Policy Changes and Modelling Challenges: Insights from PEM Analysis

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Abstract

As agricultural policies continue to evolve away from traditional modes of support towards policies based upon or primarily influencing the market for land, it has become necessary to reconsider the way such policies are reflected in models. We demonstrate how the structure of land supply is constructed in the Policy Evaluation Model (PEM), and illustrate some potential options for representing land or historical entitlement-based programs using this model. Despite some basic similarities, the different choices for policy representation lead to significantly different model results. No policy may be considered to be entirely non-distorting of production decisions.

Introduction

OECD agricultural support policies have experienced a significant change in the two decades, lead by two major agricultural producers: the United States and the European Union. This change is characterised by a moderate reduction in the level of support as expressed by the %PSE from 37% in 1986-88 to 32% in 2001-03 accompanied by a sharper movement away from price support measures to payments that are based on land (Figure 1, OECD, 2004). The contribution of price support to the %PSE has been reduced by 10 percentage points; meanwhile the contribution of payments based on land has increased 3 percentage points. This trend is even clearer in the European Union where the contribution of price support has fallen 15% and the contribution of payments based on land has increased 9% (Figure 2).

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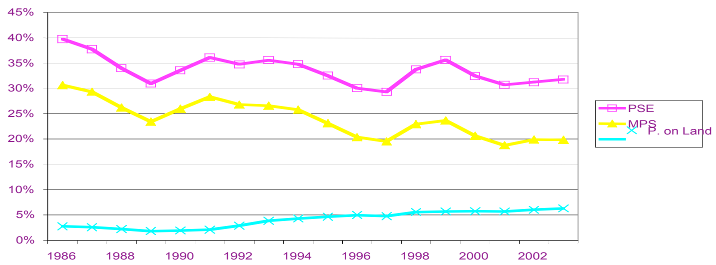

Figure 1. % PSE in OECD countries: Price support and direct payments based on land

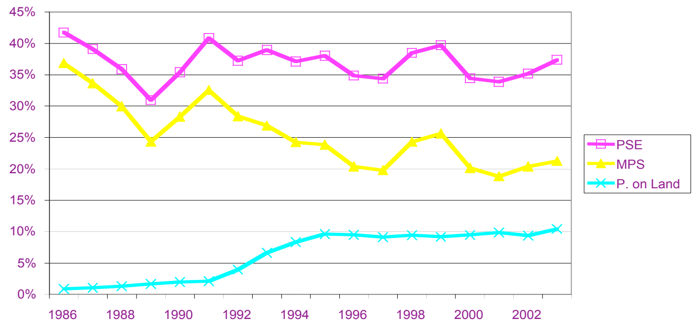

Figure 2. % PSE in the EU: price support and direct payments based on land

The characteristics of these payments based on land differ across countries and over time. The EU started to provide area payments with the 1992 reform. These area payments were intended to be a compensation for reductions on price support for specific commodities. They were, therefore, payments based on land used on current agricultural production of specific commodities. Those payments had also an aggregated base area limit used as a budgetary limit and a compulsory set aside imposed on individual producers intended to control supply.

The AMTA payments provided as part of the FAIR Act of 1996 in the United States were paid per hectare of historical land. These also had some basis on current conditions in the form of land use restrictions: land receiving the payment could not be used for the production of fruits and vegetables and it had to be maintained in "agricultural use". The new payments decided under the 2003 CAP reform in the EU have similar characteristics, but with their own features. The payments are extended to pasture land, with rates that are calculated by dividing historical payments by the number of eligible hectares in the farm, which may generate significant changes and variation of rates per hectare. Cross-compliance conditions are imposed and, in general, the exclusion of fruits, vegetables, potatoes, and non-agricultural uses is maintained (except with regionalisation). Furthermore, the payments will be tradable both with land and without land, though some eligible land will be required to claim payments. The options available to member countries include the possibility of regionalisation, where payment rates are harmonised across farms within the region, generating redistribution of payments across farms.

The 2002 Farm Act maintained the former AMTA payments and included new payments that are based on the same historical area, but with rates that are counter-cyclical with prices. This may change significantly the nature of the response to these payments even if they are paid per hectare of the same historical land (Anton and Le Mouel, 2004). The fact that there was an option for partial updating of land and yields also opens new questions about the response to these payments and the way economists can model them.

In order to model the market effects of this new generation of payments there are several effects than need to be taken into account. We can classify these effects into three categories (OECD, 2001):

- relative price effects that measure the changes in the relative returns from alternative uses of the different inputs and outputs. These changes in market prices include the response to changes in the relative rental prices of land. These prices can be significantly affected by the payments based on land, depending on how such payments are delivered.
- Risk related effects are associated with the reduction of risk associated with specific policies, particularly if they are designed to be countercyclical (insurance effects). However there are also risk related effects associated with the increase in the wealth of the farmer and the corresponding change in his response to risk (wealth effects).
- Dynamic effects associated with pluri-anual decisions. This includes mainly investment decisions that can be affected by payments that may relax credit constraints. Other dynamic effects could be associated with expectations of future payments.

Those three mechanisms represent the different ways by which the payments can affect decision making of farmers. There are also major challenges associated with the impacts of these newer payments on other variables. The old system of support through prices had a clear objective of influencing production and the first incidence of this system was precisely on the incentive to produce. However, the more decoupled payments have often other objectives and impacts that may not be well defined. These include the distributional effects of payments that are based on land, something that is mainly owned by farmers as compared to suppliers of other factors used in agricultural production. Environmental effects and impacts on local labour markets and rural development are important parts of the picture.

This is an enormous task that can not be accomplished in the short run. It requires a long run research agenda that tries to respond to these challenges. The purpose of the present paper is to explore some of the first issues that are encountered in this long road of research. They are issues just related with the modelling of the relative price effects of payments based on land. For the new generation of payments based on land, and the new generation of questions posed to agricultural policies, land modelling is crucial. This depends in large part on improvements in data and analysis related to land markets, and much more remains to be done to improve our knowledge of this important topic.

We can organize the issues on relative price effects into three main challenges:

1. Modelling land supply
2. Representing new more decoupled policies
3. Measuring impacts on welfare and other variables other than production.

We intend to show that different representations of certain program details can have a substantial impact on results. We do so using the Policy Evaluation Model (PEM) developed by the OECD. This model has an explicit representation of land markets with recognition of the heterogeneous nature of land. This relatively simple tool proves to be powerful in showing the implications of different assumptions made about the way these payments work.

1. First Challenge: Modelling the supply of farm owned factors and their linkages with production

The Policy Evaluation Model (PEM) provides a stylized representation of production, consumption, and trade of milk, beef, and major cereal and oilseeds crops in six OECD countries: Canada, the European Union[1], Japan, Mexico, Switzerland, and the United States. The PEM allows for a stylised version of existing and hypothetical policies in the participant countries. The purpose of the PEM is to provide a closer connection between measurement of support as done using the PSE and quantitative analysis of the impacts and distribution of such support. In constructing the PEM, three main sets of assumptions were required: 1) those relating to the basic structure of supply and demand response, 2) those relating to the underlying data and the elasticities, and 3) those relating to the primary incidence of support measures on prices and quantities. Economic theory and results of previous studies guided analysts' choices about the structure of the model, the data and economic parameters to use. The classification of support measures in the PSE guided choices about their primary incidence.

The starting point for analysis of policy effects for the PEM is the Producer Support Estimate (PSE). There are eight main categories in the PSE, one for market price support and seven for different kinds of budgetary payments, distinguished by implementation criteria. The PSE data conveys two kinds of information necessary for PEM analyses. First, the PSE indicates the level of, and changes over time in the level of, monetary transfers from consumers and taxpayers to farmers resulting from agricultural policies. Second, support estimates are

[1] The European Union is treated in the model as a single region.

classified according to the way the associated policy measure is implemented thereby highlighting the 'initial incidence' of the support measure for analytical purposes. Each of the main kinds of support defined in this classification appears in the model with a specific differentiated "initial incidence" on producer and consumer incentive prices.

The country 'modules' of the PEM were all developed according to a common structure. Policy experiments were carried out using a model linking these individual modules through world price and trade effects. Commodity supply is represented through a system of factor demand and factor supply equations. Excepting the rest of world module, there are equations representing demand and supply response and prices for at least four categories of inputs used to produce these crops in the study countries. The factor demand equations reflect the usual assumptions of profit maximisation constrained by the production relationship. Supply response corresponding to a medium term adjustment horizon of three to five years is reflected in the values assumed for the price elasticities of factor supplies and the parameters measuring the substitutability of factors in production as well as the factor shares.

No factor is assumed to be completely fixed in production, but land and the other farm-owned factors (mainly human capital) are assumed to be relatively more fixed (have lower price elasticities of supply) than the purchased factors. Likewise, no factor is assumed freely mobile, but purchased inputs are assumed relatively more mobile (a higher elasticity of supply) than the farm-owned factors. Most supply parameters needed for the model come from systematic reviews of the empirical literature by external consultants (see D. Abler 2000 and K. Salhofer 2000). Both reviews were commissioned by the Secretariat to obtain objectively plausible values of the parameters (and ranges of them) for carrying out sensitivity analysis[2].

Each of the country modules has two farm-owned factors: land and a residual "other farm owned factors". The set of purchased factors covered in each country includes, at the least, fertiliser and a residual "other purchased factors".

In the PEM, land is assumed heterogeneous, but transformable between one use and another. The farmer acts to maximize profits by allocating land across its possible uses (wheat, coarse grains, oilseeds, rice, other arable uses, milk or beef pasture, other agricultural uses) according to a transformation function.

The land transformation function is assumed separable for different categories of use such that the land allocation problem facing the farmer is solved in successive stages. First, the producer chooses to allocate land to rice, other agricultural uses, or to a group of uses including all other arable and pasture uses. This group is then allocated in the second stage between pasture, cereals and oilseeds, and other arable uses. Finally, the cereals and oilseeds group is allocated between wheat, coarse grains, and oilseeds and pasture is allocated to either beef or milk use (Figure 3).

[2] Although the own and cross-price elasticities of *crop* supply are not explicit parameters in the PEM crop models, their values can be calculated from knowledge of the elasticities of factor supply, factor substitution and factor shares.

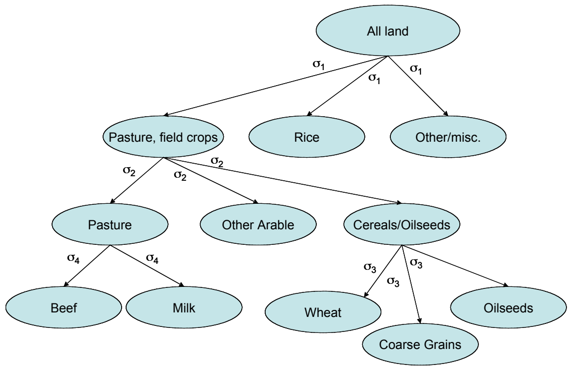

Figure 3. Land supply structure

At each of these stages a constant elasticity of transformation (CET) function is used to describe how uses may be allocated. That is, at each level in this decision-making process the transformability of land is the same, but this rate differs between levels. The parameter of the CET function, σ, determines the mobility of land between uses at each stage. As we move downward through this land allocation framework, land becomes more similar in use and therefore more easily fungible between uses. We expect [σ_3, σ_4]> $\sigma_2 > \sigma_1$ in general. We term this a **nested CET framework**, and refer the land groupings in each stage as **nests**, the top being nest 1 and the lowest nests 3 and 4.

Commodity demand equations in the PEM models relate domestic consumption of outputs to prices (at the farm level). Co-movement of prices may occur even when policy measures are targeted directly to only one or two commodities because wheat, coarse grain, oilseeds and rice may be substitutes in *both* production *and* consumption[3]. Moreover, depending on the degree to which crops are substitutes in demand, co-movement in their prices may lead to small 'net' changes in quantity demanded for any one crop and thus in their total. That is, the total demand for crops may be highly price inelastic.

The PEM does not represent in a fully comprehensive manner the specifics of support programs applying to each individual commodity in each one of the participant countries. Rather, the aim is to represent the 'incidence' of support measures in the same way that 'incidence' is implied by the classification of support measures for the PSEs.[4] In this system, support measures are classified according to the main or primary condition that producers must meet in order to be eligible for the support. Usually, knowledge of the conditions of eligibility of a particular support measure, as revealed by its classification in the PSE, will be enough to infer its "initial incidence".

In order to undertake policy simulation experiments the model must be calibrated for a specific base year using the data in the PSE database. This calibration includes all quantities

[3] Cross-elasticities of demand are assumed to exist between the crop commodities, but not between milk and beef or between these livestock commodities and crops. This assumption is driven primarily by data availability.
[4] See OECD (2003) for a definition of all categories of support in the PSEs.

produced, consumed and exported in each country and each commodity of the model, the set of world and domestic prices and the amounts of the different kinds of support creating price wedges. Land quantities are taken from FAO data and other inputs quantities are defined using quantity or constant price volume indexes. Input prices are derived then from cost shares and factor quantities.

It is useful to consider the case of one country, one output and two inputs to illustrate how the different categories of support are represented[5]. The two inputs are the aggregates: 'farm owned' and 'purchased' (Figure 4). The upper panel of the Figure shows *commodity* supply and demand curves and the lower two panels show supply and demand curves for the two aggregated factors of production.

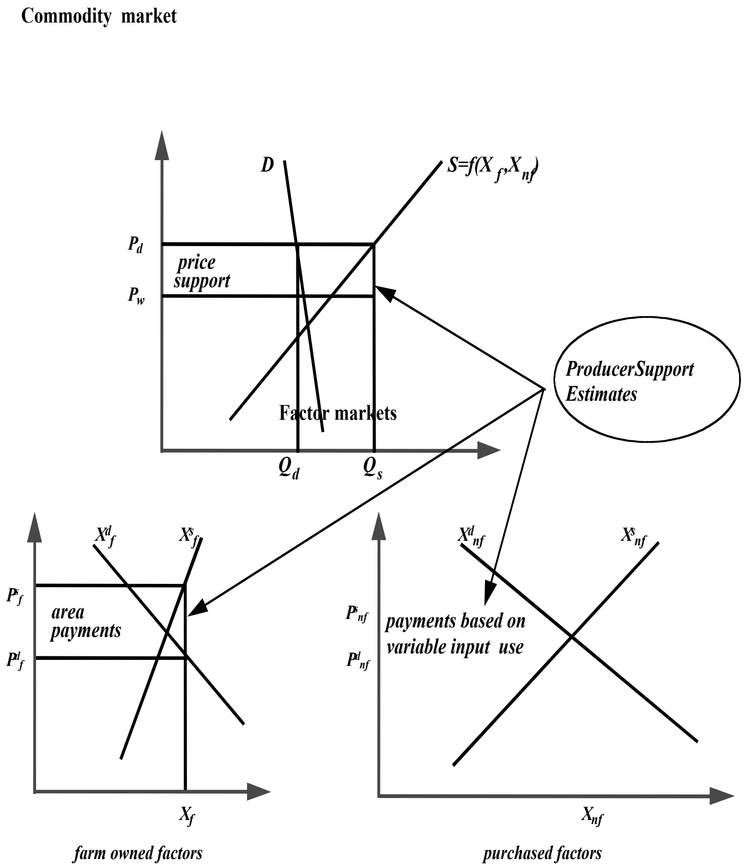

Figure 4. PEM structure

[5] In Gardner (1987), Hertel (1989), and Gunther, Jeong, and White (1996) there are some useful formulas derived from algebraic manipulations of models similar to the full PEM crop model, but containing generally fewer country, commodity, input and policy combinations.

Figure 4 shows how price wedges corresponding to unit market price support, area payments and subsidies to purchased inputs (reduction in input costs) are represented in the PEM. The market price support wedge separates prices paid by domestic consumers to domestic producers, P_d, from the corresponding price on world markets, P_w. Similarly, area payments are modelled as wedges between the price a farmer earns from using his land and other owned factors in crop production, $P^s_{f,}$ and the return, $P^d_{f,}$ those factors would earn in some alternative use. Finally, subsidies to purchased inputs are assumed to create a wedge between the price suppliers receive, $P^s_{nf,}$ and the price farmers pay for them, P^d_{nf}. Purchased input markets in the PEM crop model are not commodity specific[6]. That means any purchased inputs price wedge that is applied is the same across all commodities.

The main modelling issue related with area based payments is the modelling of the structure of land supply. For broader payments applied also to other farm owned inputs, modelling the supply of these factors would also be important. The PEM model as decribed in this section is able to recognize the heterogeneity of land and it allows for differentiated adjustments in the demand and supply side of the land market. However we are aware of the limitations of our approach that are mainly driven by the lack of empirical knowledge about how the land market operates at the micro and at the aggregate level. In fact the heterogeneity of land is likely to be better represented by a continuum rather than by a close set of land types that are imperfectly substitutable. Furthermore, land is often rotated for agronomic reasons, and not only agronomic conditions determine the degree of substitution of land but also institutional factors and market conditions can affect this substitutability. Our PEM model summarizes all this information in a substitution parameter in the CET function. At the micro farm level it can be easier to identify the constraints in the use of land and, therefore, land response. But at the aggregate level the net response of land supply and the substitutability among different uses is much more difficult to infer, estimate and model. Advancing in the modelling of land supply at the aggregate level needs further empirical work.

2. Second challenge: Representing more decoupled policies

Modelling more decoupled payments raises the issue of identifying the economic factors that are influenced by theses payments. This is crucial in representing the incentives created by the payments and to study the welfare impacts of different programmes. In this section we develop some alternatives for representing more decoupled payments and discuss some of their implications.

Support that is not specific to the production of a particular commodity or the use of a specific input is of main interest in this paper. The main category of the PSE related to this type of support is payments based on historical entitlements, though not all such policies need involve historical parameters. The PEM has some advantages in representing policies based on

[6] Though some, like concentrated feed, are specific to groups of commodities, in this case those that are livestock-based.

land or having their effect primarily in the market for land, as it is able to characterise these via a pattern of price wedges modifying the returns to land for several major commodities and to model both supply and demand response in the land market. The challenge, of course, is to determine what is the proper level and distribution of such wedges for a given program. This challenge turns on two main questions. What markets are affected by the policy? Does the policy distort relative prices in these markets?

What will be the impact of policies affecting land? The most important consideration from the perspective of the model is the change in relative land prices induced by the policy, both in terms of within included commodities, and between commodities included in or excluded from the policy. The ability of a producer to shift land from one form of commodity production to another raises the potential for changes in relative returns to each land use induced by policy to be reflected in significant changes in the commodity mix. Policies that affect the relative returns to different land uses will influence production, with the number of relative price pairings and degree of price change determinant of the degree of distortion introduced by the policy.

To create a scenario with no relative price effects between land used for commodities included in the scope of the policy, prices in all affected markets are increased by an equal percentage of their initial value, which uniformly inflates prices within the group of affected markets. Of course, relative prices will change between affected and unaffected markets as a result (between land and fertilizer, say). This scenario design is to reflect the way programs affect incentives and does not presume a program with such an explicit mechanism regarding prices. The intent is to reflect a program that would not normally provide any incentives for producers to switch production between commodities included in the program.

A set of eight policy simulations were run using the PEM model covering a range of options for these relative price effects[7]. These scenarios can be divided into two broad categories: those that alter relative land prices of included commodities (in their initial incidence) and those that do not, and with each category of policy affecting a wider and wider group of commodities. For most, it is assumed that the land market is where the initial incidence of the policy has its effect, but there is also a scenario assuming that *all* factors of production owned by the farmer are equally affected.

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[7] The EU is used as the example region for all scenarios. Baseline is 2002. Results are shown relative to each other, as absolute changes are very small for such a small shock. The largest percentage chenge, for wheat in scenario 1, amounts to 0.07%.

Table 1. Scenario descriptions

Scenario number	*Commodity*	*Description*
1	Wheat only	Simulation representing a payment made to land used for wheat production only. This corresponds to a commodity-specific area payment such as were introduced in the EU under the McSharry reforms of 1992. The scenario increases returns to wheat land by $100 million.
2	Cereals and oilseeds	Simulation representing a payment related to major cereals and oilseeds, such that the relative price of land does not change between these commodities. That is, the shock in each land market are an equal percentage of the initial land supply price in each market. This would be an example of a policy providing payments to producers of these commodities in a manner unrelated to current production (based on historical parameters, perhaps).
3	Cereals and oilseeds	As scenario 2, but payments are made as a fixed amount per hectare of eligible land. That is, the shock in each land market have the same absolute level. This corresponds to a non-commodity specific area payment.
4	All arable	As scenario 2, but applies to all arable uses of land (except animal feed). A more broadly-based program.
5	All arable	As scenario 3 but applies to all arable uses of land (except animalfeed). A more broadly-based program.
6	All commodities	As scenario 2, but applies to all land, excluding fruit and vegetables.
7	All commodities	As scenario 3 but applies to all land, excluding fruit and vegetables. A more broadly-based program.
8	All commodities +	Simulation representing a policy resulting in a general increase farm income. Prices for all farm-owned factors of production (land and "other farm-owned" are increased by an equal percentage of their initial price. This corresponds to a general income policy such as income tax concessions or income top-ups.

Figure 5 shows the result of each scenario with respect to percentage changes in production. Each scenario is designated with a number as given in Table 1. Thus, the lowest set of bars reflect the result of scenario 1, a policy affecting wheat land only, and moving upward through the eight different scenario options. The results are shown as the relative percentage change in production for each commodity category included in the model, arranged and colour-coded according to the legend. Bars to the left of the centre axis indicate a reduction in production, bars to the right an increase. Milk production quantity is governed by a binding production quota in the EU, so in no scenario are there any production movements for milk. In all scenarios the absolute changes in production are very small, as these are small shocks using, in each case, relatively highly decoupled policies[8].

[8] Relative to other classes of polices, such as market price support, for example.

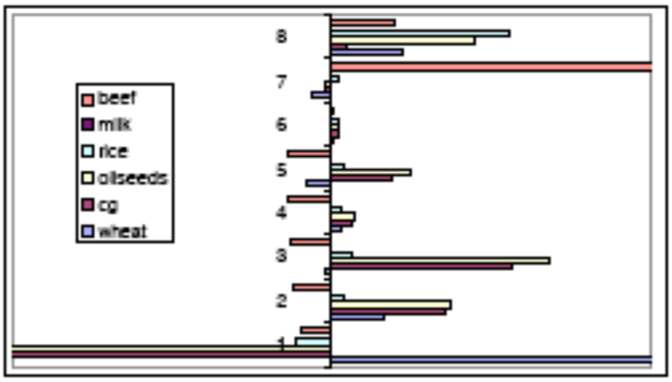

Figure 5. Percentage change in production by commodity

2.1. Relative Effect of Policies with Different Commodity coverage

The extent to which these market effects are distributed across commodities, that is, what defines the set of included commodities, is the allowable uses of land receiving payment. A policy excluding certain activities (fruit and vegetables are common examples) affects relative returns between excluded and included groups, and will be reflected in the presence or absence of price wedges in the model. This would include a policy that made payments to land based on historical production different from this allowable set. For example, a payment based on historical wheat land that allowed that land to produce any commodity except fruit and vegetables would not affect relative land prices except between fruit and vegetable land and all other land types. That is because the user of that land could switch to beef production (say) without losing the payment, thus relative prices between these commodities remain unchanged. Were the landowner to switch to vegetables (or perhaps nonagricultural use), the payment would be lost. Scenarios considered in this paper cover policies affecting a single crop, major cereals and oilseeds, all arable land, and all arable and all pasture land (the last excluding only fruits and vegetables).

The simulation results indicate that, generally speaking, broader-based payments are less distorting than narrowly focussed ones. While important, this is not a new result. The net elasticity of the included land categories as a whole determines the net response and is behind this result. As more land categories are included within the ambit of a policy, this net elasticity grows smaller and smaller, as the own- and cross-price elasticities of included land uses cancel each other out.

Payments are made to land under an historical base raise another issue that is difficult to handle in a model. That is, land that was historically used for specific commodities is entitled to the payments, but other land producing these same commodities but not inside the historical basis (these commodities were not produced in that land in the historical base period) will not receive the payment. In that case, the history of agricultural policies is very relevant in order to provide an understanding of the impacts of the land based payments.

Assume that new land-based payments are introduced in a country with no previous support to agriculture. In that case, if the new land payments are restricted to historical land producing a set of programme commodities that did not receive any support in the historical base period, the payment very likely has a binding land quantitative constraint. More land is willing to enter into the production of the programme commodities to get the payment, but this new land will not receive the payment since is not in the base, and therefore the quantitative constraint would avoid any production impact.

Let us assume now that the new land payment substitutes for other forms of support for the same commodities, notably price support. The new payment will create the incentive to keep land in the production of the programme commodities – an effect which could of course be moderated if idling of land were required or permitted. However new land could not come in if there is a historical base land entitled for the payments. Additional area payments may have no impact on land and production. But, eliminating these land based payments may have a negative impact on land used for the programme commodities. This creates an asymmetry in the response to land payments that may be difficult to capture at the aggregate level: additional area payments do not increase production, but reducing area payments reduce the land allocated to eligible commodities. The cross effects associated with these asymmetries are particularly difficult to tackle.

2.2. Relative Effect of Policies with Different Commodity rates

The EU single farm payment establishes a new payment per hectare that is the average payment per hectare in each farm, taking into account all direct payments received in the past. This means that the rate per hectare of an specific piece of land can be significantly altered by the SFP even if the total amount of payments received by each farm are not modified. This means that, initially, each farmer will receive a constant rate per hectare in his whole farm, even if the rate per hectare can significantly differ across farms in the same region and/or across regions. The option for regionalisation can eliminate the possibility of different per hectare rates in the same region, even if rates across regions can still be different. In the case of the direct payments in the United States the rates per hectare are calculated with historical commodity specific rates and historical yields. Rates per hectare can also differ across different pieces of land. This is the typical situation and one could expect that this will create cross effects in the use of land for different commodities. Furthermore, more decoupled payments are likely to have their main impact in the cross effects among eligible commodities and an effort needs to be made to improve our representation of these cross effects.

In the PEM, competitive markets assure that economic profits are zero. All producer returns come in the form of the producer surplus accruing to those inputs owned by the farmer. The model also operates over the medium term, during which it is possible for the value of support affecting total returns from farming to become capitalized in the value of these fixed factors of production. That is, to a certain extent, the value of more decoupled support ultimately must be reflected in the producer surplus to farm-owned inputs. Of these, land, the most fixed in supply, is the factor whose value will most likely be augmented by support. This assumption justifies the existence of market effects of policies, even if they are based primarily on historical characteristics.

Payments per hectare, will always be at least partially capitalized in land values. The degree of this capitalisation depends on two things. First the net response of land supply: higher response means lower demand prices (lower returns from farming) and less capitalisation. Second, the linkage between the rental rates of land and the value of land assets, which depends on how the market of land operates and market imperfections in general. The PEM model is able to give an answer to the first of these elements. it is also possible that payments based on broader returns from farming could be capitalised in other factors owned by farmers.

Some policies affecting land markets will induce relative distortions between them (within the range of included commodities) and others will not. This mainly has to do with whether the policy is 11 of a wholly historical nature, or whether there are some conditions of the policy that would distort production choices between commodities. A policy paying a fixed amount per hectare of land irrespective of its use will still induce relative price distortions, as the initial price of land used for different commodities may be different, such that proportional changes induced by this fixed payment will also be different.

The scenario results show that programs that conserve relative prices (such as historical entitlements) are significantly less distorting than fixed payments per hectare. Compare especially scenarios 6 and 7, where payments are broadly based. Scenario 6, which conserves relative prices, promotes much less total production distortion as well as much more even changes in production compared with scenario 7, which provides the same amount but as a fixed payment per hectare. The low price of beef pasture land means the payment represents a much more significant price increase in percentage terms than is the case for other land uses.

However, when, as is the case for scenario 8, if the effect of the policy is to raise returns to farmowned factors more generally, rather than land alone, the result is more production distortion rather than less. An example of such a policy would be income tax concessions, which raise factor returns in a very general sense. The reason for this is that other farm owned factors besides land are assumed to be specialized in the production of a particular commodity, and are therefore not substitutable. As a result, the effect of diminishing net elasticity does not occur in the markets for these factors of production, and the total supply response is correspondingly higher. The result is a higher degree of production distortion even though the total payment to all factors is the same, which means a smaller increase in land prices when compared with scenario 6, which represents proportionate payments to land alone. This also implies that without the system of cross-substitutability of land in the model, the results would look quite different.

2.3 Other issues

We have analysed the implications of different modelling decisions on the representation of more decoupled payments, namely the impact of the commodity coverage and the payments rates. However, as modeller, we have to acknowledge other elements associated to agricultural programmes that definitely affect the supply response, the commodity cross effects of payments and the welfare implications. The two main issues that deserve further attention in modelling are set aside and cross compliance. Many programmes permit idling the land that is entitled for the payment and/or impose some minimum set aside of land. Set aside land may need to be considered as an additional type of land with some substitutability with other uses of land, but other modelling alternatives should also be investigated. The payments typically require some conditions on what can or have to be done with the eligible land. These conditions include forbidding uses of land, as we have already discussed. But there are often other conditions associated with the entitled land on "maintaining land in good agricultural conditions", or respecting "good farming practices", or following some environmental restrictions. Those are usually called cross compliance conditions and they can influence farming practices and costs of productions of different commodities and therefore, production and welfare patterns.

3. Third challenge: Measuring impacts on welfare and other variables

Achieving a certain level of agricultural production is no longer a major objective for agricultural policy makers in most OECD countries. This has been replaced in many cases by the objective of transferring income to farmers, and we consequently explore in this section the welfare impacts of the different programmes that have been defined in section 2. Beyond this, it should be kept in mind that there can be other objectives associated with the payments, even if some are poorly defined. These objectives include generating landscape amenity, environment and rural development, according to the concept of the "multifunctional" nature of agriculture. Where these objectives are clearly associated with decoupled policies such as are investigated here, modellers (ourselves included) will be under some obligation to shed some light on the success of these policies at meeting their objectives. Such new objectives extend the required modelling domain away from traditional production, prices, and trade into more difficult area of environmental and other non-market effects. As this is outside the current capabilities of the PEM, we are forced to limit the following discussion to the welfare gains for producers and their distribution.

Welfare. This dispersion of results for production effects shown earlier in Figure 5 is the more interesting for the fact that, broadly speaking, the types of programs that may be represented by such scenarios appear to be and often are considered quite similar. Moreover, the scenarios all involve the same level of total program payment, and all provide roughly similar changes in farm household income (Figure 6). The change in farm household income, with the exception of payments made to a single commodity (scenario 1; wheat land only), also shows all these program options to be similarly (and highly) transfer efficient.

Farm household income in the PEM is defined as the producer surplus accruing to farm-owned factors of production. The two farm inputs considered owned by the farm household are the "other farm owned factors" also termed farm capital, even though it consists predominantly of the farmers' human capital, and land. The latter is a simplifying assumption, as certainly some portion of agricultural land is owned by non-producers. To the extent that agricultural land is owned by nonfarmers, some of the benefits of land-based payments will not go to farmers, and the income transfer shown in Figure 4 will overstate the actual amount. This is not the same as rental agreements between producers, which involves land owned by a producer, just not the same producer as operates the land.

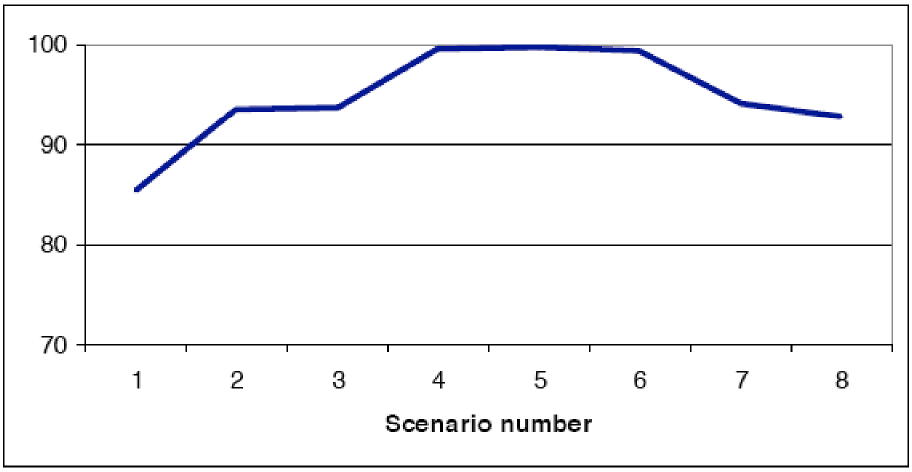

Figure 6. Change in total farm household income

While all policies simulated in scenarios 1 through 8 are efficient at turning support into welfare gains for the farm household, the distribution of these welfare gains are substantially different between them, following essentially the pattern of payment distribution (Figure 7). This distribution of welfare accrues to the holders of eligible land at the time of payment introduction and is unlikely to be transferred. While it is possible to transfer the right to the payment, through land sales for example, the fact that most of the value of the payment becomes capitalized in the land value forces the purchaser to compensate the seller for its value. The purchaser obtains along with the land the net present value of the stream of payments, and the seller essentially trades that stream for its current value in the land price. This is true as well in the case that the land is rented with eligibility for payment attached. This is evident from the results from the model in the increased rental rate (price) of land; the supply price for land for commodity production has increased because of the payment, guaranteeing the supplier of the land their value.

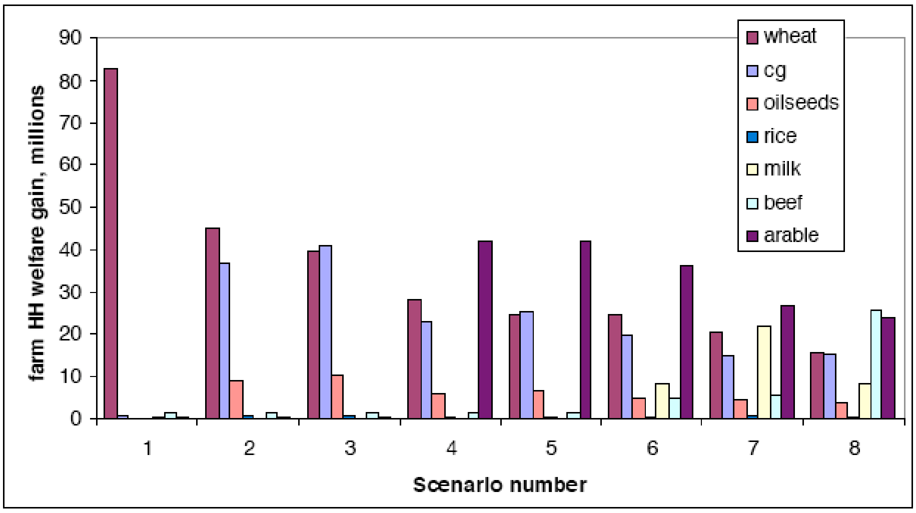

Figure 7. Distribution of welfare gains

This brings into question the conception of transfer efficiency as we normally use it. When the beneficiaries of the payment leave the sector (through retirement perhaps), they take their benefit along with them, at which point the benefits belong to non-farmers. The new recipients of the payments only a portion benefit from them as they have paid for the value of the program in advance. However, they do have much to lose if the payments were ever eliminated. This has the potential to "lock-in" policies by making the value of some farm assets contingent on the existence of the payments and thereby increasing the political difficulty in eliminating them.

The policy based on farm income, as defined by scenario 8, would not suffer from the problem of beneficiaries leaving the sector, as one has to earn farm income as a requirement. This potentially raises is longer-term transfer efficiency relative to other options. This policy also provides the most even distribution of gains across different commodities of the eight scenarios considered.

Notice in this connection that depending on the pattern of land ownership versus rental, it could well turn out that, contrary to the usual result, a direct subsidy to farm income could be both more distorting ***and*** more income transfer efficient than an area payment. The result hinges on the degree to which the benefits of area payments accrue to the current farm operator. If a large share of such benefits has been extracted either through rental or sale of land subsequent to introduction of the program then the farm operator of the moment may get little net benefit from the area payment. An income subsidy on the other hand will continue to provide some net benefit even after capitalization processes have run their course.

4. Summary and Discussion

The changing composition of farm support – generally away from measures that boost the prices farmers receive for their output and towards payments linked more directly to land and other factors they own, poses some interesting challenges for policy modellers. Broadly speaking this evolution has led to a package of support measures that is both less trade distorting and more income transfer efficient. However, important questions remain about just how much less trade distorting and how much more income transfer efficient (and for whom).

The analysis reported here shows that the magnitude and incidence of the production effects of different kinds of factor payments depend critically on the extent of coverage of commodities and factors and upon the basis for payment. These estimated differences appeared even though all the various types of factor payments examined resulted in the same budgetary expenditure and there were only small differences in the income benefits they delivered to farmers.

The model used here assumes that land, while not perfectly substitutable among different agricultural uses can be shifted amongst them in response to changes in relative returns. It comes as no surprise then to learn that area payments are less distorting the greater is the number of crop and livestock activities that policy-makers put on their list of eligible agricultural uses. More surprising is the fact that distortions may still exist even with quite a wide coverage – depending on the basis for making payments. There are two linked reasons for this. First, land is heterogeneous, and different agricultural activities use land more or less intensively. Second, the value of land in alternative uses is not fixed but varies with market conditions. These two factors combine to make it difficult to the point of impossible to design a payment package that spreads the payments in a non-distorting, uniform manner across different activities. The upshot is that it seems there will always be some agricultural activity whose use is favoured relative to the others leading to some re-arrangement of the production mix.

Agricultural support is frequently justified as a means of improving the income position of farmers. It might seem therefore that the best and least distorting way of doing this would be to target farm income directly. Such a subsidy may be viewed as one whose benefits are spread across all factors: land, human capital, fixed land and buildings etc, directly owned by the farm household.

The somewhat surprising estimated result obtained in the simulation analysis reported here is that a payment spread across both land and other farm owned factors exhibits a greater degree of production distortion than does a land only payment. As already noted, this result obtains even though, in this application, the budget implications and the income effects of the two alternatives are similar. The explanation rests, as always, on the elasticity assumptions. The key ones here are the elasticities of supply and substitution for land and the non-land bundle. The combination in the present application yields a 'net' elasticity of supply of land, which is significantly less than that applying to the non-land factor.

This robustness of this result, resting as it does on the relative elasticities of two different factors of production, is dependant on the quality of the data underpinning the model. It requires not only good data for land responsiveness, but also for the response of the farmer's own supply of human capital, which is often treated as a residual and can be very difficult to define and measure. Determining the relative impacts of policies of the type investigated here calls for renewed efforts in our empirical understanding of farm production. Even such basic details, such as what proportion of land is owned by non-farmers, remain poorly understood.

References

Abler D. (2000): *Elasticities of Substitution and factor supply in Canadian, Mexican, and US agriculture*, Consultant Report to the OECD.

Antón J. and Lemouel C. (2004): "Do counter-cyclical payments in the FSRI Act create incentives to produce?", *Agricultural Economics*, 31/2-3: 277-284.

Gardner B.L. (1987): *The Economics of Agricultural Policies*, McGraw-Hill, New York.

Gunter L.F., Jeong K.H. and White F. (1996): "Multiple Policy Goals in a trade Model with Explicit Factor Markets", *American Journal of Agricultural Economics*, 78: 313-330.

Hertel T.W. (1989): "Negotiating Reductions in Agricultural Support: Implications of Technology and Factor Mobility", *American Journal of Agricultural Economics*, 71: 343-363.

OECD (2001): *Decoupling: A conceptual Overview*, OECD Paris.

OECD (2003): *Agricultural Policies in OECD Countries: Monitoring and Evaluation 2003*, OECD Paris.

OECD (2004): *OECD Agricultural Policies 2004: At a glance*, OECD Paris.

Salhofer K. (2000): *Elasticities of Substitution and Factor Supply Elasticities in European Agriculture: a review of past studies*, Consultant report for the OECD.