentally friendly production methods and technology. The maximum effectiveness of such policies can be achieved only if the distortions in production caused by agricultural subsidies are reduced" (MAIER/STEENBLIK, 1995).*

The protection coefficient PSE[1] is used to indicate the level of such distortions caused by agricultural subsidies, whereas a similar measure, the AMS (Aggregate Measure of Support), is used to measure compliance with the Agreement on Agriculture made in the Uruguay Round. There does not exist a likewise established "measure of sustainability" for agriculture, however.

Several indicators were proposed, e.g. the diversity of crops planted in a given area (LYSON/WELSH, 1993), or a whole set of indicators including the use of fertiliser and pesticides, the number of hedges in a given area and the acreage of fallowed parcels (see e.g. NEHRER, 1992) or considering various environmental and sociological indicators simultaneously (DUMANSKI et al., 1990; PIORR, 1996). PSE values which are based on a normative concept refer to transfers and social cost associated with discretionary policies whereas indicators of sustainability as those mentioned mainly are referring to "optimal" situations that are determined by natural sciences parameters.

Welfare economics offers the well established concept of external effects that would allow to integrate both measures of protection as well as indicators of sustainability under one framework if deviations from the path of sustainability can be measured in monetary terms. Given such valuations exist the question arises whether PSE values actually are consistent with the concept of external effects or not. Another question is if PSE values in combination with environmental indicators can be used to indicate which direction policy changes should take.

3 Protection coefficients and external effects

In theory the market price of a change in agricultural output should reflect the social opportunity cost. In practice market prices are frequently different mainly due to market imperfections, the most important of which, is in agriculture, government intervention (SAUNDERS, 1996). The most frequently used indicator to measure market imperfection is the nominal protection coefficient (NPC) which is calculated

[1] Gross Total PSE (Producer Subsidy Equivalent) is defined as total assistance transferred to producers by means of *market price support* (net of *levies on output*), direct payments, and *other support*, but before deducting of the *feed adjustment*, to arrive at the *net total* PSE, where *feed adjustment* is the sum of the additional costs of animal feed to livestock producers as a result of *market price support on feeds for which* PSEs are calculated and taxes on feeds and processed feedstuffs (OECD, 1995, 288p).

by dividing the domestic price through the world market price of a given commodity. A NPC>1 indicates that there are distortions on the domestic market of this product.

An approach to measure the social cost of agricultural output is to estimate the effective rate of protection (ERP) based on the concept of effective protection developed by CORDEN (1966). By using the difference between value added at domestic prices and the value added at world prices and express it as a percentage of the value added at world prices the rate of protection of a given commodity will not systematically overestimate the social opportunity cost as is the case with the nominal protection coefficient if inputs are protected as well and therefore could be put to alternative uses (see e.g. TSAKOK, 1990).

Several assumptions which underlie the concept of effective protection may be seen as problematical. ERPs assume that the trading status of a country would be unchanged given no support, changes in domestic supply will not influence world market prices, and that there are fixed input/output coefficients. It is further assumed that there are no significant impacts on exchange rates, no transportation costs, no external effects of production, that there is homogeneity of production, and full employment of production factors.

All these assumptions also underlie the methodology of PSE that was proposed to measure the income transfer to producers in a protected sector by JOSLING (1973). The PSE, further developed by the OECD, has been modified in a way to "measure the value of the monetary transfers to agricultural production from consumers of agricultural products and from taxpayers resulting from a given set of agricultural policies, in a given year" (OECD, 1995, 193). Although according to this definition it seems that the PSE measures transfers only, it is covering social costs as well (the relative shares depend on market conditions and on the set of policies).

Several authors deal in depth with this measure (among them CHRISTEN, 1990; TSAKOK, 1990; O'CONNER et al., 1991) showing that policy measures with quite different effects on trade or production may have similar PSE values (SCHWARTZ/PARKER, 1988, CAHILL/LEGG, 1990) or investigating the influence the underlying assumptions have on the ranking of countries (MASTERS, 1993; BUREAU/KALAITZANDONAKES, 1995). GUYOMARD/MAHE (1993) show the effects production quota in combination with price support measures have on that indicator. None of these authors took account of the presence of external effects, however. In the next paragraphs a graphical model is used to show how this indicator is affected if external effects are no longer negligable.

PSE in its most simple form (the product specific *market price support* element of the PSE) is equivalent to the Subsidy Equivalent (SE). The SE is calculated by multiplying the quantity of a good produced in a country where there is a tariff on imports times the difference between domestic and world market prices. All the information required to calculate the value of SE for a given period can be observed quite easily on markets (see VOUSDEN, 1990, 32pp for an extensive treatment).

In *Figure 1* the situation of a market where domestic producers are protected by a tariff is depicted. World market price is p_W, the price for domestic producers after introducing a tariff is p_D. D and S are demand and supply, respectively. The Subsidy Equivalent (SE) is equal to area a+b. This area represents the transfer from consumers to producers (a) and includes the social costs (b) which arise because of the production loss (for allocating resources to produce too much of the commodity in question). Summing up, the Subsidy Equivalent is composed of both, transfers and social costs (SE=a+b).

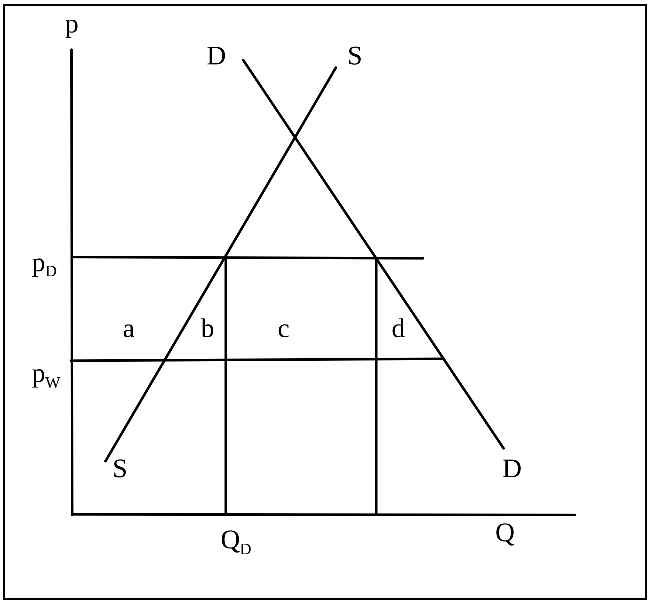

Fig. 1: Subsidy Equivalent and Consumer Tax Equivalent in a partial equilibrium

Now consider a situation where a *positive external effect* is linked to the production of this commodity. If the external effect has the property of a pure public good and is directly linked to the production of the commodity in question, government might find it appropriate to subsidise this agricultural activity. [2] In such a situation the SE only measures the total amount of transfers, no social costs are included this time if the compensation scheme is implemented in an efficient way.[3]

Exporters abroad may notice that production is subsidised (local farmers get a higher price than p_W) and can observe the increased production volumes. They might argue that they loose market shares due to policy intervention because the protection coefficient SE is positive. If the only way to match demand for landscape amenities with their supply is to subsidise agricultural products technically coupled with them, other forms of support clearly would not lead to that goal. Direct payments to farmers that are decoupled from production e.g. could be used for consumption only without any stimulating effect on the provision of the public good. Therefore, the implementation of a programme to internalise environmental benefits may imply that the SE becomes positive whereas social costs are zero.

The basic relationship between a protection coefficient like the SE and a *negative externality* can be demonstrated within the following graphical model (see *Figure 2*).

[2] This could be the case if cows or sheep are necessary to prevent alpine grassland from reverting to scrub and there are hikers and tourists enjoying these landscape amenities. The optimal quantity of a public good is determined by the condition that the sum of the individual willingness to pay for the public good has to exceed total cost of providing it (see VARIAN, 414pp for a formal treatment).

[3] The efficiency of such a policy crucially depends on the design of the compensation scheme.

In this case the country has a protective agricultural policy in place and herewith raises the domestic producer price p_D above the reference price p_w. This policy increases the production volume according to the supply function S to the level of Q_S. In such a situation the *subsidy equivalent* is the sum of the areas a to f: The loss of welfare resulting from this protectionist policy (dead-weight-loss DWL_p) is illustrated by the triangles b and f.

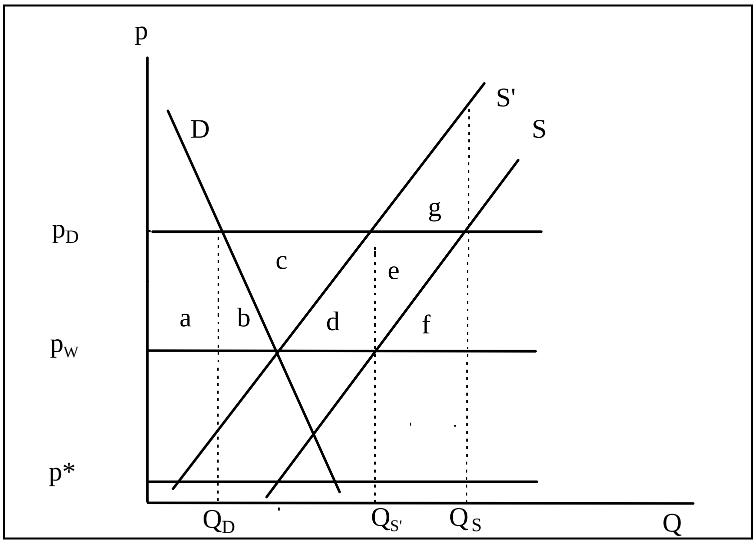

Fig. 2: Liberalising a market in presence of production related negative external effects

Now suppose that environmental damage (a negative external effect) is associated with the production of this commodity. Since too much of this particular commodity is produced internalising the social costs would require to shift production to S'. If the environmental costs are not internalised the social costs due to negative external effects (DWL_E) are given by the area d+e+g. The total loss of welfare therefore is given by the sum of welfare losses via protectionist policies (DWL_P=b+f) and welfare losses via negative externalities (DWL_E=d+e+g).

Following the argument of MAIER/STEENBLIK (1995) an abolition of the tariff could already lead to a dramatic reduction of social cost: The only source of inefficiencies remaining would be the environmental costs (d). If the environmental damage is proportional to output a tax on production could reduce DWL_E to zero (for the producers this is equivalent with the lower price p*). In such a situation farmers on the local market might argue that they are discriminated against foreign competitors because the SE has become negative as a consequence of the environmental tax. Like in the situation where government internalises a positive externality, again the SE is different from zero, whereas social costs are zero.

Table 1 gives a systematic overview of the effects of policy interventions if external effects of production are present:

- the prices are: p_W (world market price), p_C (domestic consumer price), p_P (domestic producer price), p* the "optimal price" reflecting marginal social opportunity costs;

- effects can be measured with several indicators: DWL (dead weight loss), public budget, and SE (Subsidy Equivalent);
- effects can be neutral (0), increase the value of an indicator (+), or decrease its value (-);
- damages of external effects can be covered by the taxpayer (budget: +), can be paid by future generations, or by firms/consumers (current budget: 0);
- positive external effects can be paid for by the public (budget: +), or can be internalised on the basis of private contracts (budget: 0).

The interpretation of the various prices in *table 1* is the following: In a situation where social opportunity cost are reflected on markets ($p_P = p^*$) by definition no external effects occur. This is probably most frequently the case and underlying one of the core assumptions of measures like the SE.

If prices observed on markets (e.g. p_P) are lower than p*, however, a positive external effect is associated with the production of a given commodity. In such a case the market price is too low to induce producers to provide the optimal amount (this is equivalent to an implicit tax on production). If market prices are above the "optimal" price ($p_P>p^*$) producers get a hidden subsidy because negative external effects are not internalised and thus a more than optimal production takes place.

***Tab. 1*: Effects of policy intervention in the presence of external effects of production**[4]

		no ext. effect	**positive ext. effect**	**negative ext. effect**
reference situation		***no measure taken***		
effect	prices	$p_W=p_C=p_P=p^*$	$(p_W=p_C=p_P)<p^*$	$(p_W=p_C=p_P)>p^*$
	DWL	**0**	+	+
	budget	0	+ or 0	- or 0
	SE	0	0	0
measure		***subsidy***	***subsidy (private compensation)***	***tax (private compensation)***
effect	prices	$(p_W=p_C=p^*)<p_P$	$(p_W=p_C)<(p_P=p^*)$	$(p_P=p^*)<(p_W=p_C)$
	DWL	+	**0**	**0**
	budget	**-**	- or (0)	+ or (0)
	SE	+	+ or (0)	- or. (0)
measure		***tariff***		***import subsidy***
effect	prices	$(p_W=p^*=)<(p_P=p_C)$	$p_W<(p_P=p_C=p^*)$	$(p_P=p^*=p_C)<p_W$
	DWL	+	+	+
	budget	+	+	**-**
	SE	+	+	**-**

In *Table 1* various situations are summarised: If a government is subsidising production in a situation where there are not external effects SE is positive, taxpayers loose money (budget "-") and social costs arise (DWL "+"). If tariffs (or in the short run equivalent measures like quotas or non-tariff barriers to trade) are introduced as a measure to internalise positive external effects, still social costs occur (DWL "+").

4 It is assumed that no spillover effects to neighbour countries occur. Figures in brackets refer to a situation where private compensations are used to internalise environmental costs or benefits.

The first best policy in such a situation is to pay for the provision of the public good directly (see panel "subsidy") which would involve the SE to become positive (SE "+"). Only in cases where private compensation for such services is taking place the SE is zero. In a situation where negative external effects are present, the first best policy to internalise social costs is to collect a Pigouvian tax or establish institutions that make polluters liable. In case a tax is imposed, social costs vanish (DWL=0), the measure of protection becomes negative (SE="-") indicating that production is taxed. Only in cases where polluters directly compensate people harmed by their activity the SE becomes zero.

In situations where no external effects exist, the SE is a useful indicator for social costs associated with market distortions. The major advantage is that it can be calculated quite straightforward based on market observations (SE and DWL have the same sign whatever policy is implemented). The interpretation becomes ambiguous if externalities are associated with production. Since the OECD-definition of the PSE does not account for external effects and is calculated similar to the SE a positive product specific PSE can be interpreted in two ways: (a) social costs arise due to market distortions induced by government intervention, or (b) government takes action to stimulate the production of public goods which are in short supply. A negative value can be interpreted: (a) government is distorting markets at the cost of producers, or (b) government is correcting market distortion by internalising social costs. To avoid such ambiguities it is necessary not to ignore external effects and to account for environmental taxes and compensations for the provision of public goods in a consistent way.

4 Social cost and benefits of Austrian agricultural production

The total PSE of Austrian agriculture was 37.4 billion ATS in 1994 (about 2.7 billion ECU) with a percentage PSE of 62 % and a producer NAC (nominal assistance coefficient) of 2.52 (OECD, 1995). These figures indicate that considerable transfers associated with social costs were the consequence of intervening in agricultural markets. Estimates of the social cost due to agricultural policies exist only for the bread grains market for the period before Austria's accession to the EU (see HOFREITHER et al., 1995). This study shows the puzzling fact that the welfare gains of down- and upstream industries were higher than that of grain producers.

In Austria both positive, as well as negative external effects due to agricultural production can be observed (see SINABELL, 1995 for a recent survey). HOFREITHER/SINABELL (1994) argue that liberalising agricultural markets in Austria which implies lower producer prices will have positive effects for environmental quality if this policy is combined with programmes under which farmers are paid for environmental services based on cost-benefit criteria.

Negative effects are mainly the result of an intensive use of farm chemicals which leads to a loss of plant species and other organism, a further effect is the pollution of groundwater. Recent monitoring data show that current threshold values are being exceeded on an area equivalent to 40% of arable land (BMLF/BMJUF, 1996). But no monetary estimates of the damages exist, so the social costs due to external effects are unknown.

Therefore, the question how PSE values are related to the social costs of agriculture cannot be resolved. However, environmental indicators can serve as a proxy if they are highly correlated with social cost. This is certainly true for nitrate content in groundwater. The additional costs for water providers who have to blend water from different sources or have to invest in purification facilities are estimated to amount to two billions ATS, 150 millions ECU, for the period from 1993 to 2000 (GERHOLD, 1993).

Most important among positive externalities of the Austrian agriculture are countryside stewardship goods. In several regions where a beautiful landscape is a major input for the tourist business private co-operations exist between hoteliers and farmers who provide these services (see HACKL/PRUCKNER, 1997 for a recent analysis). Several studies were carried out in which estimates of the value of positive external effects were made (PRUCKNER/HOFREIHTER, 1992, BAASKE et al., 1991 and 1995, PEVETZ et al., 1990, and PRUCKNER, 1993). Reliable estimates of the monetized value of countryside stewardship services of Austrian agriculture were made by PRUCKNER/HOFREIHTER (1992) and PRUCKNER (1993) who asked tourists from abroad for their willingness to pay for agricultural landscape. So far there is no reliable estimate of Austrian citizens' willingness to pay for similar public goods. Results from Sweden (DRAKE, 1992) suggest that it may be quite remarkable in areas where land owners switch from agricultural to forest production.

4.1 Transfers to producers on a regional level

The model depicted in *Figure 2* suggests a relationship between a protection coefficient and environmental costs in case border protection measures exacerbate negative externalities. As shown in this figure, the SE is proportionally related to both elements of total welfare loss (DWL_E+DWL_P) if negative external effects occur. If these effects are actually linked with production one would expect to observe high damage where product specific transfers are high. Nitrate content in groundwater can serve as a proxy for environmental damage since water with a nitrate content exceeding 50 mg NO_3/l may not be sold to consumers. In polluted regions water providers are required to make additional investments which are not paid by the polluters.

To test such relationships required that the PSE figures for Austria had to be broken down to community level in order to construct a "Regional Transfer Indicator" (RTI). A deviation from the PSE methodology is given by the fact that agricultural land was used in the denominator to allocate transfers not directly related to a single product because most of the data were available on a regional level (the OECD uses production volumes of commodities instead). Levies on fertilisers were not subtracted as the OECD methodology requires but were assumed to be collected to internalise some of the costs associated with nutrient emission.[5] This deviation from the PSE methodology is necessary to reach consistency with the results derived in the previous chapter. No payments, based on cost-benefit criteria, were made for the

5 This assumption may be questioned by the fact that the money collected by this levy was used for export subsidies of grains. The distributional consequences of this tax were that grain producers gained on cost of all other producers using mineral fertiliser as input. This input levy was abolished in 1994.

production of specific countryside stewardship goods during this periode. Therefore, payments from countryside stewardship schemes were treated like direct payments.

In calculating the RTI the first step was to break down the market price support element of the PSE on local crop and livestock production quantities (the "general services" element was allocated according to production volumes). The next step was to partition the "other support", " and "direct payments" elements to the relevant acreage basis. Thus several indicators were calculated which captured different elements of support, e.g. *Crop-RTI* captures *market price support* and *other support* which is directly related to plant production whereas the *Neutral-RTI* captures *direct payments*.

4.2 Regional transfers and environmental effects

ANDERSON/STRUTT (1994) showed in a cross country analysis that PSE values are significantly correlated with the amount of fertiliser used. They argue that liberalising trade which will reduce PSE values in several countries will likely lead to a reduced input of farm chemicals with positive effects from an environmental point of view.

Experiences from the policy change which took place in New Zealand confirm these arguments. During the period from 1979 to 1994 the percentage PSE dropped from 18% to 3% in New Zealand (OECD, 1995). Lifting trade barriers and reducing support of the farm sector not only strengthened competitiveness and helped saving consumers and taxpayers money but led to positive effects for the natural environment, as well (REYNOLDS et al., 1993). These empirical findings back model results of TOBEY/REINERT (1991) who conclude that agricultural policy reform encourages a reduction of farm inputs.

In the following section empirical data from Austria will be used to test two hypotheses: The first one is that we would expect higher environmental damage in regions where price support measures lead to an increase in the use of farm inputs compared to regions where support to farmers is dominated by direct payments. This analysis goes one step further than the work of ANDERSON/STRUTT (1994). They used an indicator of potential emission (fertiliser input), here an indicator of the damage (nitrate content of groundwater) is used. The second hypothesis is that we would expect that government compensates farmers for the production of landscape amenities and therefore direct transfers to farmers should be higher in regions where such amenities can be observed.

Regional transfers and environmental pollution in Austria

To be able to test the first hypothesis a very detailed model would be required that captures the major linkages between farm production, policy intervention and the physical effects on the natural environment (such a model was developed by VATN et al. 1996). A simpler approach was chosen for this study because such a sophisticated model does not exist in Austria.

HOFREITHER/RAUCHENBERGER (1995) and HOFREITHER/PARDELLER (1996) developed econometric models that can be used to analyse the effects of land use changes on the nitrate content of Austrian groundwater. In their cross-section analysis they used natural environment parameters, land use data and input intensity data as explanatory variables (about 1100 observations are included in the data set, however not for all the variables).

Data and structure of one of their models were taken and regional transfers indicators were chosen as explanatory variables instead of land use variables. Given the lack of data for important parameters it is practically impossible to establish a theoretically sound and empirically valid model to describe the complex relationships between the variables. Therefore we confined ourselves to testing the hypothesis of a statistically significant correlation between nitrate pollution of Austrian groundwater and the various RTI-variables in a cross-section analysis. This attempt can be seen as a first step to test if a causal connection between support and environmental damage exists.

The econometric analysis shows that the model in which the transfer indicator *Crop-RTI* was used as an explanatory variable yields almost the same results as the model by HOFREITHER/PARDELLER (see model 2 and model 3 in the appendix). As expected, the result indicates that those regions are more likely to be polluted where high transfers stimulate crop production. The variable capturing direct payments (*Neutral-RTI* in model 4) has a negative sign which implies that direct payments probably do not contribute to groundwater pollution. All these results hold for quite different forms of regression equations and subsamples.

The results have to be interpreted with great care, however. The models estimated are too simple to describe the complex interaction between diverse farming practices and heterogeneous soil, groundwater, and climatic conditions. Since correlations among variables do not imply causal relationships further research is required to test the validity of the results presented here. The inclusion of other potential polluters besides agriculture could be a starting point. Such efforts are hindered by the lack of site specific variables that would allow more complex models to be tested, however.

Regional transfers and landscape amenities in Austria

In the following paragraphs the interrelationship between transfers to farmers and landscape amenities in Austria will be investigated. Compensations are made for various services among them the prevention of abandonment of semi-natural habitats, the maintenance of landscape elements, and the preservation of typical cultural landscapes. The lack of data does not allow to test if such payments in fact are necessary to compensate farmers for providing public goods or if they are a form of hidden income support. Therefore this issue will be dealt with only cursory.

In *figure 3* the regional distribution of three indicators among the Austrian Länder (subnational regions) is depicted:

- tWPT is the aggregated willingness to pay for agricultural landscape by tourists from abroad (about 0.75 billions ATS = 0.056 billions ECU; see PRUCKNER, 1993);
- tRTI (Total Regional Transfer Indicator) is the aggregated total transfer to farmers (the annual average of the 1990-1993 periode is 41 billions ATS = 3 billions ECU);

- APEA 96 are the payments from the Austrian Programme for Environment and Agriculture under regulation EC 2078/92 from those schemes that are intended to stimulate the production of landscape amenities (payments under these schemes amounted to 1 billion ATS from a total of 8 billions ATS for the whole APEA programme; BMLF, 1997).

Figure 3 shows that farmers in *Länder* where tourists value the agricultural landscape highest (Salzburg, Carinthia, Tyrol) get relatively low support. With respect to the tRTI indicating the total level of support before the EU accession this is plausible because these Länder are relatively smaller. With respect to payments under the APEA 96 schemes designed to stimulate landscape amenities the graph shows that the designers of the programme obviously had some other parameters in mind than the value tourists attach to agricultural landscapes.

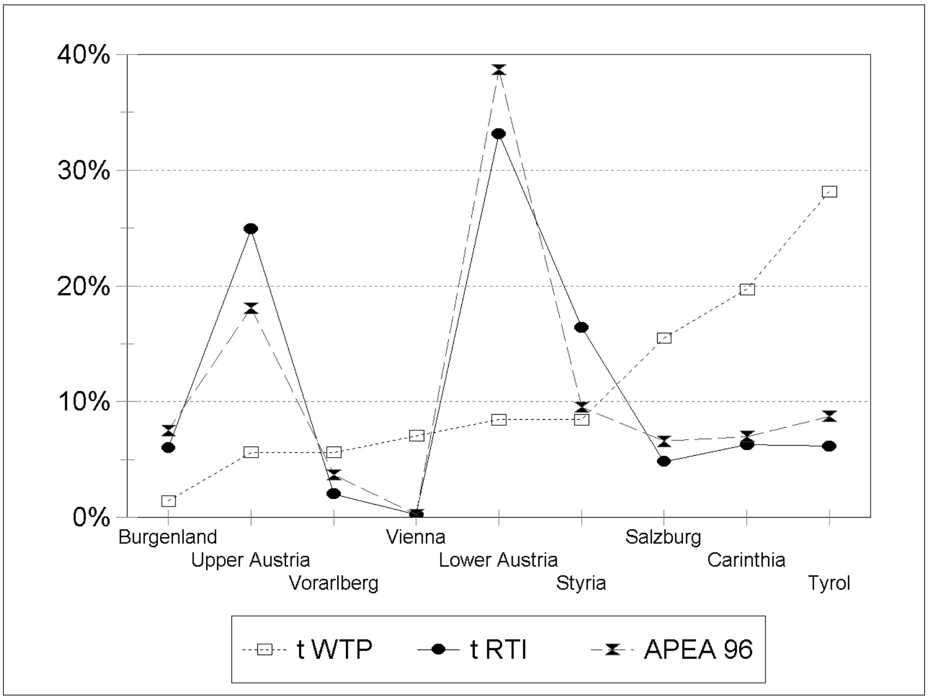

Fig. 3: Regional shares of the aggregates of total willingness to pay (t WTP), regional transfers to the agricultural sector (t RTI) and the payments under the Austrian Programme for Environment and Agriculture (APEA 96)

This very different distribution among the regional aggregates of the willingness to pay and payments under the APEA programme lead HACKL/PRUCKNER (1997) to the conclusion that there is considerable room for policy makers to better link together demand and supply of environmental services. Another interesting aspect is that the payments under the environmental programme in 1996 show the same distribution as the transfers that were made before Austria became an EU-Member State. It rather seems that the environmental programme was designed to perfectly match the pattern of transfers that were made before 1995.

5 Summary and conclusions

External effects can be observed and contribute to the net of social costs and benefits linked with agricultural production. Social costs due to market interventions by governments stimulated the development of measures of protection, however one of their underlying assumptions is that external effects are negligible. Governments in high income countries have responded to externalities by regulating agricultural emission and paying farmers who provide environmental services. Given that protection measures are not accounting for external effects there is a danger that their values cannot be interpreted correctly. This is especially relevant in cases where environmental taxes intended to internalise social costs are deducted from the total value of a protection measure. It is also relevant in cases where governments or local authorities compensate farmers for the provision of public goods in an efficient way. These payments should not be interpreted the same way as transfers to farmers resulting from e.g. tariffs, but as the price for goods not traded on commodity markets.

The Producer Subsidy Equivalent (PSE) is defined as an "indicator that measures the value of the monetary transfers to agricultural producers resulting from agricultural policies in a given year" (OECD, 1996, 227). In this broad definition the PSE does account for external costs or benefits. It would not be useful to change the methodology to overcome this shortcoming because one of the advantages of this indicator – to observe policy changes over time – could be impaired. However, the informational content of the PSE calculation could be improved, if environmental taxes and compensations for the provision of public goods would be accounted for in a separate measure. This may become more important in future when the volume of such transfers/taxes is likely to increase. A necessary precondition is to define guidelines for programmes that in fact compensate producers for providing public goods. Strict guidelines are a precondition to be able to differentiate them from programmes to support farmers out of other reasons.

The empirical sections of the paper focused on social costs associated with agricultural policies. Referring to a partial equilibrium model it was shown that transfer indicators, like the PSE are in relation to the social costs due to external effects of production. Empirically it was shown that transfers to Austrian plant producers are significantly correlated with nitrate content in groundwater (the data base is from the pre-accession period to the EU). Although data did not allow for testing a causal relationships between a measure of regional transfers and environmental damages, the results of this study indicate that the way agricultural policies were designed in Austria still have an influence on the level of groundwater pollution. In addition, there is some evidence supporting the view that nitrate contamination will not be increased if a switch from transfers stimulating production to transfers not linked to output took place.

Referring to positive externalities of Austrian agriculture it was shown that programmes designed to pay farmers for countryside stewardship services do not match the distribution of the aggregate willingness to pay for these services. Modifying existing schemes would allow to better link the supply of landscape amenities with their demand.

APPENDIX

Tab. A1: Estimated parameters of nitrate pollution of groundwater (regression results for regions with more than 400 mm precipitation between October and March)

	model 1		model 2		model 3		model 4	
observations	424		401		432		432	
variables	coeff.	t-value	coeff.	t-value	coeff.	t-value	coeff.	t-value
intercept	27.24	10.46	5.03	3.54	6.21	4.48	12.26	11.69
N-balance	0.06	4.87						
share maize			0.15	3.82				
share grassland			- 0.42	- 6.56				
precipitation	- 0.02	- 4.39	- 0.46	-2.01	- 0.73	- 3.38	- 1.23	- 6.85
redox			- 0.68	- 9.21	-0.63	-8.57	- 0.61	- 7.60
Crop-RTI					0.03	10.22		
Neutral RTI							- 0.70	- 6.75
adjusted R^2	0.12		0.42		0.41		0.34	
SE regression	17.29		0.82		0.82		0.90	

Source: Results for equations 1 and 2 are from HOFREITHER/PARDELLER (1996, table 2) results for the other two equations are own estimates.

Comment: HOFREITHER/PARDELLER (1996) provide a detailed model description and explanations to the variables used. Equation 1 is a linear model, whereas the other equations were formulated in log-linear form.

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