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THE INCIDENCE AND INCOME TRANSFER EFFICIENCY OF FARM SUPPORT MEASURES

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Foreword

Governments in OECD countries intervene in agriculture with a view to achieving a wide range of economic and social objectives, in particular the improvement of farm household incomes. This study investigates how efficient some of the most commonly used policy interventions — referred to as the transfer efficiency of support measures with respect to income — are in achieving this objective.

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Executive summary

Governments in OECD countries intervene in agriculture with a view to achieving a wide range of economic and social objectives. One of the most cited reasons for intervention is to improve the income position of farm households. Although largely a legacy of concern with the economic plight of farm families in earlier times, the belief that government intervention is needed to ensure adequate income levels for farm families is wide-spread. This paper investigates how efficient some of the most commonly used policy interventions are in increasing the income of farm households. This concept is referred to as the transfer efficiency of support measures with respect to income.

Broadly speaking, governments help farmers earn more income than the market would otherwise provide them by either *a)* imposing tariffs/granting export subsidies that drive up the prices consumers pay producers in the domestic market or *b)* supplementing market receipts with payments drawn directly from budgetary funds. With perfect transfer efficiency (which exists only in theory) every dollar of the extra money consumers pay through higher prices and every dollar of the extra money taxpayers pay to fund direct payments would find its way directly into the income of the intended beneficiaries, *i.e.* farm households.

In reality, however, the greater share of that money ends up in the pockets of others. Farmers can capture only that part of the support that remunerates the factors of production they themselves own. This is typically a rather small share of the total consisting mainly of their land and family labour. Farmers buy most farm inputs from outside the farm and, as a result, input suppliers capture some, usually significant, share of the benefits of support. Similarly, if farmers rent rather than own the land, some of the benefits of support will accrue to the landowners. Moreover, a significant proportion of what consumers and taxpayers pay to support farmers disappears in dead weight losses, the resource allocation distortions caused by the support.

The estimates of transfer efficiency reported here suggest that across the OECD area transfer efficiency is rather low. For the most commonly used measure — market price support — perhaps only 25% translates directly into a net income gain for the farm households producing the supported commodity. Even for the best performing of the agricultural support measures studied here— area payments — less than half of the original payment translates into net farm income.

Another phenomenon — the capitalisation of support into land values — means that income benefits accruing to those actually farming the land will be transitory. Land valued at prices inflated by farm support is eventually either sold or rented out. If it is sold, it will be at a ‘higher-than-otherwise’ selling price; if it is rented, the renter will pay a higher-than-otherwise rental rate. These ‘higher-than-otherwise’ selling prices or rental rates allow the sellers and landlords to capture the full economic benefits of support. However, those buying or renting that land to enter the sector or to expand will not reap any net

economic benefit from the support because the prices they have to pay reflect the expected value of the support. In fact, this "second generation" of farm households inherits higher capital (or operating) costs and reduced farm profitability.

This paper confirms results from earlier work that there is a strong inverse correlation between the extent to which a measure distorts production and trade, and its efficiency in transferring income benefits to those who farm. It also shows that even the best performing measures are relatively ineffective in income transfer efficiency terms and allow a large share of the support to go to unintended recipients.

The great bulk of support to agriculture in the OECD area is still delivered through mechanisms that distort production and trade and are inefficient in generating increased net income for farmers. It is in fact difficult to envisage any specifically agricultural measure that could achieve farm income support and protection on a continuing basis without engendering significant waste and distortion. Many measures are also inequitable as they are based on output or land with the largest farms receiving the great bulk, a group that the data suggest does not need income support.

In the light of this conclusion the best potential to resolve income problems among people who farm may be offered by measures that focus on the income needs of the individual or the family rather than on occupation, *i.e.* support measures that are not specifically agricultural at all. A first step would be to identify those farms and families actually in need of income support.

Introduction

The PSE indicates the gross value of monetary transfers from consumers and taxpayers to farmers resulting from agricultural policies. The PSE can be interpreted as the additional money farmers receive in a particular year because governments intervene in agriculture. How much of this extra money should be counted as net economic benefit for the intended beneficiaries? How much of it ends up in the pockets of unintended beneficiaries and how much of it is wasted?

The answers depend on who are designated as the 'intended' beneficiaries and on how the associated agricultural policy works. Supporting and protecting the incomes of farm households remains a dominant goal of agricultural policy-makers in many OECD countries, despite the lack of any strong evidence that farm households have systematically lower incomes than other types of household (OECD, 2002). Consumers and taxpayers pay the costs. If farm household incomes went up by one dollar for each one-dollar increase in the combined consumer and taxpayer costs of supporting farmers, the "transfer efficiency" would be 100%. However, the characteristics of a policy and the market conditions necessary to achieve 100% transfer efficiency of farm support bear no resemblance to the real world. In the real world there are transfer efficiency losses because *a)* all the different ways governments use to support farmers involve distortions to relative prices and the accompanying inefficiencies in resource use and *b)* some of the economic benefits of farm support go to people who do not farm.

Policy interest in transfer efficiency arises not just out of a desire to improve policy targeting and reduce waste but also because of a close, inverse relationship between the trade effects and the transfer efficiency of farm support. Farm support measures with the highest degree of transfer efficiency generate the smallest trade effects, while the most trade distorting farm support measures provide little income benefit for farm households per dollar of taxpayer and consumer costs. [Dewbre, Anton and Thompson; OECD (2001*a*); Schmitz and Vercammen]

Transfer efficiency has featured frequently in past Programmes of Work of the OECD Committee for Agriculture (OECD, 1995 and OECD, 1996). Some of this work focused on *quantifying* transfer efficiency in order to estimate what percentage of consumer and taxpayer costs of farm support could be counted as income gain for farm households. It showed that output related support is an inefficient way of improving the income position of farm households. This paper extends the scope of quantitative analysis of transfer efficiency in two ways. First, in addition to output-related support, the coverage of support measures is extended to include support provided to individual factors of production. Second, there is a distinction made between that part of extra farm household income due to farm support in the form of higher returns to land and that part due to higher returns to farm household labour.

Some general considerations in analysing the benefits and costs of farm support

Benefits

The broad aim of estimating and comparing the transfer efficiency of different ways governments support farmers is to identify policy alternatives that could achieve the same improvement in farm household income at the lowest cost to consumers and taxpayers, and that distort trade as little as possible. The specific indicator of transfer efficiency employed here is the ratio of the absolute *change* in farm household income to the absolute *change* in the total of consumer and taxpayer costs caused by a small increase in a support measure.

Benefits are to be measured by changes in total incomes of farm households *in the aggregate*, making no distinctions amongst different kinds of farm households within that population.[1] The total income of farm households comprises income they earn from both on-farm and off-farm activities. In fact, in many OECD countries the largest share of the total income of households designated as farm households comes from off-farm sources [OECD (1995); Gunderson *et al.* (2001) USDA (2001) and OECD (2002)]. Government policies providing financial support to farmers lead to higher-than-otherwise earnings from farming activities and, thus, to higher-than-otherwise total income from on-farm and off-farm activities.

A given increase in financial support to farmers would cause an increase in the farm component of earnings of farm households and thereby an increase in their total earnings from all sources. However, some slippage would likely occur at both levels: *1)* the increase in *farm* income due to increased farm support could be less than dollar-for-dollar and *2)* the increase in *total* income of farm households due to increased income from farming could also be less than dollar-for-dollar.

There are several reasons to expect a less than one-to-one relationship between extra money consumers and taxpayers spend to support farmers and the resulting extra total income of farm households. Some of the money consumers and taxpayers pay for farm support never reaches farmers at all, going instead towards paying the costs of administering the programme. Then, some of the money that farmers actually receive may be passed along immediately in the form of higher rents on land supplied by non-farming landlords.

Furthermore, farm support is rarely spread evenly amongst farm commodities competing for the same resources. Farmers respond to policy-induced changes in relative returns by shifting resources away from relatively unsupported crops and livestock towards those benefiting from support. The income gains they experience from an increase in returns to supported commodities may thus be partially offset by reductions in income earned from the lower production of unsupported commodities. Moreover, to fully maximise their benefits from support, farmers may expand production of supported commodities by increasing the intensity of purchased input use, expending some of the extra revenues they receive buying inputs supplied from off-farm suppliers.

Finally, even the additional income that farm households earn from their farming operations will not translate dollar-for-dollar into additional *total* income for the farm household if extra farm support encourages farm households to divert some of their work time, or other resources they own, from non-farm to farming activities. Such a reallocation would limit the gains in total income with a reduction in non-farm income partially offsetting the induced gains in income from farming.

Costs

The mix of consumer versus taxpayer contributions to the total costs of supporting farmers will differ depending on the form in which support is provided. The implications for farm household income, the transfer efficiency, will also vary depending upon the policy mechanism used. Thus, it is important to recognise the various avenues through which support is delivered from taxpayers and/or consumers.

One avenue is a policy of market intervention in order to force the market price to a government target price level. Domestic buyers of commodities under a regime of market price support pay a part, perhaps the largest part, of the costs in the form of higher domestic prices. Taxpayers must also pay if the supported commodity is exported: they pay the cost of subsidies to buyers in other countries plus the associated costs of government purchases and public stockholding. If the supported commodity is imported, however, taxpayers may benefit if the government collects and keeps tariffs on imports.

Various policies that deliver payments directly to farmers based on some criteria, such as the quantity of production or the use of a certain input (typically land), represent an alternative mechanism of support. Taxpayers pay the entire bill for agricultural policies that channel financial support to farmers in the form of direct budgetary payments. To the extent that these payments cause extra production and lower-than-otherwise market prices, consumers could become net beneficiaries of farm support. Taxpayer costs include not just the amount of money the government pays out in the form of payments to producers or as export subsidies, there are also administrative costs and so-called dead-weight costs of taxation that arise when citizens are taxed to collect revenues to fund the programs. These latter ‘transactions’ costs are ignored here (an extended discussion of them is found in OECD, 1995).

Method, scope and limitations of analysis

In the following sections there is discussion and analysis of the benefits, costs and transfer efficiency of four categories of farm support measured and classified separately for the PSE: *1)* deficiency payments, *2)* market price support, *3)* area payments, and *4)* payments based on inputs. This analysis leads, for each category of support, to a pie chart showing numerical estimates of the income incidence of farm support on farm households, farm input suppliers and landlords.

The general procedure followed involved developing equations for the benefits and then the costs of marginal changes in support. This led to the development of equations expressing transfer efficiency, the ratio of benefits to costs, as functions of some familiar economic parameters: the elasticities of supply of land, labour and capital and their cost shares; the elasticities of commodity demand; the initial rates of support and trade ratios. These equations are then solved to obtain numerical estimates of transfer efficiency by introducing “reasonable” values for all these parameters.

This method was chosen to keep the exposition as simple and self-contained as possible. However, to the extent those goals were achieved, it was at the cost of simplifying assumptions that circumscribe the generality of the results. Numerical results must be viewed as approximations because the transfer efficiency formulas are derived using the calculus applying to differential changes in the various price and quantity variables. In addition, the specific numerical estimates of transfer efficiency obtained depend on the specific values assumed for the various supply and demand parameters in the formulas. In making the illustrative calculations of transfer efficiency for this paper, a set of values thought to be generally representative of total agriculture in OECD countries was chosen. The sensitivity of results to some of the key assumptions is analysed in Annex I.

Transfer efficiency of deficiency payments

It is convenient to begin studying the transfer efficiency of farm support by comparing the costs and benefits of a simple deficiency payment. Under such a program, the government announces a target price for some farm commodity and then makes payments to producers to cover the difference between that price and the price the producer receives from the market.

This kind of support is classified as “payments based on output” under the new system for classifying PSE support measures. Although these payments do not account for a large share of total support provided to farmers in most OECD countries, it is interesting to analyse their transfer efficiency as they provide a simple starting point for introducing key parameters and formulas, as well as explaining most of the basic ideas.

Income benefits of deficiency payments

Deficiency payments increase farm household incomes because they increase earnings from the supply of owned factors to the production of the supported commodities. In the medium to longer term, the two most important categories of farm factors owned and supplied by farm households are land and farm household labour. To simplify the analysis, these two inputs are assumed to be the only farm-owned factors in the mix.

In estimating the income benefits of deficiency payments a three-step procedure, as suggested by Helmberger (1991), is followed. In the first step, the extent to which total producer revenues increase with an increase in the deficiency payment is estimated. Secondly, how much of that induced increase in total revenues is paid to each of the two farm-owned factors, *i.e.* how much do *gross* factor receipts increase, is then analysed. In the final step, an estimate is made of how much of those extra gross factor earnings can be counted as a *net* gain in farm household incomes.

Effects on total revenues

Total revenue earned by farmers from sales of a commodity supported through a deficiency payment comprise a market component and a government component,

(1) $TR = [P_m * Q_s] + [(P_p - P_m) * Q_s]$.

TR is total revenue from sales of the supported commodity,
P_m is market price,
P_p is the government target price and
Q_s is quantity produced.

The first bracketed term in Equation 1 measures what farmers earn from market sales and the second bracketed term measures what they earn as deficiency payments. If the government should increase the target price by a small amount, labelled ΔP_p[2], this would increase the size of the per unit deficiency payment by ΔP_p and thereby the government component of total revenues. It can be expected that producers would respond to the higher effective prices by increasing production, the magnitude of which would depend on the size of the price increase the government decided to give farmers and on the price responsiveness of supply.

Can the extra production be sold without causing the market price P_m to go down? More importantly for present purposes, can such price dependence be safely ignored? Results of sensitivity analysis presented in Annex I suggest that perhaps it can. When world market effects are taken into account, transfer efficiency is lowered in exporting countries or regions and is increased for importers. However, these differences are small unless the country or region in question is a ‘large’ one.[3] Accordingly, constant world market prices are assumed for this analysis. This simplification means that the change in total revenue due to an increase in a deficiency payment can be expressed as:[4]

(2) $\Delta TR = [Q_s * \Delta P_p] + [\varepsilon_s * Q_s * \Delta P_p] = Q_s * (1 + \varepsilon_s) * \Delta P_p$.

ΔTR is the induced change in total revenue due to the change in the deficiency payment and ε_s is the elasticity of supply (the per cent change in output associated with a one-percent change in the producer price). The first bracketed term in Equation 2 shows how much total revenue would increase if the quantity produced did not go up with the increase in support. The second one shows the increment to revenue earned on the induced increase in production.

Effects on gross farm factor returns

How much of the increase in total revenues shown in Equation 2 will be paid to land and to farm household labour? This question is much easier to answer by assuming constant factor shares.

Models embodying a constant factor share assumption feature frequently in analyses of agricultural production response and policy. Constant factor shares are a defining characteristic of the famous Cobb-Douglas production function, a common choice for analysing the benefits and costs of agricultural policies (Helmberger 1991, and Helmberger and Chavas, 1999). It is assumed that constant factor shares give a good approximation of changes in factor payments caused by changes in farm support measures, even if the underlying aggregate production function is not exactly of the Cobb-Douglas form.[5]

The two equations for measuring the gross increase in farm factor earnings caused by an increase in deficiency payments are thus,

(3) $\Delta GFE_n = s_n * n_r * \Delta TR$
(4) $\Delta GFE_l = s_l * l_r * \Delta TR$

ΔGFE_n and ΔGFE_l are, respectively, the change in gross factor earnings of farm household land and labour caused by a change in farm support. The symbol s_n stands for the share of total costs of production attributable to land — the total of that supplied by farm households and that supplied by landlords who do not farm. The symbol s_l corresponds to the share of total costs of production attributable to labour, the total of that labour supplied by farm households and that supplied by hired labourers. Finally, n_r is the proportion of the total land farmed that is owned by farm households and l_r is the proportion of total labour used in farming supplied by farm households. It is shown below that the four parameters s_n, n_r s_l and l_r are key determinants of the transfer efficiency of the various support measures studied. This is further illuminated in the sensitivity analysis reported in Annex I.

Effects on net farm factor earnings

How much of the increase in gross factor earnings caused by the increase in deficiency payments can be counted as gain in net factor earnings, and thus as a net gain in farm household income? One way of clarifying this question is to consider under what circumstances all of the increase in farm-owned factor payments could be counted as an increase in farm household income. This would occur only in the special circumstance where the two farm-owned factors were completely fixed in the production of the farm commodity or commodities benefiting from the extra support.

To assume that the farm household labour and land used in the production of a farm commodity receiving deficiency payments are completely fixed in that use may be realistic in the very short term. It is questionable when applied to the medium or long term. Conceptually, there are two ways farm households can adjust the number of hectares and the amount of work time they devote to production of farm commodities. These are *1)* by changing the total quantities of those factors employed on-farm versus off-farm and *2)* by reallocating amongst on-farm uses.

The possibilities for adjusting the total amount of land used on-farm versus off-farm are undoubtedly limited in most OECD countries in the short to medium run, but shifting land among competing on-farm uses can and does occur frequently in response to short to medium run changes in relative returns. Both channels of adjustment are open for farm household labour, and especially so if the adjustment horizon is medium to longer term. Typically, farm households earn a significant share of total farm household income working off the farm. Improvements over time in the education and job skills of farmers and their families have led to increased flexibility in shifting work time between on-farm and off-farm employment in response to changes in relative earnings potential.

The earnings farm households forego when they divert their land and labour from other uses to the production of farm commodities benefiting from support are the opportunity costs of those factors. These costs have to be subtracted from the increased earnings farm households get from producing supported commodities in calculating the net gain in farm household income. Consider, as a concrete example, the effects of introducing a deficiency payment for wheat. Let us suppose that farm households responded by increasing the quantity of wheat they produce. This might mean that some portion of a farm household's available work time formerly spent working off the farm might now be spent seeding, weeding and reaping wheat. It might also mean that some pastureland gets ploughed and planted to wheat. The consequent reduction in off-farm income and in livestock enterprise returns would have to be subtracted from the extra wheat earnings to arrive at the *net* gain in farm household income.

The ease with which farm households can adjust the quantities of land and labour they supply to farming activities will be reflected in the elasticity of factor supply for those two factors. The higher the elasticity of factor supply, the greater is the adjustment in factor use in response to a policy-induced change in factor returns, and the less the net gain in farm household income for a given change in support. Helmberger proposes a simple formula for using the elasticity of factor supply in calculating the net gain in factor returns due to a policy-induced increase in factor payments. The general version of the formula is

(5) $\Delta NFE = 1/(1+e) * \Delta GFE.$

ΔNFE is the net gain in factor earnings due to a policy-induced increase in gross factor earnings and e is the elasticity of supply of a factor.

A zero elasticity of supply for a factor corresponds to that situation where the factor is completely fixed in production. In Equation 5 is the only situation in which all the gains in factor payments induced by an increase in support can be counted as net gain in factor earnings. In all other circumstances, the elasticity of factor supply (which is always positive) serves to regulate what fraction of the gross gain in factor earnings gets counted as net gain.[6]

The net gain in farm household income due to a change in support is equal to the sum of the induced net gains in factor earnings on the land and labour they supply. Accordingly, the relationship shown in Equation 5 can be used to derive the following equation for calculating the net gain in farm household income due to an increase in deficiency payments

(6) $\Delta FHI = \Delta GFE_n / (1+ e_n) + \Delta GFE_l / (1+e_l)$.

ΔFHI is the change in farm household income due to the change in deficiency payments. The symbol e_n refers to the elasticity of supply of land (whether owned by farm households or by others) and e_l is the elasticity of the supply of farm household labour.

Combining Equations 5 and 6 and simplifying the result gives the following formula for estimating the gain in farm household income associated with a given increase in total farm revenues.

(7) $\Delta FHI = [s_n * n_r / (1+e_n) + s_l * l_r / (1+e_l)] * \Delta TR$

Note from Equation 7 that, all other things being equal, the increase in farm household income due to an increase in total revenues will be smaller: *a)* the smaller the cost shares of farm household land and labour and *b)* the larger is the elasticity of supply of those factors.

Leakages and length of run

Results presented below show that one reason the income transfer efficiency of farm support turns out to be so low is that a significant proportion of the economic benefits go to suppliers of inputs purchased by farmers. This can be demonstrated by following the same analytical approach as used above to measure income impacts for farm households.

Assuming constant factor cost shares for the land and labour used in agricultural production implies a factor cost share for all other factors combined that is constant as well. In this analysis we label this aggregated factor 'purchased inputs'. Multiplying this share by the induced increase in total returns analogously to the calculation of gross farm factor earnings using equations (3) and (4) above gives the extra amount that will be spent on input purchases.

In turn, net factor earnings (called input supplier profits later on) can be calculated using an equation similar to (5). That equation expresses the net increase in factor earnings as the ratio of the gross increase in factor earnings ΔGFE to $(1+e)$, where e is the elasticity of supply of the factor in question. It was noted that if that elasticity is zero, the associated factor is completely *inelastic* in supply and the entirety of the gross increase in factor payments can be counted as a net increase. However, what if e is very large indicating that the quantity of the associated factor is completely *elastic* in supply, *i.e.* that the quantity supplied can easily be increased in response to increases in its price? If that elasticity is large enough then none of the increased expenditures on the factor can be counted as net gain in factor returns.

Assuming the supply of a factor is completely inelastic means the price, but not the quantity, of that factor varies with changes in demand. Assuming the supply of a factor is infinitely elastic means the quantity, but not the price, varies with changes in quantity demanded. In measuring income distributional effects of agricultural policy analysts frequently combine these two assumptions applying the first to land, the second to all non-land inputs (including farm household labour) used in agricultural production. (See, for example, Abler and Salhofer in OECD, 2001a; Chapter 3 in Helmberger, 1991; and Chapter 4 in Gardner, 1987). As Gardner notes, these assumptions lie behind the widely accepted belief that the benefits of farm price support accrue predominantly to landowners.

The elasticity of supply of non-land inputs might reasonably be regarded as infinite if the ‘run’ is long enough. For the medium run context in which farm policy analysis is politically relevant, it seems doubtful. Filling total farm sector demand for the raw materials: natural gas, crude oil, steel and so on used to manufacture farm inputs probably puts little strain on the world prices of them, even in the short run. However, to manufacture farm inputs and then make them available to and usable by farmers requires more than raw materials. Input suppliers must add processing, transportation, distribution and marketing services. Providing these services requires investment in capital, both physical and human, that is specific to those services and which may not be as easily adjustable in the short to medium term as that of the underlying raw materials. Examples are farm machinery and equipment merchants; garages, workshops and mechanics that specialise in repairing and maintaining farm machinery and equipment; fertiliser mixing plants and the specialised equipment used to transport and distribute fertiliser; livestock feed processing plants, animal health facilities and veterinarian services.

Accordingly, in the analysis that follows it is assumed that no factor used in farm production is completely fixed in supply, though the supply of land is assumed less elastic than that of non-land factors. Likewise, no factor is assumed to be in completely elastic supply, though the supplies of purchased inputs and farm household labour are each assumed more elastic than that of land. Naturally, the longer the length of run assumed, the less the net gains overall and the greater is the share of that diminished total going to landowners. In other words, the longer the period of adjustment to an increase in support the lower the income transfer efficiency, a result which will hold regardless of the particular support measure used in delivering that support.

Taxpayer costs of deficiency payments

The taxpayer cost for a deficiency payment is,

(8) $TC = (P_p - P_m) * Q_s$,

A small change in the government target price and the associated deficiency payment rate would cause total taxpayer costs to rise by,

(9) $\Delta TC = [Q_s * \Delta P_p] + [Q_s * \varepsilon_s * op * \Delta P_p] = Q_s * (1 + \varepsilon_s * op) * \Delta P_p$

ΔTC is the change in taxpayer costs associated with a small change in deficiency payments and *op* is the initial payment ratio, (op = (Pp- Pm)/ Pp), the ratio of the initial rate of deficiency payment to the producer price. (It is given the symbol op to accord with the label ‘payments based on output’ applied to this category of support measures in the PSE.)

The initial support ratio, *op* has a familiar interpretation in the special circumstance where the deficiency payment is the only source of farm support provided. In this special case, the support ratio (converted to a percentage) would be the per cent PSE. The higher this initial ratio, the higher the costs of further increasing support. To understand why this is so, and therefore why the initial support ratio ends up in the equation, it is helpful to think of the increase in taxpayer costs as comprising two parts.

First, there is the extra cost due to having to pay the marginal increase in deficiency payment ΔP_p on the pre-existing level of production Q_s. This is shown in the first set of brackets in Equation 9. Second, there are the extra costs due to having to pay *both* the marginal increase in the deficiency payment *and* the pre-existing rate on all new production. This is measured by the second bracketed term in Equation 9.

Estimated results

The equation needed to estimate the transfer efficiency of a deficiency payment for farm household income is[7]

(10) $TE\ (fhi) = \Delta FHI / \Delta TC = [s_n * n_r / (1+e_n) + s_l * l_r / (1+e_l)] * [(1 + \varepsilon_s) / (1 + \varepsilon_s * op)]$

This equation contains eight parameters. Table 1 shows the relationship between transfer efficiency and each of these eight parameters as well as some indicative numerical values for them. Parameter values are to be viewed as indicative since they will be different for different circumstances: countries, commodities and term (medium or long). The elasticities of factor supply in Table 1 are meant to reflect factor adjustment occurring over a medium run adjustment horizon of, for example, three to five years.

The estimates of factor cost shares chosen for Table 1 were inferred from data presented in two OECD reports [OECD (2001*a*) and OECD (1999)]. The first of these reports, *Market Effects of Crop Support Measures*, synthesises results of analysis using the PEM crop model. It contains estimates of factor cost shares for crops in Canada, Japan, Mexico, the European Union (treated as one country), Switzerland and the United States. The second, *Economic Accounts for Agriculture*, reports estimates of costs of production for the entire sector.

In general, total land (that supplied by farm households plus that supplied by non-farming landlords) usually accounts for approximately 20% of total costs of crop production in the countries studied for the PEM crop analysis. Annex II contains estimates of the shares of owned farmland for a selection of OECD countries. These estimates average around 50%, the same figure used for the calculations on transfer efficiency. A recent study of the effects of government payments on land values in the United States (Barnard *et al*. 2001) found that of the land receiving the most benefits from government payments a significantly higher proportion was rented than was the case for all land.

Assuming that one half the cropland is rented gives a cost share for owned land supplied by farm households of 10%. The cost share for hired labour used in crop production in the countries studied for the *Market Effects* report was around 5%, leaving a cost share of 15% for that labour supplied by farm households. Let us suppose for present purposes that this is representative for the sector as a whole.

Combining the shares for farm household land and farm household labour would thus yield a total of 25% for all farm household factors used in crop production. The sector-wide aggregates reported in the *Economic Accounts for Agriculture* suggest a total factor share for farm household supplied factors in this same neighbourhood. Although the *Economic Accounts* data do not allow calculation of factor cost shares separately for farm household supplied labour and land, estimates of net farm income reported can be used to estimate a cost share for their total. Net farm income as a percentage of total value of output is typically less than 30% in individual OECD countries, frequently below 20%.[8]

The elasticities of factor supply for land, labour and purchased inputs in Table 1 were chosen based on data presented in reviews of past studies of agricultural supply response in North America (Abler, 2001) and in Europe (Salhofer, 2001) that were undertaken in developing the PEM crop model (OECD, 2001*a*). The authors were asked to make recommendations of ‘plausible ranges’ of parameter values to use in policy simulation analysis.

A total land-supply elasticity of 0.10 for modelling sector-wide supply response fits comfortably within their recommended ranges. In the following analysis, that elasticity is applied equally to land owned by farm households and by others. The supply of farm household labour in the medium to long term is generally assumed to be more responsive than the supply of land to changes in relative returns; a difference which widens the longer the run being considered. This elasticity will reflect the ease with which farm household members can shift between on-farm and off-farm work as well as household preferences for work versus non-work (including leisure) activities.

Mathematically, the elasticity of output supply ε_s is itself a function of values assigned the factor cost shares and the elasticities of factor supply. However, to calculate this elasticity (as was done to obtain the value 1.0 for the table) the list of factors must be extended to include all productive factors, not just land and farm labour. The factor share and the elasticity of supply characterising those inputs purchased by farmers must also be considered. A combined cost share of 0.40 for *total* land and *total* labour implies a cost share of 0.60 for all purchased inputs combined. An elasticity of purchased inputs of 1.5 is also well within the range of plausible values recommended by the PEM consultants.

As discussed above, one would be looking at substantially higher numbers for the elasticities of purchased factors if the adjustment horizon were long run. If it were only this supply elasticity, *i.e.* that for purchased factors, that would be higher in the long run, one might conclude from results shown in the table that transfer efficiency would also be higher in the long run. However, the elasticity of the supply of farm factors, especially that of farm household labour, is also likely to be greater in the longer run. In calculating transfer efficiency, the positive effect of higher purchased factor elasticities will be offset by the negative effect of higher farm factor elasticities.

The estimate of transfer efficiency for deficiency payments of 0.25 in Table 1 was obtained by introducing the listed parameter values into the transfer efficiency formula, Equation 10. This result would imply that for each extra dollar of support provided to farmers in the form of deficiency payments, only twenty-five cents translates into a gain in net earnings for the land and labour supplied by farm households. In other words, for each one-dollar gain in factor earnings, taxpayers must pay around four dollars in deficiency payments.

Figure 1. The incidence of deficiency payments

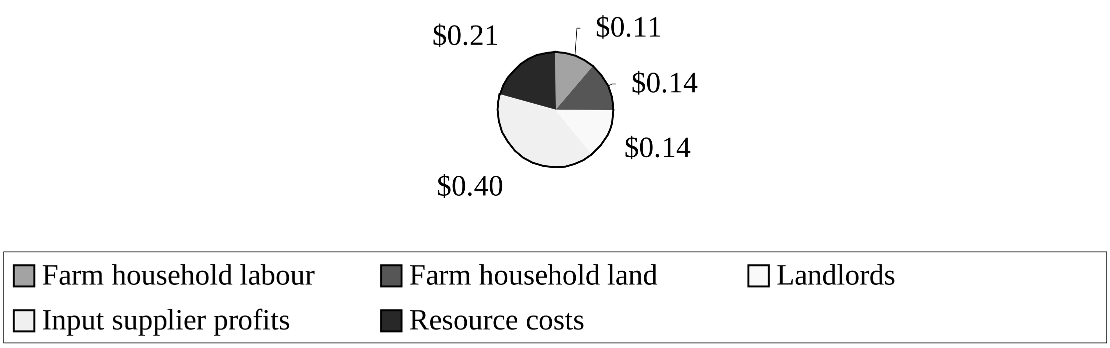


Table 1. Parameter values used and estimated results from transfer efficiency calculations

Parameter	Description	Relationship to TE	Representative value
Factor cost shares			
s_n	Land	Positive	0.20
s_l	Labour	Positive	0.20
s_o	Purchased inputs	Negative	0.60
Farm household supplied shares			
n_r	Land	Positive	0.50
l_r	Labour	Positive	0.75
Factor supply elasticities			
e_n	Land	Negative	0.10
e_l	Farm household labour	Negative	1.00
e_o	Purchased factors	Positive	1.50
ε_s	Output supply elasticity	Positive	1.00
Initial support ratios			
op	Output payment	Negative	0.30
mps	Market price support	Negative	0.30
ap	Area payment	Negative	0.30
is	Purchased input subsidy	Negative	0.30
Estimated transfer efficiency:			
	Deficiency payment		***0.25***
	Market price support		***0.24***
	Area payment		***0.48***
	Input subsidy		***0.17***

If farm households receive just twenty-five cents of each extra dollar taxpayers pay in deficiency payments, what happens to the other seventy-five cents? Figure 1 shows how the entire one-dollar of extra taxpayer costs for deficiency payments is divided up. The largest portion, forty cents, goes as extra profits to suppliers of farm inputs. Another fourteen cents goes out as extra rents for non-farming landlords.

Resource costs, that is the money needed to offset the combined opportunity costs of diverting resources from other productive uses to the production of the supported commodity, account for the remaining twenty-one cents. These costs comprise the economic efficiency losses for the domestic economy as a whole — the economy-wide costs of the production distortions caused by the deficiency payment.

The entire distribution of leakages and efficiency losses revealed in Figure 1 will be different for different assumptions concerning values of the parameters shown in the Table 1. Results presented in Annex I show the sensitivity of transfer efficiency estimates to alternative model and parameter assumptions, and reveal that the most important assumptions concern the factor shares applying to the farmland and farm household labour supplied by farm households. The higher those shares, the higher are estimated transfer efficiencies.

Note from Figure 1 that the twenty-five cents of net gain in farm household income is itself split: fourteen cents to farm household supplied land and eleven cents to farm household supplied labour. However, those fourteen cents going to farm household supplied land should be seen as transitory, applying only in the medium-run context of the present analysis. Economic theory implies that those extra land rents, appropriately discounted to reflect the time value of money and uncertainty about the permanence of government support, will be capitalised into the price of the land (Barnard *et al.*, 1997). Eventually, that land will be sold at those higher prices when farmers leave the sector or retire. The new owner may continue to receive the government payments, but their value to him/her will be just offset by the extra cost of owning that higher-priced land (either as interest expense on the loan taken out to buy the land or as foregone earnings on owner equity).

Transfer efficiency of market price support

Let us suppose now that the government rather than using a deficiency payment to increase the effective producer price, does so by a program of market price support. Market price support continues to account for the largest share of the total estimated monetary transfers to farmers attributable to agricultural policy in OECD countries (OECD, 2001*b*). A stylised version of a program of market price support under which the government sets a price to apply equally to all domestic sellers and buyers of a farm commodity will be analysed here. The government will enforce that price by imposing a tariff high enough to ensure that no imports can be sold at a lower price and, if necessary, by subsidising exports of surplus product.

Taxpayer costs of market price support

For the same effective producer price, the income benefits of market price support will be the same as for a deficiency payment. It is only the differences in their respective costs that need concern us here. The taxpayer costs of a program of market price support depend critically on whether a country is an exporter or an importer of the supported commodity. If domestic production exceeds domestic consumption, the country in question is an exporter and the government must pay subsidies to buyers in world markets to make up the difference between the supported price and the prevailing world price.

If domestic consumption exceeds domestic production, the country in question is an importer and *may* receive tariff revenues on imports. However, not all programs of market price support generate tariff revenues for governments of importing countries. Voluntary export restraints and tariff rate quotas are examples in which the rents from restricting imports may not accrue to the importing country government.

The formula for measuring the taxpayer costs of export subsidies or, if negative, the tariff revenues earned, for a program of market price support is

(11) $TC_x = (P_d - P_w) * (Q_s - Q_d)$

TC_x is the taxpayer costs (benefits) of export subsidies (import tariffs), P_d is the domestic price in the presence of market price support, P_w is the world price and Q_d is domestic consumption.

A small change in the guaranteed price and thus in the associated market price support rate would cause total taxpayer costs to change by

(12) $\Delta TC_x = [(1 + mps * \varepsilon_s) - cr * (1 + mps * \varepsilon_d)] * \Delta P_d * Q_s$

The symbol *cr* stands for the ratio of domestic consumption to domestic production (if less than one, the country in question is an exporter, if greater than one, an importer). The proportional rate of market price support is denoted by *mps* and ε_d is the elasticity of domestic demand for the supported commodity.

Consumer costs of market price support

One way of measuring the consumer costs of market price support is to simply multiply the quantity they consume — Q_d by the price gap $(P_d - P_w)$, the difference between the domestic and the world price. However, that covers only part of the additional costs imposed on consumers when domestic prices are increased by market price support measures. This is because the amount consumed at supported domestic prices is probably less than would be observed at the lower world market prices. When consumers reduce their consumption in response to policy-induced price increases there are additional costs to be accounted for. These costs are sometimes called the real income losses associated with the higher consumer prices. These can be measured by calculating, for a given policy-induced change in consumer prices, not the change in the consumer expenditures but the change in consumer surplus [see OECD (1995) for a fuller discussion and graphical exposition].

An equation to approximate the change in consumer surplus when the domestic price is increased by the small increment ΔP_d is

(13) $\Delta CS = (-\Delta P_d * Q_d + 0.5 * \Delta P_d * \Delta Q_d) = (-1 + 0.5 * \varepsilon_d * \Delta P_d / P_d) * Q_d * \Delta P_d$

ΔCS is the reduction in consumer surplus (the negative of the change in consumer costs) due to market price support.[9]

A cost-version of this equation that is more convenient for the following total cost calculations can be obtained by multiplying and dividing the last expression in Equation 13 by $-Q_s$. This accomplishes two things. First, it changes the sign of the measured change in consumer surplus from negative to positive allowing us to add it to the induced change in taxpayer costs, which we have so far measured with a positive sign. Second, it eliminates Q_d from the equation.

(14) $-\Delta CS = cr * (1 - 0.5 * \varepsilon_d * \Delta P_d / P_d) * Q_s * \Delta P_d$

An equation for the change in the total of taxpayer and consumer costs induced by the small change in market price support can now be obtained by combining results from Equations 12 and 14, giving

(15) $\Delta TC = [(1 + mps * \varepsilon_s) - cr * (1 + mps * \varepsilon_d)] + [cr * (1 - 0.5 * \varepsilon_d * \Delta P_d / P_d)] * Q_s * \Delta P_d$,

Estimated results

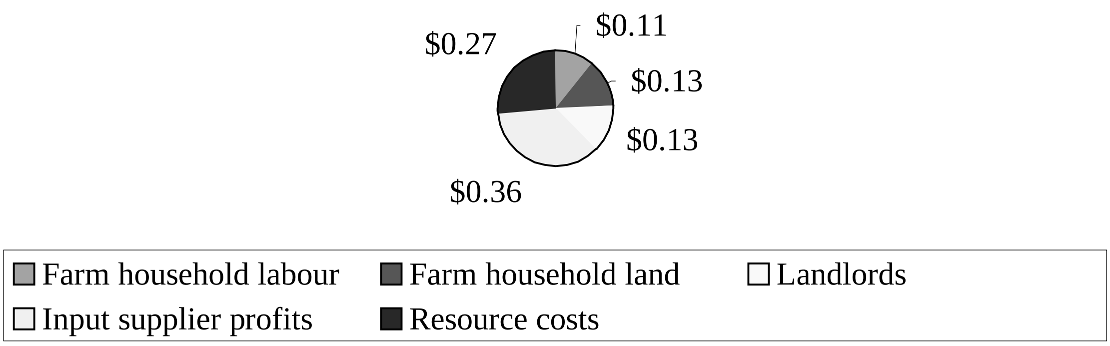
Equation 15 gives the needed measure of costs for the cost side of the transfer efficiency ratio for market price support. The benefit side of that ratio is obtained in the analysis of the transfer efficiency of deficiency payments in Equation 7. Combining these, and making the required substitutions and simplifications, leads to the following equation for measuring the transfer efficiency of market price support.

(16) $TE(fhi) = \Delta FHI / \Delta TC = [s_n * n_r / (1+e_n) + s_l * l_r / (1+e_l)] * (1 + \varepsilon_s) / [cr * (1 - 0.5 * \varepsilon_d * \Delta P_d / P_d) + (1 + mps * \varepsilon_s) - cr * (1 + mps * \varepsilon_d)]$

Equation 16 contains all of the same parameters found in Equation 10, the equation derived above for estimating the transfer efficiency of a deficiency payment, plus two new ones: ε_d the price elasticity of domestic demand and *cr* the ratio of domestic consumption to domestic production. A value of -0.20 for the price elasticity of demand for aggregated agricultural output and a ratio of domestic consumption to production of 0.90 is assumed. The latter corresponds roughly to the average relative value of total agricultural consumption and production in OECD countries. Annex I contains some results showing the sensitivity of transfer efficiency estimates to the trading status of a country.

Introducing these values, and those for all other parameters from Table 1, into Equation 16 yields an estimate of the transfer efficiency of market price support of 0.24, a figure slightly less than the result of 0.25 obtained for the transfer efficiency of a deficiency payment. In other words, farm households would experience a gain of only twenty-four cents for each one-dollar of additional taxpayer plus consumer costs for market price support. Put the other way round, taxpayers and consumers together pay more than four dollars for each one-dollar gain in farm household income due to market price support. Figure 2 shows this breakdown.

Figure 2. The incidence of market price support



The biggest difference between the transfer efficiency results obtained when analysing a deficiency payment, shown in Figure 1, and the results for market price support, shown in Figure 2, is the extra resource costs of market price support. Resource costs are higher for market price support because domestic economic losses resulting from induced reductions in consumption must be included.

Transfer efficiency of factor subsidies

The objective of the two stylised support measures analysed above, whether implemented using a deficiency payment or a tariff, is to increase the effective price farmers receive for their *output.* Another way of supporting farm incomes is to provide payments per unit of factor use. In terms of the estimated amount of money OECD governments spend each year, the most important category of factor subsidies is area payments.

The transfer efficiency of area payments is also interesting to study because it is virtually the only kind of support targeted directly to a factor of farm production owned and supplied by farm households. In principle, governments could devise policy measures aimed directly at increasing returns to farm household labour, via the income tax system for example. Surprisingly, these forms of targeted support do not account for very much of the money governments spend (or, equivalently, the tax revenues they forego) subsidising agriculture.

Accordingly, this section begins with an analysis of the benefits, costs and transfer efficiency of area payments. The only other broad category of factor subsidies accounting for a noticeable share of the PSE is payments based on inputs. An analysis of the transfer efficiency characteristics of one stylised variety of such payments — subsidies to purchased inputs concludes this section.

Income benefits of an area payment

Consider that instead of providing budgetary support to farmers via a deficiency payment the same amount of support is provided in the form of a payment to land. Suppose further that this is a per-hectare or per-acre payment made conditional on planting a crop or otherwise using the designated land in some specified agricultural use. Assume as well that this payment is made to the owner of the eligible land regardless of whether he or she is a farmer. This is actually the way the program works in some countries whereas in others the law requires that the payments be made to whoever is farming the land. However, under the usual assumptions about land markets, rental rates will eventually be driven up by the amount of the payment and the estimated transfer efficiency will come out the same regardless of who actually *first* receives the payment.

Area payments implemented in this way constitute a stylised version of an area payment program that does not correspond exactly to any one of the many area payment programs operating in Member countries. Nevertheless, by analysing this stylised version most of the really important differences in the economic effects that distinguish this general category of support measures from deficiency payments and market price support are captured. Area payments are often restricted to only a certain amount of land, either based on past uses or in total — although these restrictions may be questioned in terms of enforcement — so the elasticity of the factor supply relevant for net benefit calculations may be reduced closer to zero.

In general, as for a deficiency payment, a factor subsidy may increase incomes of farm households by increasing the returns to both the factors they supply to agriculture. It should be expected that a subsidy targeted to one of those factors, an area payment in the present case, would affect the returns to land more than the returns to household labour. The equations for calculating gross factor earnings for the land and labour supplied by farm households when farmers receive an area payment are

(17) $GFE_n = [s_n * n_r * TR] + [n_r * (AP * X_n)]$
(18) $GFE_l = s_l * l_r * TR$

AP is the per-hectare area payment and X_n is the total number of hectares of land benefiting from the payment.

The first bracketed expression in Equation 17 measures that part of the total revenues earned from sales that go as factor payments to the land supplied by farm households. The second bracketed expression, absent in Equation 18, measures the extra returns attributable to the area payment. In Equation 17, the symbol Xn refers to the total land supplied by both farm households and by non-farming landlords. The presence of the parameter nr, the proportion of land that is owned by farm households, in that part of the equation serves to emphasise the point further that only a portion of the area payments is made on land supplied by farm households.

Imagine increasing the per-hectare area payment AP by a small amount •AP. The equations for calculating the impact of this on the gross factor earnings for farm household land and labour are

(19) $\bullet GFE_n = [s_n * n_r * e_n * \bullet AP * X_n] + n_r * [(1+ ap * e_n) * \bullet AP * X_n]$
(20) $\bullet GFE_l = [s_l * l_r * e_n * \bullet AP * X_n]$

In equation 18, *ap* is the initial area payment rate expressed as a ratio to the initial rental rate of land.

Consider the first bracketed expression in Equation 19 and then the corresponding expression in Equation 20. These two formulas measure the gains in factor earnings attributable to the increase in total receipts from sales of the supported crop that might follow an increase in the area payment. (Under our assumptions about the nature of the payment and the elasticity of supply of land, the area payment stimulates additional plantings leading, ultimately, to an increase in production.)

The second bracketed expression in Equation 19 measures the portion of extra area payments that farm households get on the land they supply. There is no second term in Equation 20, reflecting the fact that farm household labour will benefit from area payments only to the extent that such payments lead to additional production. This will not amount to much if, as would be expected, the supply of land is highly price inelastic. This provides the first glimpse of an important finding about area payments that will be illustrated in the transfer efficiency calculations to follow. It is that the lion's share of the economic benefit of such payments goes to land.

The final equation for estimating the income benefits of area payments for farm households is

(21) $\Delta FHI = \Delta GFE_n / (1+ e_n) + \Delta GFE_l / (1+e_l)$

$$= [s_n * n_r * e_n * \bullet AP *X_n] / (1+e_n) + n_r * [(1+ ap * e_n) * \bullet AP * X_n] / (1 + e_n) + [s_l * l_r * e_n * \bullet AP * X_n] / (1+e_l)$$

$$= [(s_n * n_r * e_n + n_r * (1+ ap * e_n)) / (1 + e_n) + (s_l * l_r * e_n) / (1+e_l)] * \Delta AP * X_n$$

Taxpayer costs of area payments

The taxpayer cost for an area payment is,

(22) $TC = AP * X_n$

A small change in the area payment rate would cause total taxpayer costs to rise by,

(23) $\Delta TC = [X_n * \Delta AP] + [X_n * e_n * ap * \Delta AP]$

The role of the variable *ap* in determining the cost of increasing an area payment is analogous to that of the support ratio *op* in determining the cost of an increase in a deficiency payment or *mps* in determining the costs of market price support.

Estimated results

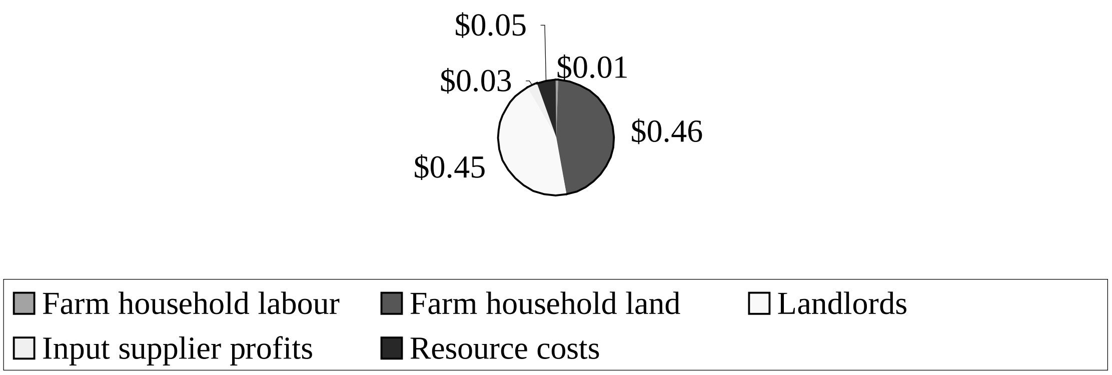
The equation needed to estimate the transfer efficiency of an area payment for farm household income can now be derived. It is, after "simplifying",

(24) $TE\ (fhi) = \Delta FHI / \Delta TC$
$= [(s_n * n_r * e_n + n_r * (1 + ap * e_n)) / (1 + e_n) + (s_l * l_r * e_n) / (1 + e_l)] / (1 + e_n * ap)$

The only new parameter in Equation 24 is the initial support ratio *ap* applying to area payments. To calculate an indicative numerical estimate of the transfer efficiency of an area payment let us assume a value of 0.30 for this parameter. Introducing this value and those for factor shares and supply elasticities from Table 1 into Equation 24 yields an estimate of the transfer efficiency of an area payment of 0.47, more than double that of either the deficiency payment or market price support.

According to this result farm households would experience a gain of forty-seven cents for each one-dollar of additional taxpayer costs for an area payment. In other words, taxpayers pay a little over two dollars for each one-dollar gain in farm household income due to an area payment. One can ask that if farm households receive only forty-seven cents of a dollar spent by taxpayers for area payments, what happens to the rest? Figure 3 shows this breakdown.

Figure 3 -The incidence of area payments



The division of the taxpayer dollar for area payments is considerably different than was the case for deficiency payments. Input suppliers capture almost none of the benefits and the resource costs are considerably lower. On the other hand, a much bigger share of the benefits of area payments, 46%, as compared to 14% for deficiency payments, goes to landlords. Moreover, farm households themselves gain almost exclusively from the increase in rents for the land they themselves supply, forty-six cents. Very little, less than one-cent, of farm households' gains come in the form of increased returns to farm household supplied labour.

Income benefits of subsidies to purchased inputs

The category of the PSE called 'Payments based on use of inputs' contains a wide variety of government subsidies to farmers not otherwise classified. In this final section, we will analyse the transfer efficiency of just one stylised sub-category in that group of support measures — subsidies to purchased inputs. Real life examples include unit price subsidies applying to fertiliser, fuel, interest and insurance, as well as the subsidy-equivalent of, for example, tax incentives the government provides to encourage farmer investment in machinery and equipment.

Imagine simultaneously increasing the per-unit price subsidy, or subsidy equivalent, applying to all of the inputs purchased by farmers. The equations for calculating the impact of this on the gross factor earnings for farm household supplied labour and land are,

(25) $\bullet GFE_n = s_n * n_r * e_o * \bullet IS * X_o$
(26) $\bullet GFE_l = s_l * l_r * e_o * \bullet IS * X_o$

The symbol e_o stands for the elasticity of supply of purchased inputs, considered as an aggregate, ΔIS is the unit input subsidy and X_o is the quantity used of the subsidised inputs.

The corresponding equation for estimating the change in farm household income, derived following the same procedure as for all the other kinds of support above gives

(27) $\Delta FHI = \Delta GFE_n / (1+ e_n) + \Delta GFE_l / (1+e_l)$
$= [(s_n * n_r * e_o * \bullet IS) * X_o] / (1+e_n) + [(s_l * l_r * e_o * \bullet IS) * X_o] / (1+e_l)$
$= [(s_n * n_r * e_o) / (1+e_n) + (s_l * l_r * e_o) / (1+e_l)] * \Delta IS * X_o$

Taxpayer costs of input subsidies

The taxpayer cost for an input subsidy is,

(28) $TC = IS * X_o$

A small change in the input subsidy rate would cause total taxpayer costs to rise by

(29) $\Delta TC = [X_o * \Delta IS] + [X_o * e_o * is * \Delta IS]$

The symbol *is* stands for the initial input subsidy rate, expressed as a ratio to the initial price of the input, which has a role in estimating the costs of increasing an input subsidy analogous to that of *op, mps* and *ap* in earlier cost equations.

Estimated results

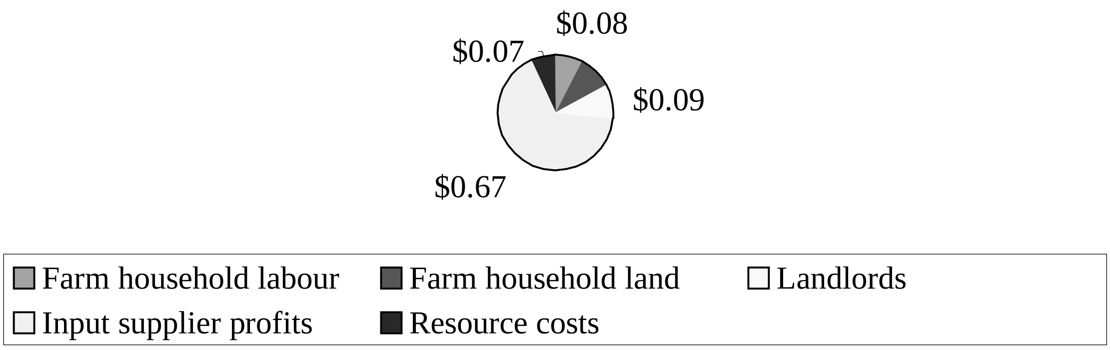
The equation for estimating the transfer efficiency of an input subsidy is thus

(30) $TE\ (fhi) = \Delta FHI / \Delta TC = [(s_n * n_r * e_o) / (1+e_n) + (s_l * l_r * e_o) / (1+e_l)] / (1 + e_o * is)$

Comparing this equation to the earlier equations used to make transfer efficiency calculations, there are only two new parameters: e_o the elasticity of supply for the subsidised input and *is* the ratio of the initial subsidy to the initial price of the input. A value of 1.50 for the first of these was assumed. Similarly, in keeping with earlier assumptions about support ratios, let us assume a value of 0.30 for the 'is' parameter. Introducing this value and those for factor shares and supply elasticities from Table 1 into Equation 30 yields an estimate of the transfer efficiency of an input subsidy of only 0.17.

According to this result, farm households would experience a gain of only seventeen cents for each one-dollar of additional taxpayer costs for a subsidy to inputs they purchase. Put the other way round, taxpayers pay almost six dollars for each one-dollar gain in farm household income due to such a subsidy. Figure 4 shows the breakdown. The big winners from subsidies to purchased inputs are, not surprisingly, suppliers of purchased inputs. The seventeen cents that farm households gain splits nearly evenly between farm household supplied labour and farm household supplied land. It is interesting to note that the gain to farm household supplied labour due to a subsidy to purchased inputs is significantly greater than the corresponding gain due to an area payment.

Figure 4. The incidence of an input subsidy



Conclusions and policy implications

This paper began by asking how much of the gross monetary transfers from taxpayers and consumers to farmers attributable to agricultural policies can be counted as net gain in the income of farm households? The answer is that, measured in terms of changes in benefits and costs ‘at the margin’, probably less than one-half even for the most efficient of support measures. For market price support the answer is less than one-fourth, and for input subsidies less than one-fifth. Although some measures are less inefficient than others none of the support measures studied would seem to provide long term income benefits for farm households efficiently.

Area payments deliver greater income benefit per dollar of taxpayer (or consumer) costs than the other forms of support studied. However, nearly 100% of those gains take the form of increased land rents. Furthermore, increased land rent accounts for the greatest share of the income gain farm households enjoy from farm support, regardless of the policy mechanism used to deliver that support. Those gains cannot be viewed, however, as a source of continuing improvement in the long-term economic well being of people who farm. Those extra land rents will be capitalised into the selling price of land and that land will eventually be sold or leased at those inflated prices leaving little net economic benefit from farm support for farmers who subsequently buy or lease it. In fact, those farmers will face higher capital and associated debt servicing costs (or higher leasing expenses), and ultimately reduced farm profitability.

Area payments, especially if implemented in conjunction with planting restrictions or other provisions mitigating their effects on production, have often been recommended by economists as a better alternative than, for example, market price support for supporting farm incomes. When viewed in terms of their associated resource costs and induced distortions to trade, a well-packaged program of area payments might well be considered a preferable alternative. Limiting the time horizon and reducing the level of payments would check the adverse effects of support inevitably being reflected in land prices. Linking payments to a fixed historical period and eliminating the requirement to plant/produce would further curb unwanted production increases. Nevertheless, because a significant share of the benefits of area payments are captured by landlords who do not farm, even this category of support fails to deliver income benefits for farm households constituting a high proportion of total costs.

It is clear that widely prevailing approaches to support are not efficient in improving farm household income, and even have the opposite effect of raising costs and reducing farm profitability over the longer term. No farm support policy seems to transfer income to farm households efficiently, although some measures are more efficient than others are. None seem to provide long term income benefits for farm households: all create some degree of distortion in resource use that ultimately shows up as distortion in international trade.

Are there better ways of providing income support for farm households that would not result in the capitalisation of benefits into land? Some of the alternatives would merely change the nature of the asset into which such benefits become capitalised, a marketable production quota or other entitlement to produce, for example. One proposal calls for governments to issue bonds to replace existing programs of price and income support (Swinbank and Tangermann, 2000). These bonds, whose value could be made equal to the net economic benefits provided by a given package of current support measures, would be given to farmers to compensate them for the removal of those measures. Eligibility would be based on the characteristic of the individual, *i.e.* that he/she is a farmer, rather than on a characteristic of the associated farm business, *e.g.* quantity of production or land area. This would allow the current generation of farmers to extract the full expected value of future program benefits and would facilitate a transition to more efficient and effective policies.

It is also possible that at least part of the solution for governments who may wish to ensure 'reasonable' income levels for farm households lies outside of agricultural policy entirely. Even then the appropriate policy response depends importantly on the explicit goal and intended beneficiary of support. Many farm households already have income levels equivalent to or in excess of those of non-farm households. The public policy interest in these cases would seem to be poorly served with any income related policy instrument, though provision of necessary public services to rural and remote areas, so that they are not disadvantaged relative to urban areas, might be considered. A number of farm households, however, are characterised by relatively low-income levels. While the nature and causes of lower incomes would warrant further study, broader social policies, such as those available to others in society, seem appropriate to consider in some cases. Temporary income support, training and skills upgrading, re-employment assistance, etc., could prove to be more efficient and cost-effective than the current policy set.

ENDNOTES

1. In a recent USDA-ERS paper, Gunderson *et al.* showed that the distribution of government direct payments in the United States strongly favours those households with above average household incomes and wealth. Relatively poor farm households receive very little from these payments.

2. Given that a specific figure is needed for the assumed small increase in order to do some of the calculations of transfer efficiency, it is assumed that this figure is equal to 1% of the initial price.

3. This can be understood by assuming a hypothetical increase in deficiency payments which leads to extra production, which in turn would lead to lower world market prices. It is further assumed that these lower prices are passed back to both domestic producers and to consumers in the country under study.

   The implications of lower world market prices for producer returns, and thereby the taxpayer costs of deficiency payments, will be considered first. Note that under a deficiency payment program, the government must cover the difference between the target price and the world price, revealing that the taxpayer costs of the deficiency payment will be higher than if world market prices had remained the same. In so far as the effects on consumer costs are concerned, given the assumption that the lower world market prices are passed back to the domestic market, domestic buyers of the supported commodity pay less.

   Therefore, lower world market prices mean that the cost to taxpayers for deficiency payments would increase, but that for consumers the cost would decrease. The final combined total will depend on the relative magnitudes of production and consumption. If production is greater than consumption, *i.e.* if the country is a net exporter, lower world prices will lead to a net increase in combined costs and lower transfer efficiency. If consumption is greater than production, *i.e.* if the country is a net importer, lower world prices will lead to a net reduction in combined costs and higher transfer efficiency. If levels of production and consumption are similar, as is the case for total agriculture in most OECD countries, estimated transfer efficiency should be about the same whether world market price effects are accounted for or not. The analysis reported in Annex I confirms this.

4. Using partial derivatives, the change in total revenue ΔTR caused by a small change in producer price ΔPp is approximated by

$$\Delta TR = \partial TR / \partial P_p * \Delta P_p = \partial (Q_s * P_p) / \partial P_p * \Delta P_p ,$$

$$\Delta TR = (\partial Q_s / \partial P_p * P_p + Q_s) * \Delta P_p .$$

   If we multiply and divide this last equation by Qs, the following is obtained

$$\Delta TR = Q_s * \Delta P_p + (\partial Q_s / \partial P_p * P_p / Q_s) * Q_s * \Delta P_p$$

   which, noting that the elasticity of supply is,

$$\varepsilon_s = (\partial Q_s / \partial P_p * P_p / Q_s)$$

gives the result in the text. There are several more of these elasticity-based formulas used in the paper, all developed using this same general procedure.

5. Support for this assumption can be found in the results reported in Annex I. Transfer efficiency estimates are obtained using a Cobb-Douglas version of the production function and are compared with those obtained using a less-restrictive Constant-Elasticity-of-Substitution (CES) model. There are no substantial differences between the two sets of results.

6. The formula applies only if the factor supply function is of the constant elasticity, log-linear form. However, it is probably safe to assume that a log-linear equation can provide a good approximation for the present purpose.

7. This is obtained through a three-step process: replace ΔTR in Equation 7 with the last result in Equation 2, take the ratio of that result to the last result in Equation 9, then simplify by eliminating the variables ΔQ_s and ΔP_p.

8. Net farm income as a percentage of value of production overstates somewhat the true factor cost share for factors supplied by farm households. This is because: *a)* no account is taken of the fact that estimated net farm income in the Economic Accounts includes ‘subsidies’ and *b)* those estimates include land rents, some of which are paid to non-farming landlords.

9. The last expression in the equation is obtained by exploiting the definition of the demand elasticity, $\varepsilon_d = \Delta Q_d/\Delta P_d * P_d/Q_d$, so that $\Delta Q_d = \varepsilon_d * \Delta P_d /P_d * Q_d$.

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Annex I

Sensitivity of transfer efficiency estimates to selected assumptions

The transfer efficiency estimates reported in the main body of this paper are specific to the assumptions made about the country under study: its relative importance in the world agricultural market (small) and its trading status (exporter), as well as the particular numerical values of key economic parameters. Analysis presented in this annex addresses the sensitivity of estimated transfer efficiency results to these assumptions.

The sensitivity of results to assumptions is easy to see for the parameter values appearing in the various transfer efficiency formulas. If any of those numbers are changed, the results will also change. The sensitivity of results to changing assumptions about the size and trading status of the country is less obvious. Undertaking that kind of sensitivity analysis requires a model in which the limiting assumptions can be relaxed.

I. A two-region model of agricultural trade

The simplest model that permits the assumptions to be relaxed is a partial equilibrium trade model representing market-clearing interaction of supply and demand for output and inputs. The model used here is a two-region version (a home country and a rest-of-world) of a multi-country model described in Gunter *et al.*, 1996. It is the same basic model on which the OECD's PEM analysis was developed. (OECD, 2001). In keeping with the simplifications adopted for the analysis reported in the main text, the agricultural sector of a country is considered as producing a single tradable output using three non-tradable aggregated factors of production: land, labour and purchased inputs.

Producers and consumers in the home country face market prices which government can make higher or lower than the corresponding world price through the use of export subsidies or taxes. It is assumed that producers and consumers in the rest of the world face the world market price. Likewise, producers in the home country may benefit from government payments based on output or on input use. These policy interventions are introduced as price wedges in the same way as was done for the analysis reported in the main text.

Table AI.1 contains variable and parameter definitions and the equations of the model. All behavioural relationships in the model are approximated with equations linear in elasticities and percentage changes in the variables. Lower case versions of the symbols used to denote price and quantity variables in the main text here denote percentage changes in them.

Table A1.I. Variables, parameters and equations of the transfer efficiency model

Variables	*Definition*
Endogenous variables	
$q_s^h, q_d^h, q_s^r, q_d^r$	Quantities supplied and demanded of total agricultural output in a home country, denoted with the superscript *h*, and a rest of world, denoted with the superscript *r*.
p_s^h, p_d^h, p^w	Output supply and demand prices in the home country and on the world market, the latter designated with the superscript w.
$x_{ns}^h, x_{ls}^h, x_{os}^h, x_{nd}^h, x_{ld}^h, x_{od}^h$	Supply of and demand for land, labour and purchased inputs in the home country.
$x_{ns}^r, x_{ls}^r, x_{os}^r, x_{nd}^r, x_{ld}^r, x_{od}^r$	Supply of and demand for land, labour and purchased inputs in the rest of world.
$w_{ns}^h, w_{ls}^h, w_{os}^h, w_{nd}^h, w_{ld}^h, w_{od}^h$	Supply and demand prices of land, labour and purchased inputs in the home country.
$w_{ns}^r, w_{ls}^r, w_{os}^r, w_{nd}^r, w_{ld}^r, w_{od}^r$	Supply and demand prices of land, labour and purchased inputs in the rest of world.
$x_{ns}^h, x_{ls}^h, x_{os}^h, x_{nd}^h, x_{ld}^h, x_{od}^h$	Quantities supplied and demanded of land, labour and purchased inputs in the home country.
$x_{ns}^r, x_{ls}^r, x_{os}^r, x_{nd}^r, x_{ld}^r, x_{od}^r$	Quantities of land, labour and purchased inputs in the rest of world.
Policy variables	
mps, op, ap, is	Proportional rates of market price support, output price support, area payments, input subsidies
Parameters and elasticities	
$\varepsilon_d^h, \varepsilon_d^r$	Elasticities of domestic demand in the home country and rest of world.
$s_n^h, s_l^h, s_o^h, s_n^r, s_l^r, s_o^r$	Factor cost shares for land, labour and purchased inputs in the home country and rest of world.
$e_n^h, e_l^h, e_o^h, e_n^r, e_l^r, e_o^r$	Factor supply elasticities for land, labour and purchased inputs in the home country and rest of world.
$\sigma_{n,l}^h, \sigma_{n,o}^h, \sigma_{l,o}^h, \sigma_{n,l}^r, \sigma_{n,o}^r, \sigma_{l,o}^r$	Allen elasticities of factor substitution for the home country and rest of world. Notice these are symmetric so that $\sigma_{i,j} = \sigma_{j,i}$ for all combinations of land, labour and purchased inputs for both the home country and rest of world. Moreover, $\sigma_{i,i} = -\sum_j s_j \sigma_{j,i} / s_i$.

Table AI.1. Equations of the transfer efficiency model *(cont.)*

Equations	***Definition***
1. $q_d^h = \varepsilon_d^h p_d^h$ 2. $q_d^r = \varepsilon_d^r p^w$	Output demands.
3. $x_{i,d}^h = \sum_{j=1}^{3} s_j^h \sigma_{i,j}^h w_{j,d}^h + q_s^h$ 4. $x_{i,d}^r = \sum_{j=1}^{3} s_j^r \sigma_{i,j}^r w_{j,d}^r + q_s^r$	Input demands. The subscripts *j* and *i* each run from 1 to 3 for: land, farm household labour and purchased inputs respectively.
5. $p_s^h = \sum_{i=1}^{3} s_i^h w_{i,d}^h$ 6. $p^w = \sum_{i=1}^{3} s_i^r w_{i,d}^r$	Zero profit conditions ensuring that total market receipts are fully exhausted in payments to factors and reflecting an implicit assumption that the production function exhibits constant returns to scale.
7. $x_{i,s}^h = e_{i,s}^h w_{i,s}^h$ 8. $x_{i,s}^r = e_{i,s}^r w_{i,s}^r$	Input supplies.
9. $X_{i,d}^h = X_{i,s}^h$ 10. $X_{i,d}^r = X_{i,s}^r$	Input market clearing.
11. $W_{n,s}^h = W_{n,d}^h * (1 + ap)$ 12. $W_{o,s}^h = W_{o,d}^h * (1 + is)$	Input supply prices.
13. $p_d^h = p^w + mps$	Home country output demand price.
14. $p_s^h = p^w + op + mps$	Home country (effective) output supply price.
15. $Q_s^h + Q_s^r = Q_d^h + Q_d^r$	World market clearing.

Most of the variables and parameters in Table A1.1 were introduced in the main text. The most important of the new parameters are the elasticities of factor substitution – the $\sigma_{i,j}$. These parameters are necessary because the model documented in Table A1.1 is based on a Constant-Elasticity-of-Substitution (CES) production function. The Cobb-Douglas function, on which the analysis in the main text was based, is usefully viewed as a special case of the CES function in which all the elasticities of factor substitution are equal to 1.0.

Another special case is the linear production function in which all the elasticities of substitution are zero. Known variously as an 'input-output', 'Leontif' production function? the linear production function is one in which the factors are combined, as in a recipe, in fixed proportions: just so much land, this many tons of fertiliser, this many hours of labour, etc. Fixed proportions assumptions characterise the way agricultural production is modelled in all linear programming models and in many of the partial equilibrium and general equilibrium models used in agricultural policy analysis. In the Aglink model, for example, crop production is modelled by assuming that yields are determined independently of land area planted. In the GTAP model, there are explicit production functions for a long list of outputs but intermediate inputs, fertiliser for example, are combined with land in fixed proportions.

The assumption of unitary elasticities of factor substitution highlights the limiting nature of the Cobb-Douglas representation of a production technology. Alternatives to that function are usually described and justified in terms of their less restrictive assumptions about factor substitution. The CES function maintains the assumption of constancy of the substitution parameters but allows for different degrees of substitutability among different factors. In this version, land and labour substitute less well — elasticity of substitution of 0.3, than labour and purchased inputs — elasticity of substitution of 0.8.

Table AI.2 below contains estimates of 'base' and 'alternative' values for all those parameters featuring in the sensitivity analysis. For other parameters in the model, the same values were used as reported in Table 1 in the main text. Most of these parameters come from, or were adapted directly from 'best-guess' estimates published in the earlier cited report of results of PEM analyses. In general, sensitivity analysis may be undertaken either just to show how results depend on parameter values or to obtain ranges of 'plausible' values for result variables. The analysis reported here was motivated by the first of these objectives. Accordingly, the parameter values used for the 'alternative' simulations should not be interpreted as 'equally plausible' as those used for the 'base' simulations. Some of these parameters represent unlikely extremes.

Table AI.2 – Model parameters used in sensitivity analysis

Country size and trading status			
	Base	**Large (exporting) country**	**Importing country**
Home country share of world production	0.20	0.50	0.20
Consumption ratio	0.50	0.20	2.00
Farm Factor shares			
	Base	**High**	**Low**
Land	0.20	0.30	0.10
…% owned by farm household	50%	100%	50%
Farm household labour	0.15	0.20	0.10
Elasticities of factor supply			
	Base	**High**	**Low**
Land	0.10	0.30	0.00
Farm household labour	1.00	3.00	0.10
Purchased inputs	1.50	4.50	0.50
Elasticities of factor substitution			
	Base (CD)	**CES**	**Linear**
Land - labour	1.00	0.30	0.00
Land - purchased	1.00	0.50	0.00
Labour - purchased	1.00	0.80	0.00

In order to do policy simulation experiments the model is calibrated to replicate a given set of initial conditions — the actual prices and quantities in some base period for example. (It does not matter which base period is chosen since all the functional relationships in the model are approximated with equations linear in per cent changes in the variables.) A small change in the value of one of the policy parameters is introduced and the model re-solved to calculate a new set of equilibrium values for all endogenous prices and quantities.[1]

Seven different kinds of simulation experiments were undertaken with the model. The aim of these experiments was to measure differences in transfer efficiency results depending on whether we assume:

- Different market structures
  1. Endogenous or exogenous world market prices
  2. Country in question is large or small
  3. Country in question is an exporter or an importer

- Different production structure/parameter values
  4. Production function is Cobb-Douglas, CES or linear
  5. Farm household factor shares are high or low
  6. Elasticities of factor supply are high or low
  7. Initial support levels are high versus low

II. Results

Table AI.3 contains estimates of transfer efficiency from the sensitivity analyses. These estimates were obtained by solving the model documented in Table AI.1 as a single system of simultaneous equations. Base results in the first row of the table embody exactly the same assumptions as those invoked in doing the analysis for the main text — constant world market prices, Cobb-Douglas production technology and base parameter values.[2] All the results presented in the remaining rows were obtained under endogenous world market price assumptions, but with different assumed values for key parameters as shown in Table AI.2 above.

Table AI.3. Sensitivity of transfer efficiency to alternative assumptions

	Deficiency payment	Market price support	Area payment	Input subsidy
Base	***0.26***	***0.25***	***0.48***	***0.15***
Endogenous world prices	0.24	0.24	0.48	0.11
Large (exporting) country	0.18	0.19	0.46	0.03
Importing country	0.27	0.26	0.48	0.12
CES production function	0.27	0.27	0.47	0.13
Linear production function	0.39	0.38	0.42	0.40
High farm factor shares	0.35	0.34	0.96	0.11
Low farm factor shares	0.15	0.15	0.47	0.07
High factor elasticities	0.22	0.22	0.44	0.13
Low factor elasticities	0.27	0.26	0.50	0.04
Zero initial support	0.28	0.28	0.48	0.12

Effect of size and trading status of the home country

Extra producer support, regardless of whether given in the form of market price support or as direct payments based on output, area or input use, leads to some increase in production and a corresponding decline in world market prices. If passed through to the domestic market, a decline in market prices diminishes the income gain that would otherwise be attributable to higher support levels (or, equivalently, increases the costs of providing the same amount of support). However, lower market prices also result in lower-than-otherwise consumer costs. The combined total of taxpayer and consumer costs will be unambiguously higher for a given increase in support in an exporting country but could be lower for an importing country.

In terms of the transfer efficiency calculations, the reduction in income gain associated with lower world market prices will always be greater for an exporting country than any associated induced reduction in the combined total of consumer and taxpayer costs. This means estimated transfer efficiency should be lower where world market prices are accounted for than when not, a result confirmed by the second row of Table AI.3 and illuminated further in the 'large–country' case reported in the third row.

The 'large-country' results in the third row of the table are associated with an assumed home-country share of world agricultural production of 50%. Although no country in the OECD accounts for nearly that high a proportion of production of any one of the PSE commodities, much less for agriculture in total, these results highlight the fact that, if sufficiently widespread, tit-for-tat increases in farm subsidies by governments of 'large-enough' countries are likely to lead to highly inefficient transfers. Or, put the other way round, co-ordinated *reduction*s in agricultural subsidies would likely lead to less income loss among farmers in all countries than would unilateral reductions.

Generally speaking, the transfer efficiency of support measures providing direct price or payment benefits to farmers (all categories studied except input subsidies) is higher for an importing country than for an exporting country. Consumption being larger than production means that the induced gains in consumer surplus are *relatively* more important for the importing country. Recall in this connection that in doing the analysis to estimate the transfer efficiency of market price support it was assumed that trade intervention is one under which the government collects tariff revenues. Transfer efficiency of market price support might be lower under regimes, such as voluntary export restraints or tariff-rate quotas, where the tariff rents are allocated to suppliers.

The most notable differences between the results that were reported in the main text and those reported in Table AI.3 are the much lower transfer efficiency estimates applying to input subsidies, in particular the estimate of 0.03 for the large country case. Indeed, one cannot rule out the logical possibility that an increase in input subsidies could lead to an actual fall in farm household incomes. That is to say, there are combinations of still-reasonable parameter values such that a given increase in subsidies to purchased inputs would cause a subsidy-induced fall in world market price and an associated negative impact on income sufficiently great to swamp the positive income effect of lower purchased input prices. This further explains the relative unimportance of subsidies to purchased inputs in the mix of support measures actually used by OECD governments.

Parameter sensitivity

Compare the estimates of transfer efficiency in the row labelled 'base' with those in the two rows labelled 'CES production function' and 'Linear production function'. There is less difference between the base (Cobb-Douglas) and CES assumptions than between either of these sets of results and those obtained with the linear production function. The qualitative ranking across the four support measures is the same for the linear production function as for the Cobb-Douglas and CES versions. However, with the linear function the transfer efficiencies of the various support measures are all about the same. This is because the linear production function gives simulated *production* effects for each of four support measures (for the same change in support level) that are roughly the same.

More generally, there might be less need to distinguish among various kinds of support measures in discussing the production, trade and welfare effects of support if one could be confident that the aggregate agricultural production function could be represented by a linear function in the context of this study. The conclusions from reviews of past studies of agricultural production done for the PEM crop analysis, published as annexes in the final report (OECD, 2001), are not friendly to such an assumption. Those reviews may not provide consensus estimates of elasticities of factor substitution sufficiently definitive to choose between the Cobb-Douglas and CES alternatives. On the other hand, they do provide a strong basis for rejecting zero values and thus the linear production function as a useful representation for research that focuses on the effects of farm support based on inputs.

Results in the seventh and eighth rows of Table AI.3 reveal the importance of factor share assumptions to estimated transfer efficiency. The logic of the results is simple: the higher the share of total market receipts going to pay for factors supplied by farm households, the higher is transfer efficiency. It does not matter whether those shares are higher because the underlying factor shares for total land and labour are higher or because the proportions of those two factors supplied by farm households are higher. The most flagrant difference in the estimates of transfer efficiency presented in these two rows and those in the rest of the table is that for area payments. Clearly, when all farmland is owned by farming households, area payments constitute a highly efficient means of supporting farm household incomes.

The ninth and tenth rows of Table AI.3 indicates the importance of factor mobility for transfer efficiency. The noteworthy result here is, once again, one relating to subsidies to purchased inputs. It is the 0.04 estimate obtained under assumptions of low elasticities of factor supply. Generally speaking the lower the elasticity of factor supply the higher the economic efficiency of financial transfers. At the limit, subsidising a factor in completely inelastic supply should rank on an efficiency scale (but not usually on an equity scale) alongside the theoretical “pure” lump sum transfer. However, this analysis is not of economic efficiency in the pure sense of the term but of transfer efficiency. In the present context, subsidies to purchased inputs that are inelastically supplied may lead to highly inefficient transfers to farm households.

The final row in Table AI.3 shows results obtained under zero initial levels of support. All the other transfer efficiency results in that and previous tables were obtained assuming a 30% initial rate of support applying to the category of support under study.[3] Comparing these results with those in the base row gives the expected result – the transfer efficiency of a support measure declines with the level of support provided by that measure. The decreasing marginal returns to support follows from the need to apply the full level of support to any new production which occurs as a consequence of the marginal increase in the incentives relating to output or input use.

III. Summary

The estimated transfer efficiency of deficiency payments, of market price support, of area payments and, especially, of subsidies to purchased inputs depends on whether the country in question is large or small, an exporter or an importer and on the particular parameter values assumed. However, taking account of those additional considerations, as was done in this annex, leaves unaltered the essential conclusions reached from the analysis reported in the main text.

NOTES

1. A version of the model in EXCEL was created using the SOLVER software. This EXCEL workbook is available on request.

2 Numerical results differ slightly from those reported in the main text. There are two main reasons for this: *1)* the consumption ratios that were parameters in some of the transfer efficiency formulas are, in effect, endogenous variables in the model, and *2)* numerical results were obtained simulating 'discrete' rather than 'differential' changes in the various policy measures.

3. Italics applied to the latter part of the sentence serve to emphasize that there are many different aspects to the notion of pre-existing levels of support. The very real-world phenomenon of pre-existing levels of support in all categories was not acknowledged. These also have implications for the estimated transfer efficiency of any one category of support. Those possibilities were ignored because of the very large number of permutations and combinations of policy simulation experiments needed to fully address the issue.

Annex II.

Share of farmed land owned by the farmer

	1990	1993	1995	1997	2000
			percentage		
Belgium	33.0	32.8	32.3	31.9	
Denmark	80.9	78.9	77.5	75.1	74.8
Germany	43.3	39.9	38.1	37.0	
Greece	76.4	75.2	73.7	73.8	
Spain	72.3	72.7	72.3	72.3	
France	43.3	39.3	36.8	34.9	
Ireland	87.6	88.1	87.6	86.7	
Italy	80.9	77.8	78.1	78.1	
Luxembourg	50.4	47.6	47.1	46.5	46.1
The Netherlands	66.9	64.6	69.7	71.7	
Austria			78.0	77.2	
Portugal	69.0	69.6	69.6	69.6	
Finland			77.9	80.2	
Sweden			54.8	54.4	
United Kingdom	61.6	61.9	63.7	65.2	
EU15			59.4	59.0	
United States	58.0			61.4	
Canada					82.1

Notes:

EU: total agricultural area (AA) is split between three categories: AA owner farmed + AA tenant farmed + AA share farmed or in other modes of tenure. **USA**: Total land operated defined as owned land plus land rented or leased from others (including AUM land) less land rented out. **Canada:** Area owned in percentage of total area of farms

Source:

EU (region and countries): EUROSTAT, Structure of agricultural holdings. **USA:** Farm Costs and Returns Survey. (USDA) in Farm Operating and Financial Characteristics, 1990 and 1997 Census of Agriculture, USDA. **Canada:** Statistics Canada, Statistical profile highlights, 1998.