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**EFFECTS OF QUANTITATIVE CONSTRAINTS ON THE DEGREE OF DECOUPLING
OF CROP SUPPORT MEASURES**

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NOTE BY THE SECRETARIAT

This paper is the first in a series of five studies on the measurement of decoupling under Activity 6 of the Programme of Work 2001-2002 of the Committee for Agriculture. It has been prepared by Chantal Le Mouél while a member of the Secretariat (currently at INRA, Rennes). It follows the conceptual framework defined in [COM/AGR/APM/TD/WP(2000)14/FINAL] declassified at the 26-28 September 2000 session of the APM and the detailed project proposals defined in [AGR/CA/APM(2001)26] presented in the 30th session of the APM in November 2001.

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EFFECTS OF QUANTITATIVE CONSTRAINTS ON THE DEGREE OF DECOUPLING OF CROP SUPPORT MEASURES

The various categories of measures that comprise the Producer Support Estimates (PSEs) have different effects on production and trade. A study using the Policy Evaluation Matrix (PEM model) (which focuses on cereals and oilseeds) has ranked these effects by size and then classified the various categories of measure according to their degree of decoupling (OECD, 2001*b*). Its findings show that payments based on the use of variable inputs and those based on output (market price support and output payments) are the categories with the greatest impact on production and trade. Conversely, payments based on acreage are the most decoupled category. Furthermore, the impact of such payments is all the lower where there is no obligation to grow specific crops on eligible land in order to receive the support. Finally, the study also reveals a positive correlation between the degree of decoupling of the relevant categories of measure and their efficiency in terms of income transfer to producers.

In this study, the PSE categories considered are stylised representations of the schemes actually implemented in the relevant countries. In particular, certain restrictions or constraints on the allocation of support contained in existing schemes are not taken into account. The restrictions are usually intended to limit the incentive effects on supply and/or the budgetary effects of the scheme concerned. Consequently, if they are really binding, the restrictions potentially lead to an increase in the extent to which a scheme is decoupled. Hence the importance of taking them into account when assessing the degree of decoupling of the various measures used to support agricultural producers.

That is the purpose of this report. The effects of quantitative constraints on the degree of decoupling of crop support measures are particularly relevant in the case of the area payments system used under the Common Market Organisation (CMO) for arable crops in the European Union (EU). This system contains two provisions that are quantitative constraints based on land:

- Historical base area, restricting the acreage entitling farmers to payments;
- Compulsory set-aside which, under the general scheme, is mandatory for farmers applying for payments.¹

This study accordingly focuses on the EU system of area (per hectare) payments. Its purpose is to evaluate the effects of the two quantitative restrictions - base area and set-aside - on the degree of decoupling of the system. The degree of decoupling is analysed according to the two definitions of decoupling adopted by OECD (2001*a*).

1. The EU system of area payments distinguishes between two schemes (simplified/general) and two types of producer (small/commercial). Small producers are those declaring an acreage of cereals, oilseeds and protein crops corresponding to a cereal output of less than 92 tonnes. These small producers are eligible for the simplified scheme exempting them from set-aside. Commercial producers, on the other hand, are large-scale farmers. They must subscribe to the general scheme whereby payments are subject to compulsory set-aside.

The concept of “effective decoupling” corresponds to the least restrictive definition. A policy is considered as being effectively decoupled if it does not lead to an increase in production or trade in the country examined compared to a situation in which the policy was not in place. This notion of decoupling applies when examining the effects of policy instruments on the equilibrium quantities (produced and traded) and refers to a scenario where the only change taken into account is that in the policy instrument itself. The concept of “full decoupling” is more restrictive in that it introduces an additional element. A policy is considered to be fully decoupled if it is effectively decoupled and the measure does not modify the response of production and trade to an exogenous shock. Thus, “full decoupling” focuses on the effects of policy instruments that act, at the same time, on the equilibrium quantities and on the domestic market response to exogenous shocks. This notion therefore refers to a situation in which exogenous shocks accompany the implementation of the policy change under consideration.

The impact of base area and set-aside provisions on the degree of decoupling of the EU system of direct area payments is analysed in this paper from the two perspectives. It is generally accepted that the introduction of a quantitative constraint, of the kind considered here, tends to lessen the effects of the scheme in question on domestic production and trade. This first set of consequences relates to the notion of “effective decoupling”. However, such quantitative constraints also introduce a certain rigidity by making domestic markets less responsive to exogenous shocks. Such effects relate to the concept of “total decoupling”. In so far as this second concept is concerned, this report deals particularly with domestic market response to world market conditions. The objective is to analyse the extent to which base area and set-aside provisions contribute, via the rigidity potentially introduced in the EU supply response, to increase the adjustment pressure on other countries and to increase the variability of world prices.

Our analysis of the degree of decoupling of the EU’s area payments scheme is based on simulations using the PEM model. This model, which focuses on cereals and oilseeds and was developed with the help of some OECD Members, has been adapted by the Secretariat in order to explicitly incorporate base area and set-aside constraints in the EU.

This report is divided into four parts. Part One gives a brief description of base area and set-aside provisions in the EU’s direct area payments scheme, and examines the extent to which they are binding. Part Two analyses the degree of effective decoupling of the scheme. Particular attention is paid to the impact of base area and set-aside constraints on the degree of decoupling. In the context of “total decoupling”, Part Three looks at the impact of the EU system of direct area payments, in particular base area and set-aside provisions, on the variability of world prices. The fourth part sets out the conclusions. It endeavours, on the basis of the specific findings reported here, to gain broader insight into the impact of quantitative constraints on the degree of decoupling of support measures to agricultural producers.

Part 1. Base area and set-aside: how great a constraint on EU producers?

The direct area payment scheme for cereals, oilseeds and protein (COP) crops was introduced in the European Union under the reform of the Common Agricultural Policy (CAP) in 1992 and amended under the Agenda 2000 reform. Base area and compulsory set-aside provisions are an integral part of that scheme, which aims at stabilising COP budget expenses and/or output in the EU.

1.1 The base area provision introduces a slight constraint for EU producers

The base area provision limits the number of hectares for which payments may be claimed. It therefore acts directly as a budget stabiliser and indirectly as a production stabiliser. The base area provision operates as follows:²

- Member States define a national base area or several regional base areas, corresponding (for the country as a whole or individual regions) to the acreage under COP crops (including land set aside under a subsidised set-aside scheme) during the period 1989 to 1991.³
- In the event of a base area “overshoot”, area payments are reduced in proportion to the overshoot for that year, and an extraordinary set-aside requirement, also proportional to the overshoot and not eligible for payment, is applied the following year.⁴ These penalties are confined to the Member State that has recorded the overshoot.

Data observed since the launch of the EU area payments scheme show that the base area provision has always been complied with in the EU as a whole but that there have been frequent overshoots by individual Member States (see Figure 1 and Table 1, together with individual country figures in Annex 1). Figure 1 also suggests that from 1993 to 1999 the total acreage covered by applications for payments in the EU has always been lower (by some 4%) than the total base area.

2. For further details, see Arnoult (2001), an unpublished document available on request.

3. Within the national base area or each regional base area, Member States may distinguish a base area specific to maize, and base areas specific to irrigated and non-irrigated crops.

4. Extraordinary set-aside as a penalty for overshoot was abolished in 1996.

Figure 1. Base area, COP acreage and area set-aside in the EU
(1993-1999)

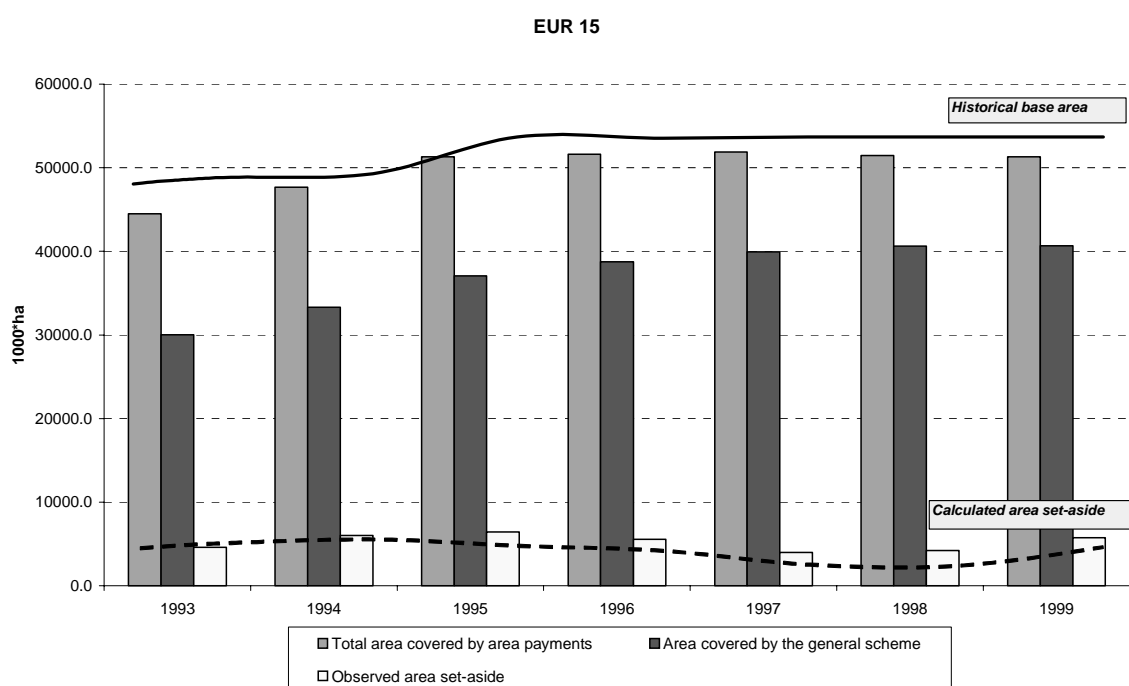


Table 1. Base area overshoots by EU Member States, 1993-1999
(as percentage of base area)

	Number of overshoots	Average overshoot in overshoot years (%)	Maximum overshoot during the period (%)	Minimum overshoot ¹ during the period (%)	Average overshoot during the period (%)	Overshoot - standard deviation (%)
EU	0		(-2.79)	-9.04	-4.41	2.11
Austria	0		(-2.49)	-4.90	-4.07	0.96
Belgium	3	2.30	4.18	-5.43	0.00	3.01
Denmark	4	1.26	1.93	-2.88	0.20	1.61
Finland	0		(-12.07)	-20.11	-16.20	3.36
France	6	1.72	2.62	-0.46	1.41	1.19
Germany	4	0.41	0.65	-2.30	-0.34	1.14
Greece	0		(-11.19)	-19.44	-14.55	3.25
Ireland	0		(-0.58)	-13.01	-7.56	4.61
Italy	0		(-12.43)	-21.71	-17.53	4.47
Luxemb.	1	0.70	0.70	-9.30	-4.65	3.71
Netherlands	0		(-6.64)	-14.68	-8.60	2.77
Portugal	0		(-9.99)	-27.42	-20.35	5.85
Spain	0		(-1.80)	-8.47	-4.80	2.20
Sweden	0		(-8.12)	-11.57	-9.64	1.26
United Kingdom	5	1.54	2.26	-5.20	0.33	2.60

1. "Overshoot" is defined as the difference between the area of crop grown and the base area. The figures reported may be positive (in the case of an overshoot) or negative (in the case of an undershoot). Source : EAGGF Guarantee Section and DG-Agri.

Table 1 shows that the situation in some Member States is similar to that of the EU as a whole. They are Austria, Finland, Greece, Ireland, Italy, the Netherlands, Portugal, Spain and Sweden which, from 1993 to 1999, never overshoot or even reached their base area ceiling (see also figures for individual Member States, Annex 1). For the remaining Member States, however, the base area is a potential constraint. These (with the exception of Luxembourg) regularly registered overshoots between 1993 and 1999 (France six times, the United Kingdom five times, Germany and Denmark four times and Belgium three times).

It is difficult to draw any final conclusions as to whether the base area provision is binding for these Member States.⁵ The fact that they systematically reach their ceiling and that the overshoot is low as a percentage of the base area (Table 1) suggest that the constraint is binding. However, these frequent overshoots may also mean that the penalty system is not dissuasive enough for individual producers, and hence that the base area is not a real constraint at the level of the individual member country.

Clearly the base area provision in the EU does not impose individual constraints on producers since the restriction is defined nationally or regionally.⁶ Each European producer is therefore free to increase his COP acreage if he thinks it will be profitable (and provided he has sufficient eligible land) and receive additional area payments. Such decisions may lead to an overshoot at national or regional level, and to a penalty. When individual producers make their decisions, they must therefore weigh the gain to be derived from allocating more acreage to COP crops against the loss incurred in case of overshoot. Clearly the potential loss must be heavy enough to make producers abandon the idea of increasing their COP acreage. In other words, the penalty must be sufficiently dissuasive in order for the base area to become binding at the Member State level.

However, the penalty system as applied in the EU is probably not very dissuasive. First, the penalty is collective in that it is based on the national or regional overshoot and applied uniformly to all producers, whether or not they have contributed to the overshoot. In other words, contribution to the overshoot is individual, whereas the penalty is collective. There is accordingly no direct link at individual producer level between a contribution to the overshoot and the penalty to be paid. This “dilution” of the penalty means that it is most probably not a disincentive for individual producers⁷. Second, various provisions of the penalty system allow for recorded overshoots to be exempted from any sanction in some cases (for example, overshoots that are less than 1% of the base area provision are not counted; there are compensation possibilities between maize specific and non specific base areas; exemptions can be granted due to bad climatic conditions). Finally, the sanction itself was weakened during the period in that the exceptional set-aside for which no payment could be received (a sanction applied in the year following any overshoot) was suppressed as of 1996.

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5. By definition, a binding restriction is one that effectively constrains decision-making by economic agents and, subsequently, modifies the equilibrium of the relevant market(s), compared with a situation in which the restriction would not apply. In the case in hand, the constrained variable (in this case, the acreage under COP crops for which payments have been claimed) regularly reaches the ceiling (in this case the base area). Conversely, a non-binding restriction has no effect on the equilibrium of the relevant market(s). The constrained variable never reaches the ceiling or regularly exceeds it when the inspection/penalty system is not sufficiently dissuasive.
 6. When the EU’s direct area payments scheme was introduced, Member States could opt for individual base areas, but none of them did so.
 7. This type of situation is conducive to “free-riding”. Since the penalty for overshoot is the same for all producers, regardless of whether they have contributed to it, any producer who might gain from contributing to a potential overshoot will find it worthwhile to do so because the penalty will be the same whether he does so or not, and by going ahead he will increase the likelihood of facing a penalty only very slightly.

Overall, the data observed since the launch of the EU's area payments scheme as well as the analysis of the application of base area provisions suggest that these provisions are likely to be not binding, or at most induce a very slight constraint, on most Member States. It must be underlined, however, that in practice the way the base area provision operates as well as the way producers decide to allocate their land to COP crops are complex, and a certain number of other elements may make the base area provision more binding than suggested by the data. Data used are aggregated data at Member State and EU levels. Aggregated data may hide a range of situations differentiated according to the degree of constraint exerted by the base area provision. Hence, behind aggregated data suggesting a non-binding base area at a Member State level, there may exist producers (considered individually or at the level of a region) who are effectively constrained by the base area provision. This may be the case, for instance, for producers facing technical constraints such as crop rotation requirements which, in addition to the base area constraint, restrain effectively their area allocation decisions to COP crop. This may be the case also for producers located in regions with little available eligible land. If there is available eligible land in other regions, but which is inaccessible to producers in constrained regions⁸, although aggregated data at national level will suggest that the base area is non binding, it is binding for some producers or groups of producers. In the same vein, some producers must decide between receiving area payments for COP crop or animal premia. Their final choice may lead some to declare part of their COP crop area as forage area (in order to benefit from extensification premia). At the national level, such a decision contributes to decreasing the total declared COP area for which payment per hectare has been requested. This can result that such area remains lower than the base area ceiling, thereby suggesting that the base area provision at the national level is not completely binding, when in fact for certain groups of producers it is. Similar situations may appear when, for any reason, some producers decide to grow COP crops without applying for area payments (*i.e.* when producers do not apply for payment by hectare for areas under COP cultivation).⁹ Finally, within the management system of applications for area payments, certain administrative mechanisms in the various Member states and at the EU level may have contributed, and continues to do so, to the fact that over 1993-1999 some Member States and the EU as a whole have never reached their base area ceilings.

Consequently, so as not to restrict the discussion, we shall consider that the three alternatives, namely (1) the base area provision is not binding for Member States, so for the EU as a whole; (2) the base area provision is binding for some Member States but not for the EU as a whole; (3) the base area provision is binding for all Member States and for the EU as a whole, could reflect the reality of the situation in the European Union. We shall keep in mind however that this situation, when observed through aggregated data on the period 1993-1999, rather corresponds to both first alternatives.

1.2. *Compulsory set-aside is a binding constraint on EU producers*

A producer applying for area (per hectare) payments for a specific acreage of COP crops is required to set aside some of that land if he is to receive the payments. The set-aside scheme is therefore a production stabiliser.

8. Available eligible land may be inaccessible because it is located too far from farms of the constrained region. In other respects, some national provisions may prevent farms located in one region to expand by buying or renting land located in another region.

9. DG Agri estimates that, for the EU as a whole, there is an average 1.5 million hectares (that is 3% of the EU base area) gap between the total COP acreage covered by applications for payments and the total cultivated COP acreage. Logically, this gap should correspond to areas cultivated under COP crops without area payment claims. For further details, see Arnoult (2001).

More specifically, the set-aside scheme operates as follows:¹⁰

- Every year an official rate is set for set-aside.
- Only commercial producers, who must belong to the general scheme, are subject to the set-aside requirement.
- Under the general scheme, area payments for a declared acreage of COP crops are subject to the requirement that some of that land (at least the official rate) be set aside.¹¹
- Set-aside acreage is eligible for payments just as is acreage under crops.

Data observed since the launch of direct area payments in the EU show that the set-aside provision has always been complied with by the EU as a whole and by individual Member States (Figure 1 and individual country figures in Annex 1). Some Member States even regularly declare a substantially higher area set-aside than strictly required by the official set-aside rate (called “calculated area set-aside” in the figures). They include Finland, Spain and Sweden. This is why the area set-aside in the EU as a whole exceeds the official rate.

One interesting point is that Member States where the set-aside is regularly above the minimum strictly required by the official set-aside rate are, in general, the same States that systematically under use their base areas (this is particularly true in the case of the two Scandinavian countries). This is partly due to conditions prevailing in the countries concerned which encourage producers to set-aside land on a voluntary basis rather than to cultivate that land for COP crops. Conversely, the Member States where set-aside is, over the period under study, equal to or very slightly exceeding the requirement are, in general, those which regularly overshoot their base areas (notably Belgium, France and the United Kingdom). Production conditions are indeed more favourable in these Member States, and producers are more inclined to opt for the maximum acreage of COP production.

Unlike the base area provision, compulsory set-aside operates at individual producer level. The constraint is individual since all producers in the general scheme must set aside some of their own declared COP acreage. The penalty too is individual, effectively making it dissuasive.¹² The fact that the scheme works on an individual level probably explains why compulsory set-aside is strictly complied with by individual Member States.

10. For further details, see Arnoult (2001).

11. Producers can choose, on a voluntary basis, a set-aside that is higher than the minimum required (corresponding to the institutional rate). This voluntary set-aside must represent a minimum 10% of the surface area allocated to crop production. The land set-aside on a voluntary basis receives the same payment as that land set-aside under the mandatory scheme, up to a limit of 50% of the land surface allocated for crop production.

12. Producers are required to report individually details of their acreage and the breakdown into COP crops and set-aside. Inspections are individual and penalties are confined to producers making false declarations. The penalty for a declaration recognised as intentionally false is exclusion from the direct area payments scheme but also exclusion from any aid scheme (in respect of an area equal to that for which the aid application was rejected) for the following calendar year. For more details of the inspection and penalties system, see Arnoult (2001).

1.3. Potential effects of the base area and set-aside provisions: graphical analysis

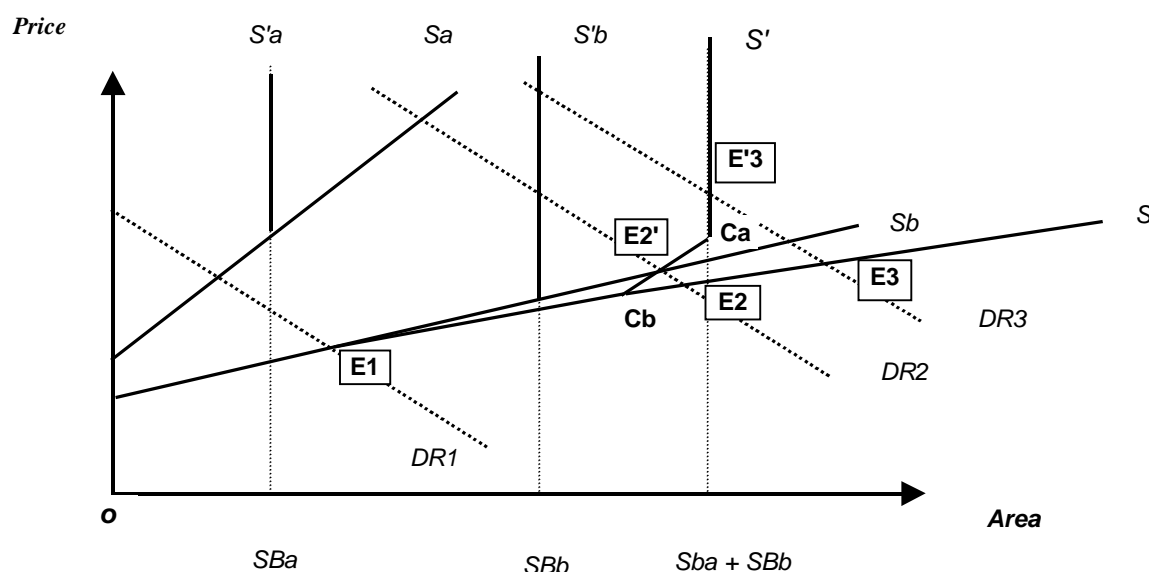
The direct outcome of imposing base area and compulsory set-aside restrictions is to limit the total area of land available for COP crops. The initial impact of the two restrictions therefore affects the supply of COP land in each Member State.

In the figures below, this type of land is taken to be a homogeneous factor in the EU. This simplifying assumption makes it possible to represent the total EU supply of COP land as the sum of the corresponding supply in individual Member States.

1.3.1. Potential effects of the base area provision

Figure 2 shows two groups of Member States, namely group *a*, whose supply of COP land is shown as curve S_a and group *b*, whose supply is shown as curve S_b . With no base area provision, the total supply of COP-type land in the EU corresponds to curve S (obtained by adding curves S_a and S_b).

Figure 2. Base area provision: three possible regimes



Let us now assume that the base area for group *a* is set at SB_a and that of group *b* at SB_b . In that case, the supply curves for the two groups of Member States are kinked and become perfectly inelastic from SB_a and SB_b respectively. These new supply curves are denoted S'_a and S'_b . The curve for total COP land supply in the EU then becomes S' . It contains two kinks, the first at C_b corresponding to the point at which the base area SB_b becomes binding for the group of Member States *b*, and the second at C_a where the group of Member States *a* is also constrained by its base area. Beyond C_a , the S' curve becomes perfectly inelastic since both base areas are then binding.

When there is a base area provision, we can accordingly define three equilibrium regimes on the EU market for COP land:

- The first regime (R1) is a situation in which EU demand for COP land is such that equilibrium is achieved on that part of S' that lies between the origin and C_b . In this case, the base area provision is not binding and its introduction in the EU does not alter the total EU supply around the equilibrium point. This kind of situation is found when the demand curve for COP land in the EU is DR_1 for instance. The initial equilibrium E_1 does not change following the introduction of the base area provision.
- In the second regime (R2), equilibrium is achieved on that part of S' that lies between C_b and C_a . In this case, the base area provision is binding solely for group b and its introduction increases the rigidity of the total EU supply of COP land.¹³ When the demand curve is DR_2 this kind of situation occurs. We then see in Figure 2 that the introduction of the base area provision alters the equilibrium, which moves from E_2 to E'_2 .¹⁴ So, at EU level the base area constraint reduces the acreage under COP crops and increases the supply price of COP land.
- The third regime (R3) corresponds to a situation where equilibrium is achieved on the vertical portion of S' . In this case, the base area provision is a binding for both groups of Member States and its introduction makes the total EU supply of COP land completely inelastic.¹⁵ This occurs when the demand curve is DR_3 . With equilibrium being displaced from E_3 to E'_3 , the adjustments noted are similar to those described for regime R2 but greater in magnitude.

The data observed, at the level of Member states and the EU as a whole, since the launch of the direct area payments scheme tend to indicate that the situation on the market for COP land in the EU does not correspond to regime R3, but rather R2. This is because the evidence resembles equilibrium E_2 or E'_2 in Figure 2. In both cases, COP acreage across the EU as a whole does not amount to the total base area ($SB_a + SB_b$ in Figure 2), one group of Member States reaches its own base area ceiling (group b , *i.e.* Member States which regularly reach or overshoot their base area) while the other group remains below its base area ceiling (group a , *i.e.* Member States where the COP acreage is always less than the base area). Equilibrium E_2 corresponds to the situation whereby group b , although it has reached its base area ceiling, is not effectively under constraint. Equilibrium E'_2 represents the alternative situation in which group b is effectively under constraint.

Accordingly, in the simulations below, we consider that the EU is in regime R2 (Member States regularly exceeding their base area being effectively under constraint or not). However, regime R3 is also taken into consideration to illustrate the effects of a base area that is effectively binding for the EU as a whole. Annex 2 describes how these two regimes are represented in the PEM model.

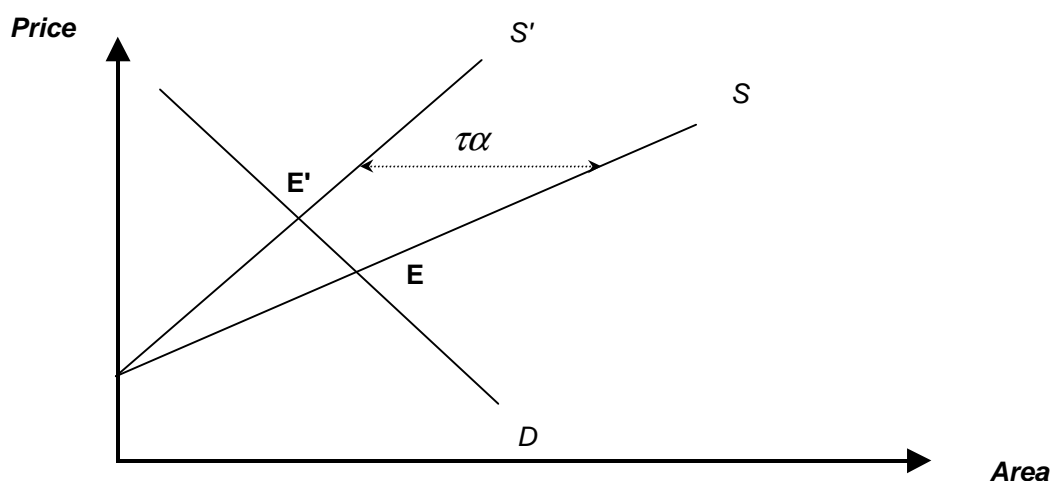
1.3.2. Potential effects of compulsory set-aside

Figure 3 is confined to the total EU supply of COP-type land. Applying an official rate for set-aside (α) causes a shift in the total supply curve from S to S' . Like the base area provision, set-aside

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13. This increased rigidity is expressed in Figure 2 by the steeper slope of the supply curve from S to S' , implying a reduction in the direct price-elasticity of the total supply of COP-type land in the EU.
 14. To simplify the analysis, it is assumed here (and in regime R3) that introducing the base area provision has no effect on total demand for COP-type land in the EU.
 15. In regime R3, the direct price-elasticity of total EU supply is nil.

increases the rigidity of the EU supply of COP-type land. When the demand curve is D , compulsory set-aside shifts the equilibrium from E to E' . Introducing this provision therefore leads to a reduction in COP acreage and an increase in the supply price of such land.

Figure 3. Potential effects of set-aside



In Figure 3, the shift from S to S' implies that the effective rate of set-aside ($\tau\alpha$) is lower than the official rate. This imperfect correspondence between the official and actual rate results from what is commonly known as the « slippage » effect.¹⁶ There are two main reasons for this :

- First, producers are not all required to set aside α % of their COP acreage. Some, for instance, may decide to grow COP crops regardless of requirements or support, *i.e.* without joining the area payments scheme. Second, of those producers involved in the scheme, only those in the general scheme are subject to compulsory set-aside. So the official rate does not apply to all EU land declared as COP land, but only to the acreage covered by the general scheme (which on average over the period 1993-1999 accounted for 75% of the total EU acreage declared under COP crops, see Figure 1).
- Second, producers tend to begin by setting aside the plots that are least productive in terms of COP crops. This results in an increase in the average yield for the remaining acreage. In a framework which does not allow to figure plot heterogeneity, as is the case in Figure 3, this effect can be represented by effectively withdrawing less land from production than implied by the official rate.¹⁷

16. It is important to note that this analysis is based on mandatory set-aside only; the voluntary set-aside is not taken into account. The mandatory rate of set-aside considered here does not include voluntary set-aside.

17. In the following simulations, the slippage factor (corresponding to τ in Figure 3) is set at 0.70. It has been calibrated on the observation that the official rate applies to only 75% of the total EU acreage declared as being under COP crops (average for 1993-1999). The shift to 0.70 seeks to represent the impact of the average yield increase on the remaining acreage.

The data observed since the launch of the EU's direct area payments scheme indicate that compulsory set-aside is a binding constraint on the EU, in that it effectively leads to a specific area (determined by the official rate for set-aside) being excluded from cultivation of COP crops. The « slippage » effect suggests, however, that withdrawing land does not automatically give rise to a proportional reduction in COP output. The relationship between land withdrawal and the impact on output is complex and involves commodity substitution and changes in the overall input mix.

Part 2. Base area and set-aside: impact on the degree of decoupling of area payments

The purpose of this section is to evaluate the production and trade effects of the EU's direct area payments scheme when it includes base area and compulsory set-aside provisions. The analysis is based on a modified version of the PEM model.¹⁸ Changes have been made to the EU land supply module in the initial version of the model, in order to allow the explicit simulation of implementation of base area and set-aside provisions. Annex 2 describes the changes made to the EU land supply module, and the way the effects of the base area and the set-aside provisions are represented in the various scenarios.

2.1. Defining the scenarios

Seven scenarios are used, all of them relating to the EU. Six of them involve an increase in direct area payments:

- The « AP » scenario involves an increase in area payments for wheat, coarse grains and oilseeds. For each crop, a 10% increase in expenditure on area payments is applied compared with their level in base year 1998.
- The « AP-BA2 » scenario uses the same assumptions as the « AP » scenario, with the addition of a base area provision in regime R2, deemed to be binding for some Member States.
- The « AP-BA3 » scenario is based on the same assumptions as « AP-BA2 », except for the base area regime which in this case is R3.
- The « AP-SA » scenario also uses the « AP » scenario assumptions. It also includes an increase of 0.3 percentage points in the official set-aside rate.¹⁹
- The « AP-BA2-SA » scenario (respectively, « AP-BA3-SA ») merges « AP-BA2 » (respectively « AP-BA3 ») and « AP-SA ». In this type of scenario, the base area and set-aside provisions apply simultaneously.

The last scenario involves another PSE category: market price support (« MPS » scenario). The MPS scenario is the reference base as it is possible to compare the effects of the six scenarios based on area payments with the effects of an identical increase in support expenditure but allocated via another category.²⁰

18. A description of the model is given in OECD (2001*b*).

19. This increase in the official set-aside rate has been calibrated so that total receipts for producers of wheat, coarse grains and oilseeds remain unchanged against base year 1998.

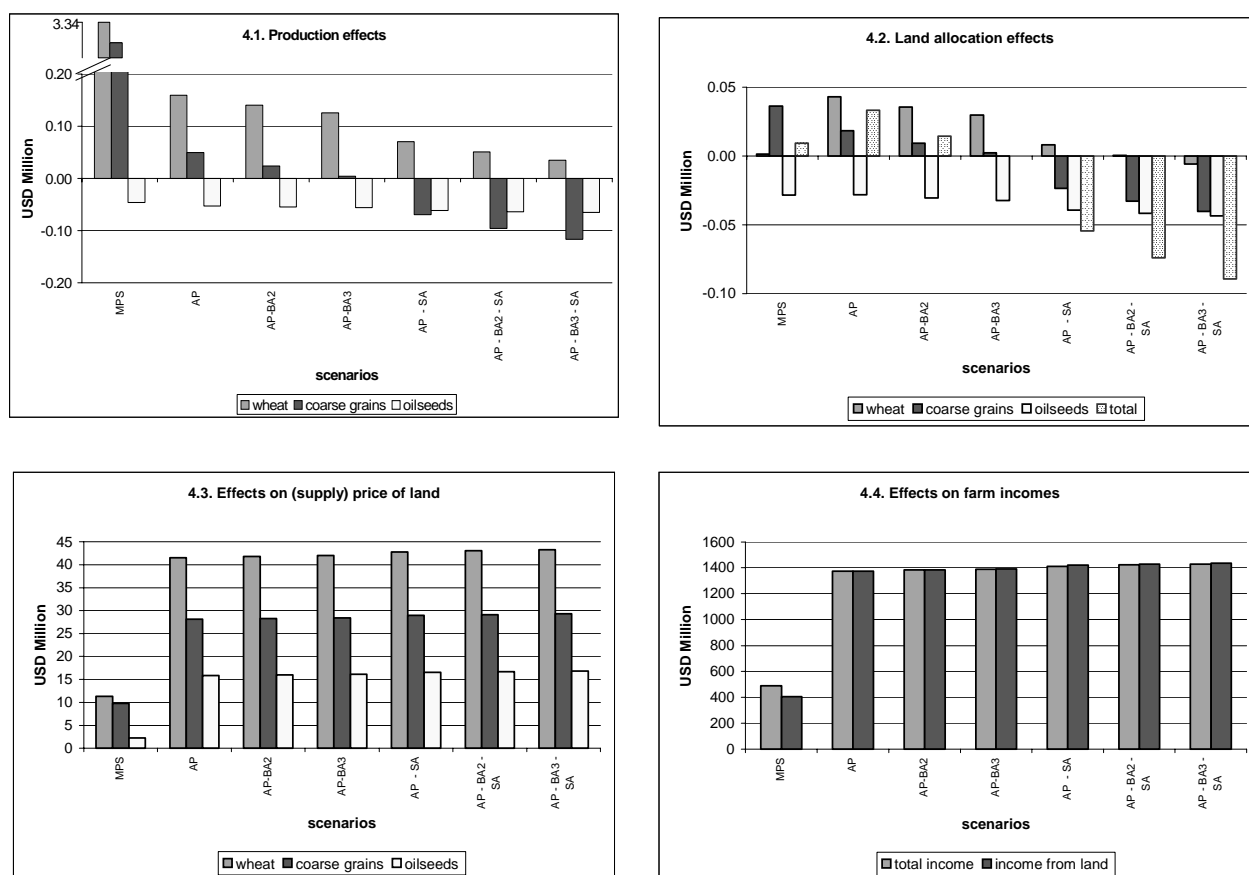
20. For example, in the six scenarios on direct area payments, expenditures associated with direct payments increased by USD 740 million for wheat (corresponding to a 10% increase in direct payments for the base

The « AP » and « AP-BA2 » scenarios are closest to the realities of the EU situation, as described through observed data, in terms of the degree of constraint imposed by the base area provision. The « AP-BA2 » scenario corresponds to regime R2 in which some Member States are effectively constrained. The « AP » scenario relates to a situation in which no Member State is really constrained.

2.2 Effects of the various scenarios on production, trade and land allocation in the EU

Figure 4 and Table 2 summarise the simulation results of the seven scenarios for the EU.

Figure 4. Simulation results for the seven EU scenarios
(differences with base year 1998)



year 1998). In the MPS scenario, transfer payments associated with market price subsidies for wheat increased by the same amount only in the six preceding scenarios, *i.e.* USD 740 million.

Table 2. Simulation results of the seven EU scenarios
(percentage change on base year 1998)

	MPS	AP	AP-BA2	AP-BA3	AP-SA	AP-BA2-SA	AP-BA2-SA
Output							
Wheat	3.22	0.15	0.14	0.12	0.07	0.05	0.03
Coarse grains	3.33	0.05	0.03	0.00	-0.07	-0.10	-0.12
Oilseeds	-0.32	-0.36	-0.37	-0.38	-0.42	-0.44	-0.45
Net exports¹							
Wheat	14.24	0.63	0.55	0.50	0.29	0.21	0.15
Coarse grains	25.74	0.37	0.18	0.03	-0.53	-0.73	-0.89
Oilseeds	-0.63	0.34	0.35	0.36	0.39	0.41	0.42
Land allocation							
Wheat	0.01	0.25	0.21	0.17	0.05	0.00	-0.03
Coarse grains	0.18	0.09	0.05	0.01	-0.12	-0.16	-0.20
Oilseeds	-0.49	-0.49	-0.53	-0.56	-0.08	-0.72	-0.75
Total	0.02	0.08	0.03	0.00	-0.13	-0.17	-0.21
Price of land (supply)							
Wheat	2.07	7.61	7.66	7.70	7.84	7.89	7.93
Coarse grains	2.51	7.18	7.23	7.27	7.40	7.44	7.48
Oilseeds	0.81	5.65	5.70	5.74	5.90	5.95	6.00
Price of land (demand)							
Wheat	9.82	-0.20	-0.15	-0.11	0.04	0.09	0.14
Coarse grains	9.42	-0.08	-0.04	-0.01	0.09	0.12	0.15
Oilseeds	1.70	0.28	0.35	0.39	0.58	0.64	0.70
Income (USD million)							
From land	404.56	1373.87	1382.66	1389.31	1414.45	1423.50	1430.64
Total	489.64	1374.34	1382.69	1389.01	1412.90	1421.50	1428.29

1. Exports nettes = Production intérieure – Consommation intérieure. Les exportations nettes d'oléagineux sont négatives car l'UE est importatrice nette de ce produit. Dans ce cas, un pourcentage de variation positif (négatif) indique une augmentation (diminution) des importations.

1. Net exports = Domestic output – domestic consumption. Net oilseed exports are negative as the EU is a net importer of this commodity. In this case a positive (negative) percentage change indicates an increase (decrease) in imports.

2.2.1. Different effects depending on the crop examined

First let us look at the « MPS » and « AP » scenarios. Figure 4.1 shows that these two scenarios have different effects on production depending on the crop considered. These two scenarios clearly favour cereals to the detriment of oilseeds. Thus, for the EU the “MPS scenario” leads to a +3.33 increased output of coarse grains and a +3.22% increase of wheat with respect to base year 1998 (Table 2). However, this same scenario leads to a -0,32% decrease in oilseed production. The « AP » scenario produces similar effects for all three crops, but of a lesser magnitude for cereals (+0.05% and +0.15% respectively for coarse grains and wheat), but slightly greater for oilseeds (-0.36% for the base year 1998).

This first result is a perfect illustration of the role of cross effects between crops. It shows that due to cross effects (reflected in the PEM model, through competition between crops for land) an increase in support to producers, using a measure that covers several crops, can favour certain crops to the detriment of others.

Figure 4.2 shows that these differentiated effects by crops in the two scenarios, also apply to land allocation in a way that is analogous to the effects on production. One interesting point is that adjustments to acreage compared with adjustments to output are, as a rule, smaller in the « AP » scenario than in the « MPS » scenario. In the « AP » scenario, the additional expenditure on support is granted to the land factor. This scenario leads directly to an adjustment in acreage. Substitutions between land and other inputs then lead to the adjustments observed in output. In the « MPS » scenario, on the other hand, additional expenditure goes directly to commodities. Consequently the scenario directly generates an adjustment in output, achieved through substitution between all of the inputs. In this case, however, there is no direct impetus « forcing » adjustment in the less mobile inputs (including land), so that it is basically the more mobile inputs (in particular variable ones such as fertiliser and pesticides) that undergo adjustment. For instance, Table 2 suggests that in the « MPS » scenario, the +3.22% increase in wheat output stems mainly from increased yields per hectare, since the corresponding acreage remains virtually unchanged. On the other hand, in the « AP » scenario the additional +0.15% in wheat output is accompanied by a +0.25% increase in acreage, implying a decrease in yields per hectare.

2.2.2. *Impact of introducing base area and set-aside provisions*

Let us look at the « AP » and « AP-BA2 » scenarios, which most closely resemble the reality of the EU situation, as described by observed data, concerning the degree of constraint imposed by the current base area provision. The « AP » scenario corresponds to a situation where the base area is not binding for Member States or for the EU as a whole. In this case, introducing the provision does not change in any way the effects of an increase in area payments on production and trade.

The « AP-BA2 » scenario corresponds to a situation whereby the base area is binding for some EU Member States. Figures 4.1 and 4.2 and Table 2 show that the implementation of the base area provision, in this case, has very little impact on the production and trade effects of direct area payments. By reducing the mobility of land across COP crops and other agricultural uses a little, the base area does slightly curb the expansion effect on COP acreage compared with that observed in the « AP » scenario. As there is no change in the substitution effects between COP crops, the introduction of the base area results in a slightly smaller increase for cereals and a slightly higher decrease for oilseeds.

Overall, the results of the « AP » and « AP-BA2 » scenarios suggest that the base area provision, as applied in the EU, would have very little impact on the degree of decoupling of the EU's direct area payments scheme.

The results of the « AP-BA3 » scenario indicate that even when the base area provision is binding for all member countries of the EU, it does not cancel out the production and trade effects of direct area payments. The main impact of a binding base area is that it cancels out the expansion effect on COP acreage, following an increase in area payments. A binding base area is therefore a greater curb on the incentive effects of area payments on land allocation and production. In this regard, Figures 4.1 and 4.2 and Table 2 indicate that the « AP-BA3 » scenario has effects similar to those described above for « AP-BA2 », but of a slightly greater magnitude. However, even when it is binding, the base area does not prevent adjustments in acreage for each COP crop within the limits of the constraint, nor changes in the input mix. The results of our simulations show, for instance, that even when the base area is a constraint, direct area payments still increase cereal production and net exports, and result in a slightly greater reduction in oilseed production and net imports.

Overall, the findings of the « AP-BA3 » scenario suggest that introducing a base area provision that is binding for Member States and for the EU as a whole would slightly increase the degree of decoupling of the direct area payments scheme. However, the provision would not fully cancel out the

production and trade effects of these direct payments. The impact of the base area provision in reducing the incentive effects of direct area payments on production and trade remains limited, even when that provision is effectively binding. There are three main reasons for this:

- The base area applies to an input — land — which is not very mobile. Its main effect is to reduce the mobility of land across COP crops and other possible farm uses. As the initial degree of mobility is already very low, the base area is bound to have only a limited impact.
- The base area applies to total COP acreage. Consequently, even when it is binding, it does not prevent adjustments to the area given over to each COP crop within that constraint.
- The base area applies to an input which can, to some extent, be substituted for other inputs. This provision, even binding, allows adjustments to the input mix via input substitution.

Figures 4.1 and 4.2 and Table 2 suggest that the set-aside provision causes a more noticeable reduction in the incentive effects of direct area payments on production than the base area provision. The simulation results of the « AP-SA » scenario reveal that set-aside is a quite effective way of limiting the EU supply of cereals and oilseeds. They show that a slight increase in the set-aside rate is sufficient to offset the incentive effects of area payments on production. Our simulation findings accordingly suggest that the current EU set-aside provision effectively tends to increase the degree of decoupling of the EU direct area payments scheme.

The effects of set-aside on supply and land-allocation are, of course, more noticeable when set-aside is combined with the base area provision (« AP-BA2-SA » and « AP-BA3-SA » scenarios). In this case, it may be harder or impossible to adjust the acreage under cereals and oilseeds.

2.2.3 *Sensitivity of simulation results to EU land supply parameters*

An analysis of the sensitivity of the simulation results to direct and cross price-elasticities of the EU supply of different types of land (Annex 2) shows that these results are, of course, sensitive to these parameters. Table 3 lists various indicators for testing the sensitivity of the results of various scenarios to price elasticities of land supply in the EU.

It comes as no surprise to find the results of the « AP » scenario are generally more sensitive than those of the « MPS » scenario. Area payments are directly targeted at cereal and oilseed acreage. Their impact on production therefore depends to a great extent on the degree of land mobility between the cereal/oilseed group and other possible farm uses on the one hand, and between the various cereals and oilseeds on the other. It is the various price-elasticities of land supply that represent this degree of mobility which are varied in the sensitivity analysis.

Table 3. Sensitivity of simulation results to price elasticities of EU land supply
(percentage change on base year 1998, based on the results of 100 simulations
incorporating stochastic values for the parameters of the EU land supply module)

		SPM	PH	PH-SB3	PH-GT	PH-SB3-GT
Output						
Wheat	Average	3.227	0.171	0.116	0.089	0.028
	Min	3.208	0.000	0.005	-0.067	-0.083
	Max	3.235	0.302	0.191	0.220	0.104
	Standard deviation	0.006	0.085	0.053	0.082	0.054
Coarse grains	Mo Average	3.341	0.096	0.005	-0.025	-0.123
	Min	3.246	-0.018	0.000	-0.148	-0.124
	Max	3.418	0.186	0.008	0.062	-0.122
	Standard deviation	0.050	0.054	0.002	0.052	0.001
Oilseeds.	Average	-0.300	-0.304	-0.368	-0.363	-0.430
	Min	-0.584	-0.619	-0.610	-0.676	-0.667
	Max	-0.005	0.000	-0.016	0.000	-0.086
	Standard deviation	0.159	0.159	0.170	0.159	0.167
Trade						
Wheat	Average	14.261	0.696	0.476	0.368	0.129
	Min	14.208	0.000	0.021	-0.267	-0.330
	Max	14.315	1.227	0.787	0.899	0.442
	Standard deviation	0.032	0.344	0.220	0.334	0.221
Coarse grains	Average	25.780	0.683	0.029	-0.183	-0.891
	Min	25.175	-0.136	0.001	-1.069	-0.893
	Max	26.271	1.330	0.051	0.440	-0.887
	Standard deviation	0.317	0.388	0.015	0.372	0.002
Oilseeds.	Average	-0.643	0.288	0.345	0.340	0.401
	Min	-0.917	0.000	0.015	0.000	0.078
	Max	-0.385	0.581	0.573	0.631	0.623
	Standard deviation	0.146	0.150	0.160	0.150	0.156

Neither does it come as a surprise to find that the least sensitive results are those of the scenarios that include a base area that is binding for the EU (« AP-BA3 » and « AP-BA3-SA »). This is because, for the latter, the supply of land for cereals and oilseeds is completely inelastic, meaning that this part of the land supply system is no longer sensitive to changes in price-elasticities.²¹

The findings of our sensitivity analysis, however, do not call into question any of the conclusions set out above.

21. This applies above all to the results for cereals, since those for oilseeds tend to be more sensitive in the “AP-BA3” and “AP-BA3-SA” scenarios than in the “AP” and “AP-SA” scenarios.

2.3. *Impact of base area and set-aside provisions on land supply prices and farm incomes*

Let us first consider the « MPS » and « AP » scenarios. Figure 4.3 and Table 2 show that these two scenarios have a positive effect on the supply prices of various types of land, the impact of « AP » being significantly greater here than the impact of « MPS ». This illustrates the implications of more or less closely targeting support at a specific input. In the « MPS » scenario, support is not targeted to any specific input but is spread across them all. Conversely, in the « AP » scenario, support is targeted at land. This explains why increases in the supply price of the various types of land are higher in the « AP » than in the « MPS » scenario.

Consequently, since base area and set-aside both make EU supply of land for cereals and oilseeds less elastic, *i.e.* less mobile between cereals/oilseeds on the one hand and other farm uses on the other, the two provisions make area payments more targeted. In other words, when base area and set-aside provisions apply, cereal and oilseed acreage becomes more crop-specific. The more crop-specific a factor of production is, the less the support for that factor is spread among other inputs and the greater its positive impact will be on the price of that factor. The results of the « AP-BA3 », « AP-SA » and « AP-BA3-SA » scenarios indicate that introducing base area and set-aside provisions very slightly amplifies upward adjustment in the supply price of the various types of land, following the increase in area payments (Figure 4.3 and Table 2).

For the purposes of this analysis, all land is considered as belonging to agricultural producers. Some of their income is accordingly derived from land rent. Figure 4.4 and Table 2 show that all of the scenarios generate an increase in farm incomes, and that the increase stems almost exclusively from the increase in land rent. This in turn stems from the upward adjustment of land supply prices, described earlier. The adjustment is smaller in the « MPS » scenario, which accordingly gives a markedly smaller increase in farm income than the other scenarios. Similarly, because the supply price of the various types of land rise more when land becomes less mobile across alternative uses, the introduction of base area and set-aside provisions leads to a greater increase in land rent and farm income.

A final point worth noting is that, since all of our scenarios involve the same increase in support expenditure, the findings obtained here concerning the effects of each scenario on farm income are fully consistent with those set out in OECD (2001*b*), regarding the transfer efficiency of different PSE categories of measures.²² As in OECD (2001*b*), our findings suggest that direct area payments (« AP » scenario) are markedly more transfer-efficient than market price support (« MPS » scenario).

22. The transfer efficiency of a category of measures is its capacity to transfer income to agricultural producers. For a detailed analysis of the transfer efficiency of the various categories of PSE measures, see also OECD (2001*c*).

Part 3. Base area and set-aside : impact on world price variability

Base area and set-aside provisions make the EU supply of land for cereals and oilseeds more rigid. This additional rigidity tends, as we saw in the previous part, to reduce the positive response of EU COP production and trade to direct area payments. At the same time, the additional rigidity may reduce the domestic market response to changes in world market conditions, thereby accentuating the adjustment required in other countries. This type of effect, which relates to the notion of “total decoupling” of a policy instrument can be evaluated by its impact on world price variability ; an increase suggesting reduced domestic market response and a greater need for adjustment in other countries.

The purpose of this section is therefore to measure the impact of introducing base area and set-aside provisions on the variability of world cereal and oilseed prices. To that end, the preceding scenarios have been simulated by incorporating into the PEM model random shocks on « Rest of the World » output. These random shocks are assumed to be normally distributed and calibrated so that the simulated coefficient of variation²³ for the world price of each commodity in the PEM model is equal to its coefficient of variation based on the PSE database for 1986-2000.²⁴

Two series of 100 simulations were carried out using alternative, extreme hypotheses on the degree of transmission between world and EU cereal prices : no transmission versus perfect transmission. The coefficients of variation for world cereal and oilseed prices obtained in both cases for the scenarios focusing on direct area payments are given in Table 4.

Table 4 illustrates first of all the importance of the degree of transmission between world and domestic prices with regard to the impact of each scenario on world price variability. This impact is greater when there is no transmission between EU and world cereal prices. The effect of the degree of price transmission is particularly important for wheat. Whatever the scenario, the coefficient of variation of the world wheat price shifts from around 0.26 when transmission is perfect to around 0.42 when there is no transmission. The findings are less spectacular for coarse grains, but the effect of the degree of price transmission is still significant, since the coefficient of variation of the world price shifts from around 0.21 when transmission is perfect to around 0.27 when there is no transmission.

23. The coefficient of variation for the random variable X is defined as: $CV(X) = \sigma_X / \bar{X}$, where σ_X is the standard deviation of X and \bar{X} , its mean. The coefficient of variation measures the variability of variable X.

24. The definition and calibration of random shocks on the “Rest of the World” output are the same as those used in [AGR/CA/APM(2002)13/REV1].

Table 4. Coefficients of variation of world prices and output, acreage and yields in the EU

(based on the results of two series of 100 simulations incorporating stochastic shocks on « Rest of the World » supply)

	No price transmission				Perfect price transmission			
	AP	AP-SA	AP-BA3	AP-BA3-SA	AP	AP-SA	AP-BA3	AP-BA3-SA
Wheat								
World prices	0.425	0.425	0.426	0.424	0.266	0.266	0.267	0.267
EU output	0.029	0.029	0.032	0.032	0.282	0.282	0.282	0.282
EU acreage	0.009	0.009	0.015	0.015	0.017	0.017	0.015	0.015
EU yields	0.021	0.020	0.017	0.017	0.265	0.265	0.266	0.266
Coarse grains								
World prices	0.270	0.270	0.271	0.271	0.209	0.209	0.210	0.210
EU output	0.037	0.037	0.041	0.041	0.126	0.126	0.125	0.125
EU acreage	0.010	0.010	0.017	0.017	0.018	0.019	0.017	0.017
EU yields	0.027	0.026	0.024	0.024	0.126	0.127	0.127	0.127
Oilseeds								
World prices	0.202	0.175	0.202	0.202	0.173	0.173	0.174	0.174
EU output	0.362	0.361	0.359	0.360	0.154	0.154	0.154	0.154
EU acreage	0.106	0.107	0.100	0.101	0.028	0.028	0.100	0.101
EU yields	0.252	0.256	0.259	0.258	0.126	0.126	0.133	0.129
EU cereal/oilseed acreage	0.006	0.006	0	0	0.003	0.003	0	0

This comes as no surprise, since the lack of price transmission between world and EU prices makes the EU supply of both types of cereal inelastic with respect to world price variations. For instance, domestic wheat and coarse grain markets do not respond to developments on world markets (here it is worth noting that, when transmission is assumed to be nil, the coefficients of variation for EU wheat and coarse grain output are very low). The result is greater variability in corresponding world prices.

A similar impact was expected once base area and set-aside provisions were introduced. As both provisions help to reduce mobility (across alternative uses) of one of the inputs required for cereal and oilseed production (in this case land), they also make for greater rigidity in the EU supply of these crops. In fact Table 4 shows that the additional rigidity introduced via the land factor is very low. Consequently, base area and set-aside provisions have no marked effect on the world price variability of cereals and oilseeds (for each price transmission alternative, the coefficients of variation of world prices are virtually constant, whatever the scenario).

Several factors help to explain why there is no effect. The rigidity introduced into the EU land supply system is relatively low. More specifically, as land is already a relatively immobile factor across the cereal/oilseed group and other possible farm uses, the introduction of base area and set-aside provisions does not involve a drastic reduction in that mobility. Here, Table 4 shows that the variability of the EU acreage under cereals and oilseeds alters very little with the introduction of base area and set-aside provisions (the coefficient of variation falls from 0.006 to 0 when price transmission is assumed to be nil and from 0.003 to 0 under the alternative assumption).

- The rigidity affects the total cereal and oilseed acreage. It does not therefore make the acreage for each of these crops completely rigid, since there is still the option of adjustment within the constraint. In the case of perfect price transmission, for instance, it is clear that introducing base area and set-aside provisions does not really affect the variability of wheat and coarse grain acreages, whereas it does increase the variability of oilseed acreage.

- The rigidity introduced into the land factor does not really lead to greater rigidity in commodity supply. More specifically, since land is substitutable by other inputs, it is those inputs that are adjusted when land is hard or impossible to adjust.

Conclusion

The data observed since the introduction of the EU's direct area payments scheme suggest that the base area provision, as it currently operates, would not be binding for the EU as a whole and would probably induce only a slight constraint on Member States. Simulations carried out, under this assumption, with the PEM model show that the provision has very little impact on the degree of decoupling of area payments.

It should be recalled, however, that aggregate data may lead to underestimate the degree of constraint effectively exerted by the base area provision on EU producers. This is the reason why the assumption of a binding base area for all Member states and the EU as a whole has also been considered in our analysis. Simulation results obtained under this assumption show that a binding base area would make for increased decoupling of area payments. However, the impact would be limited and the introduction of a binding base area would not fully cancel out the production and trade effects of direct area payments. There are several reasons for this. First, because it applies to an input that is already not very mobile (land), a base area is bound to have a limited impact when it comes to reducing the mobility of that input across alternative uses. Second, because it applies to the total acreage under COP crops, a base area does not prevent the acreage allocated to each of those crops from being adjusted within the constraint. Finally, because it applies to an input that is substitutable for other inputs, a base area — even when it is binding — does not prevent adjustment in the input mix. The production effects of a quantitative constraint on a single input such as the base area are accordingly far less direct and automatic than the effects of a quantitative constraint directly affecting output.

As for the set-aside provision, it is a binding constraint on the EU in that it effectively leads to a specific acreage being excluded from COP production. The simulation findings show that set-aside diminishes the incentive effects on production generated by direct area payments more significantly than base area. They indicate that a small rise in the official set-aside rate may offset the positive production and trade effects of direct area payments.

Finally, the simulation findings indicate that base area and set-aside provisions have no marked effect on the variability of world prices of cereals and oilseeds (*i.e.* on the degree of « total decoupling » of direct area payments) in the EU. This is because the additional rigidity introduced into the EU supply of the various COP crops by both of these quantitative constraints remains very limited. Consequently, the reduction in domestic market response to changes in world market conditions that can be attributed solely to the impact of base area and set-aside provisions is very slight. These two quantitative constraints accordingly have no significant effect on the variability of world cereal and oilseed prices.

The quantitative constraints accompanying specific farm support schemes are, in general, efficient at limiting the incentive effects on production and trade only if they place effective constraints at the level of the individual producer. Our study clearly illustrates this :

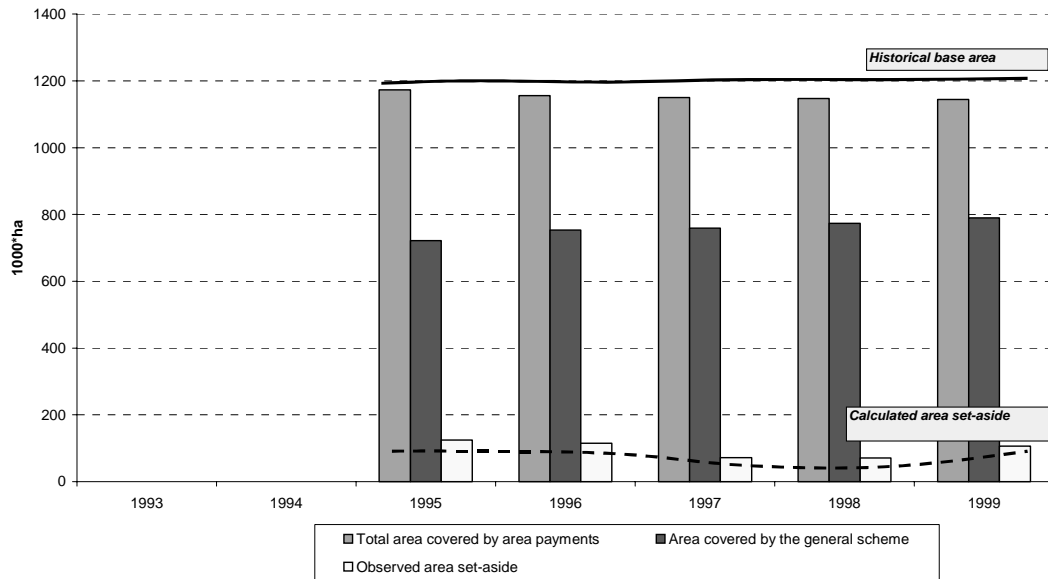
- The base area provision, as used in the EU, is above all a means of stabilising budgetary expenditure on the direct area payments scheme. Its use at national or regional level and its collective penalty system are consistent with an objective of stabilising budgetary expenditure. But this *modus operandi* imposes no constraint on individual producers. The provision is therefore a very weak constraint on producers and has a limited impact on the production

incentives of area payments. In other words, the base area provision has little impact on the degree of decoupling of direct area payments.

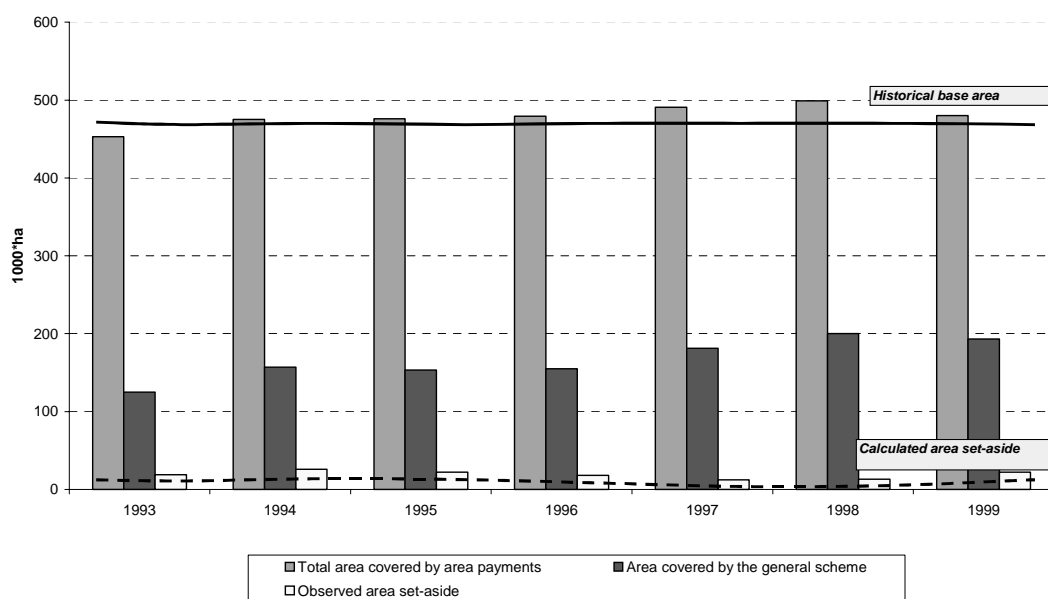
- The compulsory set-aside provision is an instrument for managing the EU supply of COP crops, the aim of which is to regulate domestic market equilibrium. Set-aside therefore has a more direct impact on supply than the base area provision. Our simulation findings are a good illustration of this and show that set-aside can effectively reduce the incentive effects of the EU's direct area payments on production and trade. Thus, the obligatory set-aside requirement increases the degree of decoupling of area payments.
- Our study also shows that the introduction of a quantitative constraint such as the base area cannot, even when it is effectively binding, fully cancel out the incentive effects of the relevant support scheme on supply. This could be achieved by quantitative constraints applied directly to output, thereby directly preventing any expansion effect the scheme might have on production. At the same time, however, such an instrument would make domestic supply completely rigid, and therefore no longer responsive to world price variations. Hence, such an instrument would increase the world price variability of the products concerned, or in other words would reduce the degree of « total decoupling » of the relevant support scheme.

Annex 1.
Base area, COP Acreage and area set-aside
in individual EU Member States (1993-1999)

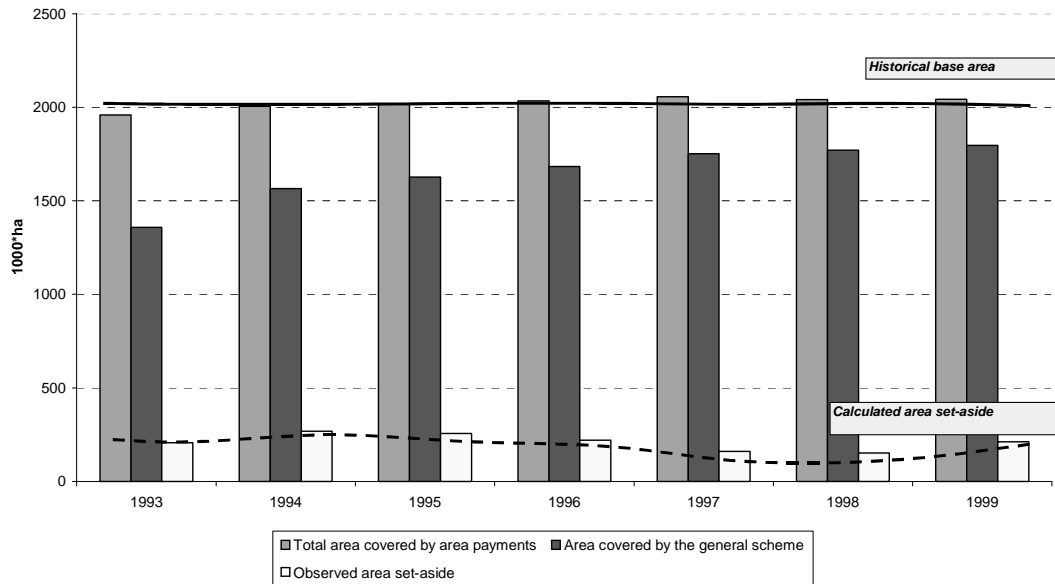
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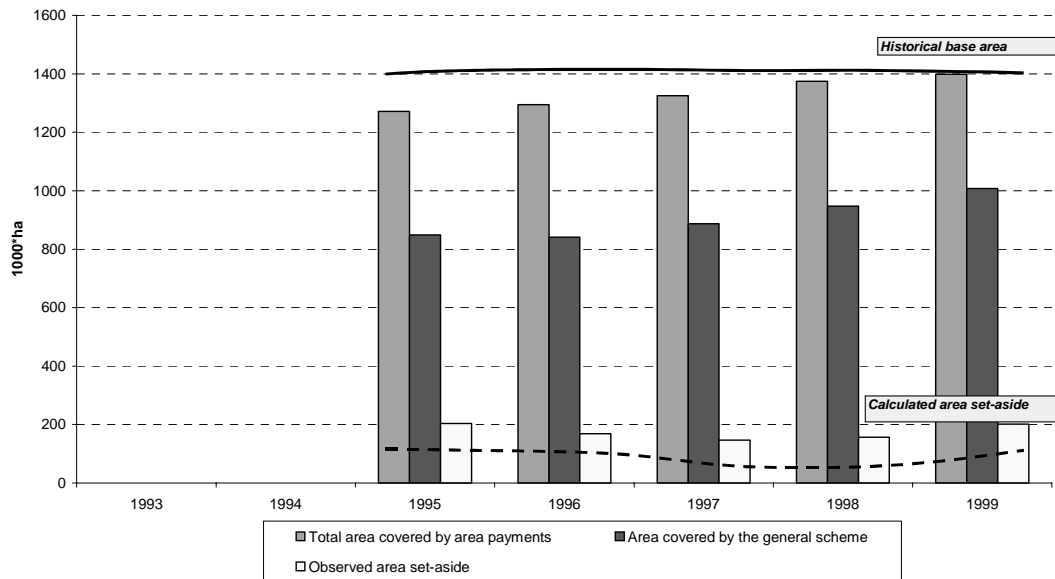
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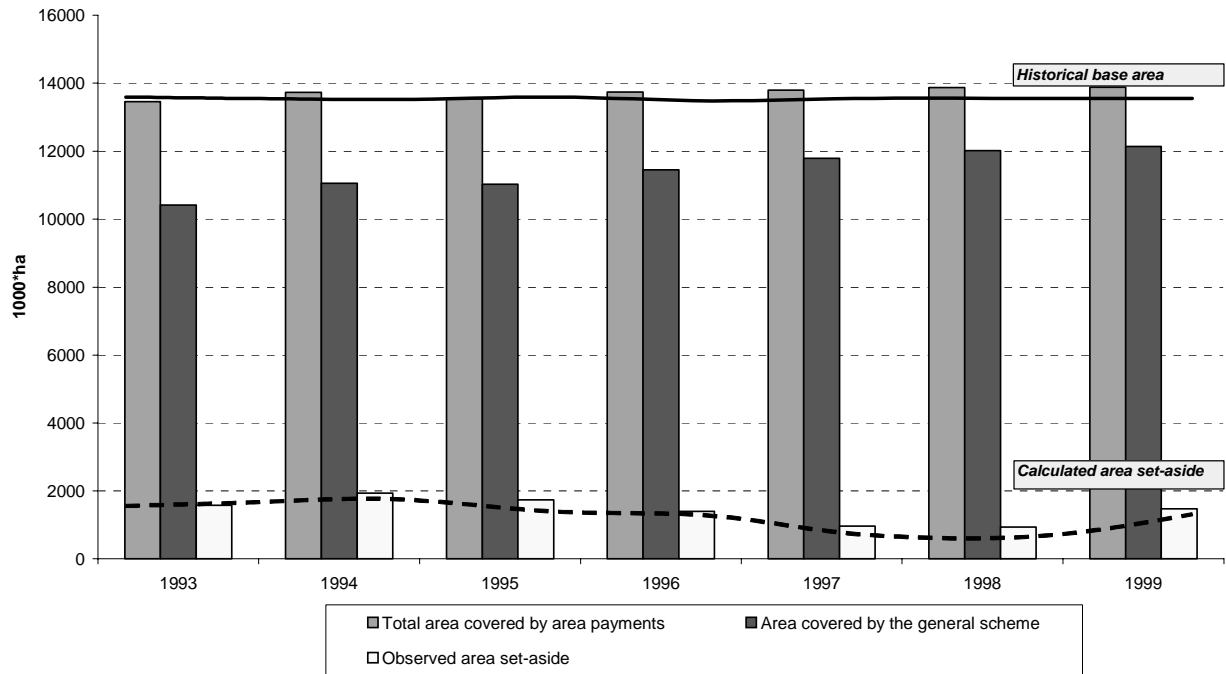
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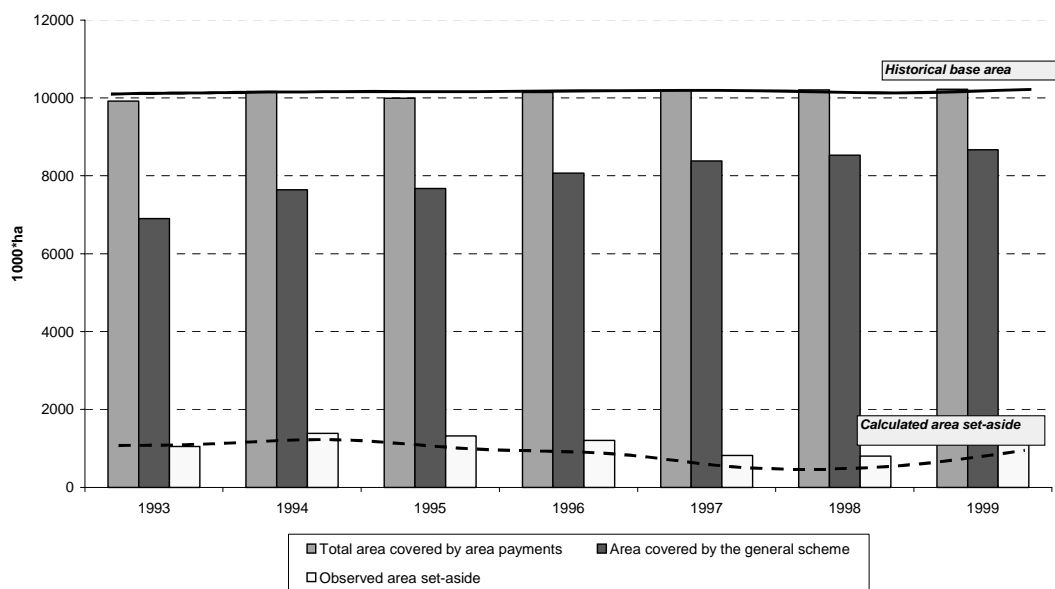
FINLAND



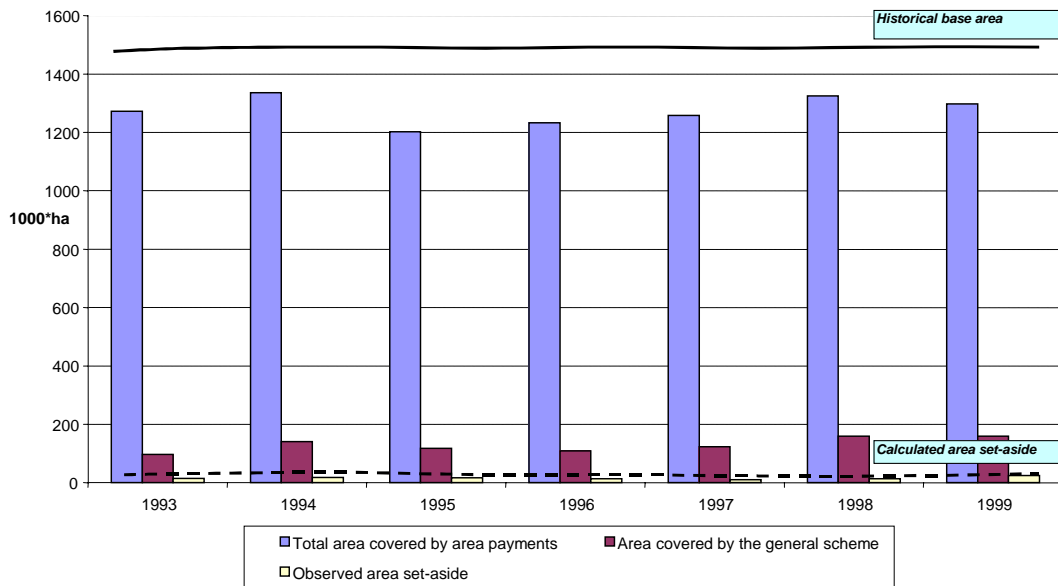
FRANCE



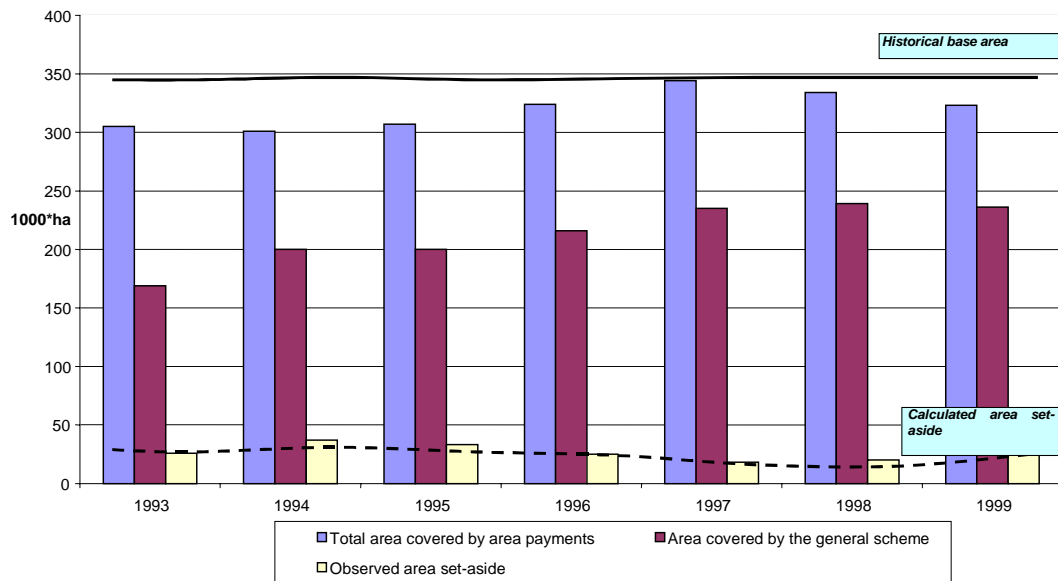
GERMANY



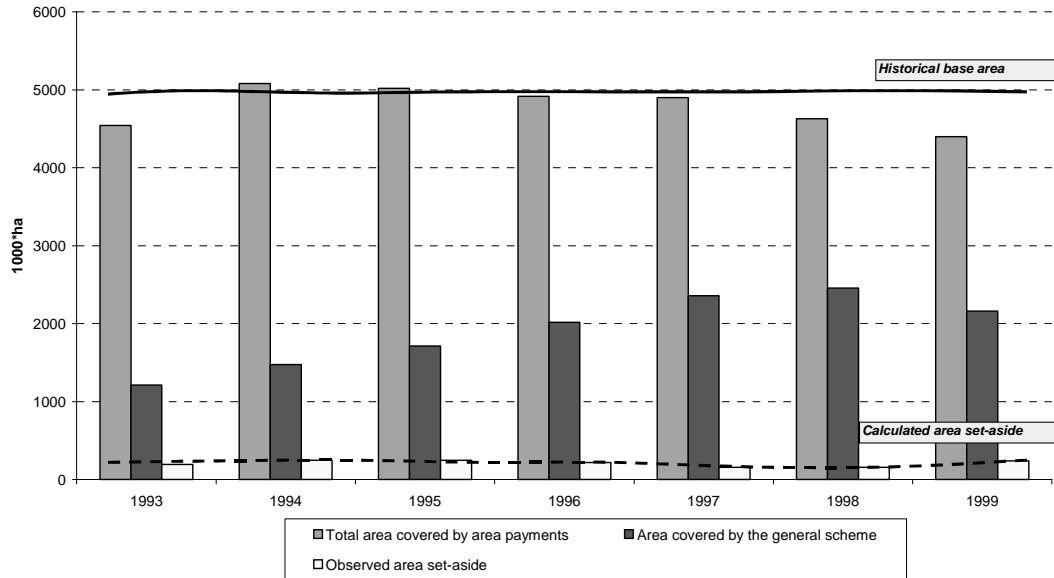
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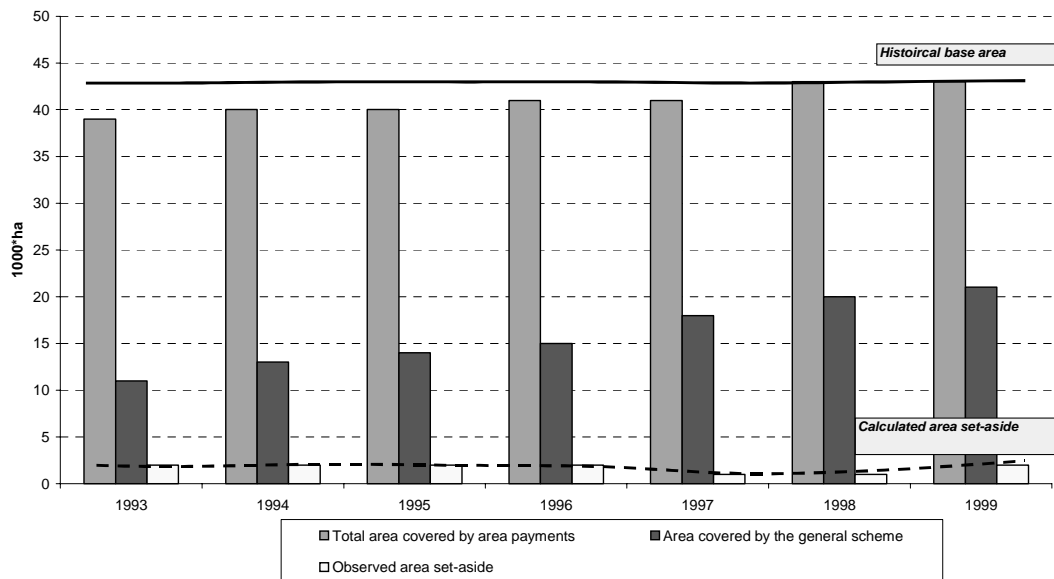
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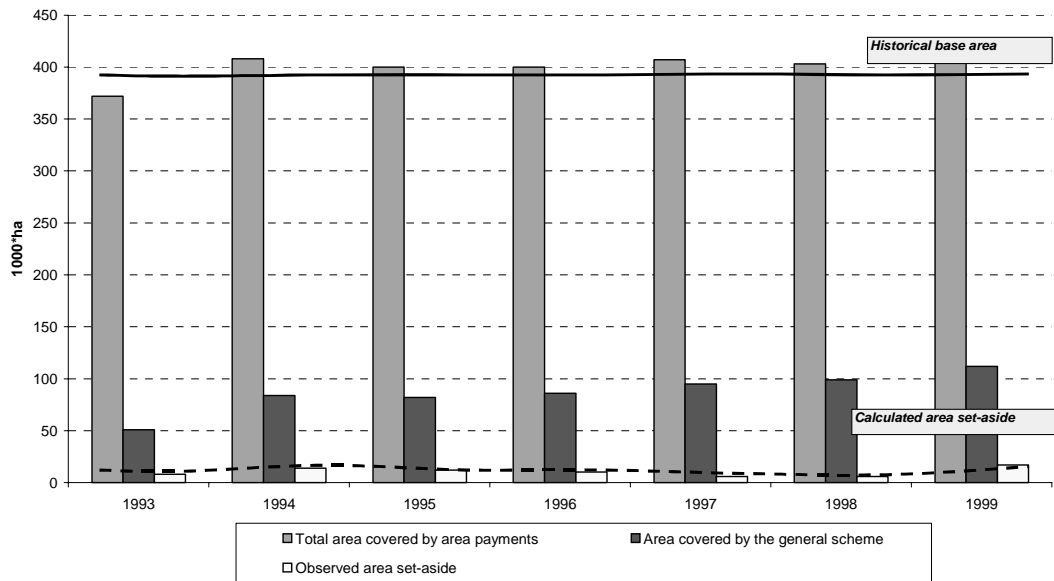
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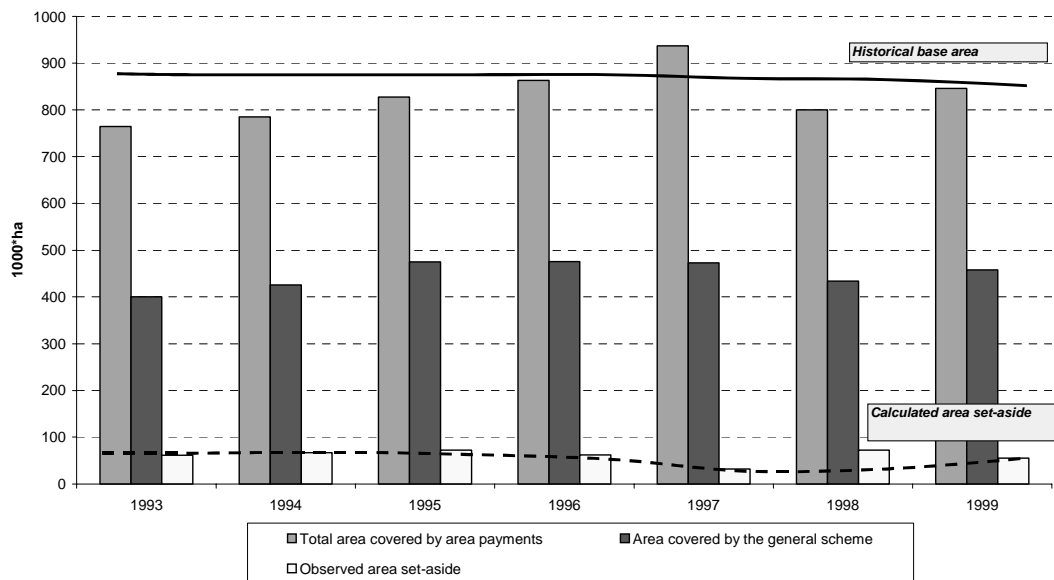
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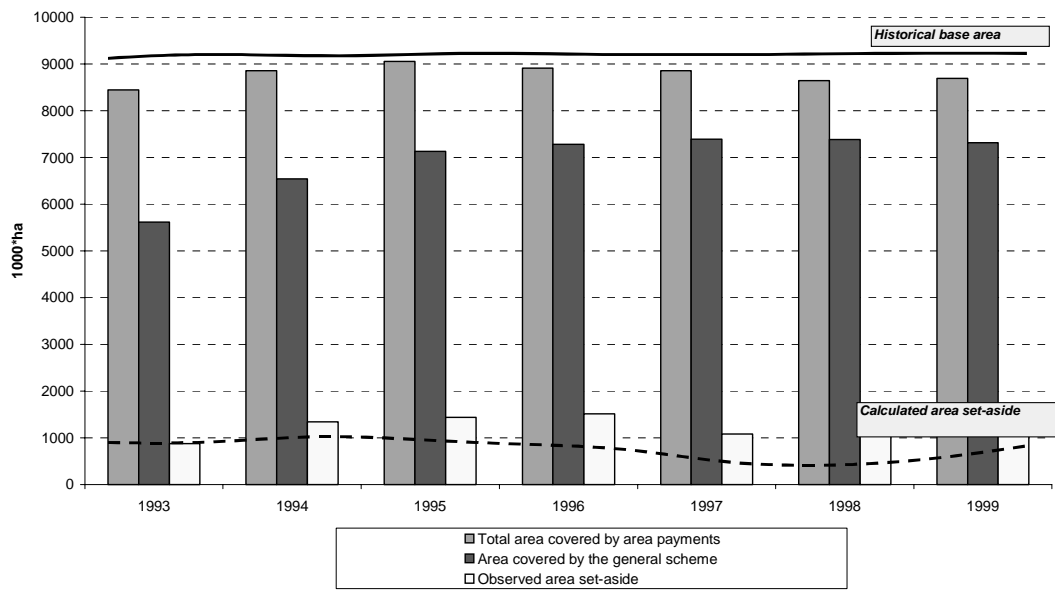
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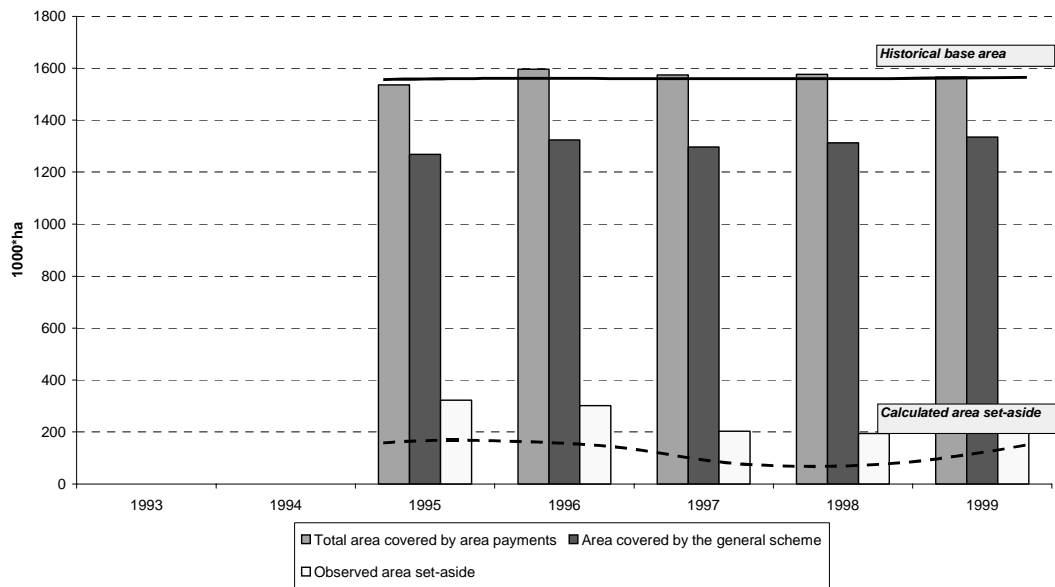
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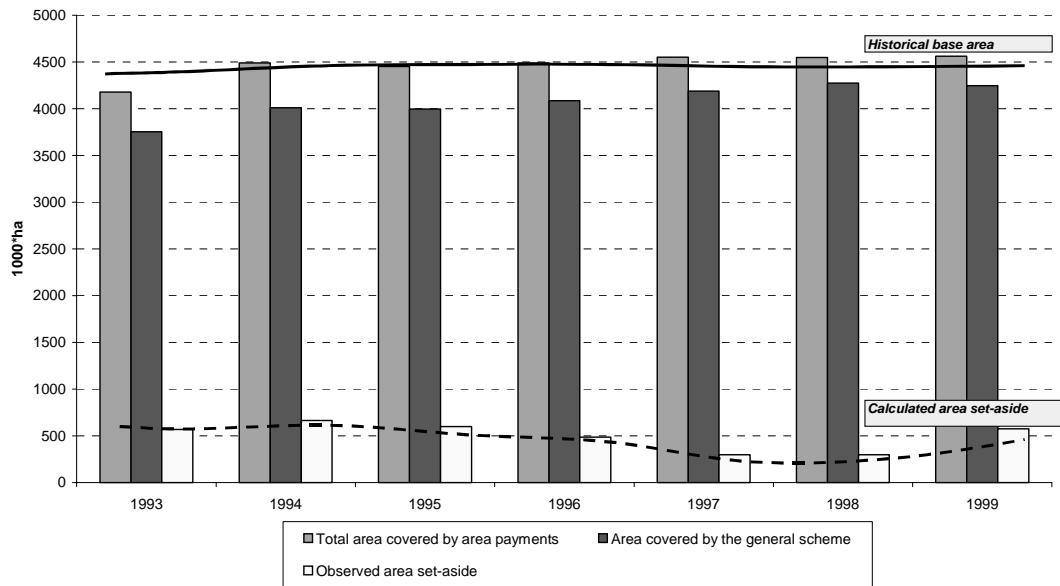
SPAIN



SWEDEN



UNITED KINGDOM



Annex 2.

Land supply in the PEM model: modelling the effects of the base area and set-aside provisions

In the PEM model, it is assumed that land is not a homogeneous factor. The model covers several types of land more or less suited to various crops (*i.e.* wheat, coarse grains, oilseeds, rice and other agricultural uses). It is assumed that the various types of land are imperfectly substitutable. In other words, land is assumed to be imperfectly mobile across alternative uses.

In the initial version of the PEM, land supply is modelled using a system of supply equations for the various types of land. The supply of each type of land depends on the prices of all land types. The inclusion of restrictions such as the EU's base area and compulsory set-aside provisions, which apply to the total area under COP crops rather than that given over to each crop, calls for a more rigorous theoretical framework. The land supply module in the PEM model has therefore been adapted for EU so that the base area and set-aside provisions can be explicitly incorporated. This Annex describes the new specification and the calibration procedure for the EU land supply module.

Theoretical framework

Let us consider a landowner with a total area of land \bar{L} . His aim is to maximise his receipts by allocating that land to a variety of uses. He has five alternatives: wheat, coarse grains, oilseeds, rice and other agricultural uses. The landowner's maximisation programme may be written thus :

$$\text{Max}_{l_i} \sum_i w_i l_i \quad \text{under the constraint} \quad \bar{L} = f(l_i) \quad (1)$$

where l_i is the area allocated to use i and w_i the price of the relevant land.

Function f is a transformation function describing the extent to which a hectare allocated to use or activity i can be « transformed » into a hectare allocated to activity j . Function f therefore relates to the degree of land mobility across the various activities.¹ In the PEM model, land is assumed to be heterogeneous and imperfectly mobile across activities. We may thus consider that there are different types of land, more or less suited to each activity. Function f therefore reflects the degree of substitutability between different types of land.

Assuming that the transformation function is separable on the partition COP crops (*i.e.* in this model wheat, coarse grains and oilseeds), rice and other farm uses, the landowner's objective to maximise his receipts can be viewed as a programme in two stages. In stage 1, the landowner allocates available land

1. When land is a homogeneous factor, perfectly mobile across activities, function f is simply the sum of all the acreages allocated to each activity.

(\bar{L}) into COP crops (L_C), rice (L_R) and other farm uses (L_O). In stage 2, he divides the land allocated to COP crops (L_C) into wheat, coarse grains and oilseeds ($l_k, k = 1,2,3$ for wheat, coarse grains and oilseeds, respectively).

6. During stage 2, the landowner's maximisation sub-programme may be written:

$$Max_{l_k} \sum_{k=1}^3 w_k l_k \quad \text{under the constraint} \quad L_C = f_2(l_k) \quad k = 1,2,3 \quad (2)$$

where f_2 is the transformation function associated with the COP crop nest.

The first-order conditions give the following system:

$$w_k = \lambda \frac{\partial f_2(l_s)}{\partial l_k} \quad k,s = 1,2,3 \quad (3)$$

$$L_C = f_2(l_k)$$

where λ is the Lagrange multiplier associated with the total COP land constraint.

Solving the system of equations defined in (3) gives the supply function for each type of land:

$$l_k = l(w_s, L_C) \quad k,s = 1,2,3 \quad (4)$$

and the Lagrange multiplier (assuming an interior solution) which, at the optimum corresponds to the implicit price of COP land:

$$\lambda = \lambda(w_s, L_C) \quad s = 1,2,3 \quad (5)$$

7. Stage 1 in the landowner's programme is similar to Stage 2 described above. The corresponding maximisation sub-programme may be written:

$$Max_{L_J} \sum_J w_J L_J \quad \text{under the constraint} \quad \bar{L} = f_1(L_J) \quad J = C,R,O \quad (6)$$

where f_1 is the transformation function associated with the COP-rice-other farm uses nest.

The first order conditions may be written:

$$w_J = \mu \frac{\partial f_1(L_H)}{\partial L_J} \quad J,H = C,R,O \quad (7)$$

$$\bar{L} = f_1(L_J)$$

where μ is the Lagrange multiplier associated with the total available land constraint (\bar{L}).

Solving the system of equations defined in (7) gives the supply functions for each type of land:

$$L_J = L(w_H, \bar{L}) \quad J, H = C, R, O \quad (8)$$

and the Lagrange multiplier (assuming an interior solution) which, at the optimum, is the implicit price of total land:

$$\mu = \mu(w_H, \bar{L}) \quad H = C, R, O \quad (9)$$

Introducing the base area and set-aside provisions

8. In the PEM model, the equations are expressed in terms of relative variations. If we differentiate equations (4), (5), (8) and (9) completely and express them as percentage variations, we get:

$$\frac{dl_k}{l_k} = \sum_{s=1}^3 \varepsilon_{ks} \frac{dw_s}{w_s} + \varepsilon_{kC} \frac{dL_C}{L_C} \quad k = 1, 2, 3 \quad (10)$$

$$\frac{d\lambda}{\lambda} = \frac{dw_C}{w_C} = \sum_{s=1}^3 \varepsilon_{\lambda s} \frac{dw_s}{w_s} + \varepsilon_{\lambda C} \frac{dL_C}{L_C} \quad (11)$$

$$\frac{dL_J}{L_J} = \sum_H \varepsilon_{JH} \frac{dw_H}{w_H} + \varepsilon_{J\bar{L}} \frac{d\bar{L}}{\bar{L}} \quad J, H = C, R, O \quad (12)$$

$$\frac{d\mu}{\mu} = \frac{dw}{w} = \sum_H \varepsilon_{\mu H} \frac{dw_H}{w_H} + \varepsilon_{\mu\bar{L}} \frac{d\bar{L}}{\bar{L}} \quad (13)$$

where ε_{ks} (ε_{JH}) is the supply elasticity of land-type k (J) with respect to the price of land-type s (H), ε_{kC} ($\varepsilon_{J\bar{L}}$) is the supply elasticity of land-type k (J) with respect to total land allocated to COP crops (total available land), $\varepsilon_{\lambda s}$ ($\varepsilon_{\mu H}$) is the price elasticity of COP land (total land) with respect to the price of land-type s (H) and $\varepsilon_{\lambda C}$ ($\varepsilon_{\mu\bar{L}}$) is the price elasticity of COP land (total land) with respect to the land allocated to COP crops (total available land).

9. This specification then makes it easy to simulate the effects of acreage constraints such as base area and compulsory set-aside.

- The introduction of set-aside means that we no longer reason in terms of $\frac{dL_C}{L_C}$ but of

$(1-\beta) \frac{dL_C}{L_C}$ (where β is a function of the official set-aside rate) in equations (10) and (11).

Here, the land allocated to COP crops remains an unconstrained endogenous variable.

- On the contrary, the introduction of a base area constraint will limit the margin of adjustment for that land. The change that will occur in how total available land is allocated between COP crops, rice and other farm uses depends on the equilibrium regime of the relevant land market (Figure 2). In regime R3, the acreage allocated to COP crops becomes exogenous and fixed. In regime R2, there is a decrease in the margin of adjustment for that acreage. Based on Figure 2, this increased rigidity can be expressed by a reduction in the direct price elasticity of COP land supply (*i.e.* ε_{CC} in equation (12)). This is the option chosen for our simulations. More specifically, the direct price elasticity of supply of COP land in the EU may be written:

$$\varepsilon_{CC}^{UE} = \frac{dL_C / dw_C}{w_C / L_C} = \sum_{t=1}^{15} \varepsilon_{CC}^t \frac{L_{Ct}}{L_C}$$

where ε_{CC}^t is the direct price elasticity of supply of COP land in Member State t .

Let us assume that all Member States start out with the same price elasticity, namely $\varepsilon_{CC}^t = \varepsilon_{CC} \forall t$. Once the base area has been introduced, Member States for which the constraints is effectively binding see their elasticity fall to zero. EU price elasticity is then:

$$\varepsilon_{CC}^{UE} = \varepsilon_{CC} \sum_{t \in NC} \frac{L_{Ct}}{L_C} \text{ where } NC \text{ is the set of Member States for which base area is not binding.}$$

10. In scenarios « AP-BA2 » and « AP-BA2-SA », the direct price elasticity of supply of COP land in the EU is set at 62% of its initial value. This percentage is the average share, for 1993-1999, of Member States deemed not to be constrained by their base area, in total EU COP acreage. In this study, a Member State is considered to be under constraint if it has overshoot its base area at least once between 1993 and 1999 and if its average overshoot for these years is higher than 1% of the base area (*i.e.* Belgium, Denmark, France and United Kingdom).

11. The threshold of 1% of the base area has been chosen to reflect the measures of the penalty system which currently stipulate that only overshoots higher than 1% of the base area are accounted for and thus subject to penalties. This 1% rule implies that any overshoot observed less than this figure is not considered as an overshoot. The rule chosen to determine constrained Member states leads to retain all those which have overshoot their base area ceiling at least three times between 1993 to 1999, with the exception of Germany. Although Germany overshoot its base area four times during the period under study, the percentage of overshoots observed (the maximum overshoot observed was 0,65% of the base area, see Table 1) suggests that this country was probably not constrained by the base area provision.

12. As it is however difficult to refute in a definitive way the restrictive nature of this provision as it applies to Germany, it should be noted that the inclusion of this country amongst the group of countries constrained would have led us to fix the direct price elasticity of land supply in the EU for COP crops at 42%, and not 62%, of its initial value in the « AP-BA2 » and « AP-BA2-SA » scenarios. Indeed, these two scenarios correspond to an intermediary situation between the two extreme cases represented by the “AP” and “AP-SA” scenarios (no constraint on any Member State) and the “AP-BA3” and “AP-BA3-SA” scenarios (constraints on all Member States). Therefore, the inclusion of Germany amongst those countries constrained would lead to results in the scenarios “AP-BA2” and “AP-BA2-SA” slightly further away from those of the “AP” and “AP-SA” scenarios and closer to those of the “AP-BA3” and “AP-BA3-SA” scenarios.

Calibrating the new EU land supply module

13. The first step in calibrating elasticities of the land supply system represented by equations (10) to (13) is to select a functional form for the transformation functions $f_1(L_J)$ and $f_2(l_k)$. For both functions, we have selected CET (Constant Elasticity of Transformation, Powell and Gruen, 1968) functional forms. CET is the most common function used to figure imperfect factor and input mobility in models, particularly in Computable General Equilibrium models (CGE) (see for instance Hertel and Tsigas, 1988, 1997; Peerlings, 1993 ; Gohin, 1998).

14. The constraints in both stages of the landowner's maximisation programme may therefore be written:

$$\bar{L} = \beta_0 \left(\sum_{J=C,R,O} \beta_J L_J^\theta \right)^{\frac{1}{\theta}} \quad \text{with } \theta > 1 \quad (14)$$

$$L_C = \alpha_0 \left(\sum_{k=1}^3 \alpha_k l_k^\rho \right)^{\frac{1}{\rho}} \quad \text{with } \rho > 1 \quad (15)$$

where parameters θ and ρ measure, for each nest, the degree of mobility of various types of land across different activities. High values for these parameters indicate low mobility across activities, while values close to 1 correspond to near-perfect mobility.

15. It is then possible to solve for the values of the various elasticities required to calibrate the system of equations (10) to (13). The key parameters here are elasticities of transformation, *i.e.*:

$$\sigma_1 = \frac{d(L_J / L_H) (w_J / w_H)}{d(w_J / w_H) (L_J / L_H)} = \frac{1}{\theta - 1} \quad \forall J \neq H \quad J, H = C, R, O \quad (16)$$

$$\sigma_2 = \frac{d(l_k / l_s) (w_k / w_s)}{d(w_k / w_s) (l_k / l_s)} = \frac{1}{\rho - 1} \quad \forall k \neq s \quad k, s = 1, 2, 3 \quad (17)$$

16. These two parameters alone give us all the direct and cross price elasticities of supply of each type of land, within each nest:

$$\varepsilon_{JH} = -\sigma_1 sh_H \leq 0 \quad \forall J \neq H \quad ; \quad \varepsilon_{JJ} = \sigma_1 (1 - sh_J) \geq 0 \quad J, H = C, R, O$$

$$\varepsilon_{ks} = -\sigma_2 sh_s \leq 0 \quad \forall k \neq s \quad ; \quad \varepsilon_{kk} = \sigma_2 (1 - sh_k) \geq 0 \quad k, s = 1, 2, 3$$

where $sh_J = w_J L_J / \sum_H w_H L_H$ is land-type J as a share of total receipts and $sh_k = w_k l_k / \sum_{s=1}^3 w_s l_s$ is land-type k as a share of the receipts from COP land.

17. The other parameters required are directly derived from the CET form. Hence:

$$\varepsilon_{J\bar{L}} = 1 \quad ; \quad \varepsilon_{\mu H} = sh_H \quad ; \quad \varepsilon_{\mu\bar{L}} = 0 \quad J, H = C, R, O$$

$$\varepsilon_{kC} = 1 \quad ; \quad \varepsilon_{\lambda s} = sh_s \quad ; \quad \varepsilon_{\lambda C} = 0 \quad k, s = 1, 2, 3$$

18. At this point, we can clearly see one of the main advantages of using the CET form: giving a value to the elasticity of transformation makes it possible to calibrate all the supply elasticities. In the case in hand, we only have to give a value to σ_1 and σ_2 to obtain all the elasticities required to calibrate the new EU land supply module.

19. In this study, the values for σ_1 and σ_2 have been set in such a way that the values for the direct price elasticities of supply of each type of land remain as close as possible to those initially used in the PEM model. Hence:

$$\sigma_1 = 0.1 \text{ and } \sigma_2 = 0.4$$

This leads to the following matrix of direct and cross price elasticities:

	Price	Wheat	Coarse grains	Oilseeds	Rice	Other uses
Supply						
Wheat		0,21	-0,16	-0,04	0	-0,01
Coarse grains		-0,19	0,24	-0,04	0	-0,01
Oilseeds		-0,19	-0,16	0,36	0	-0,01
Rice		-0,03	-0,03	0	0,07	-0,01

Testing for sensitivity of results to the parameters of the new EU land supply module

20. A systematic sensitivity analysis regarding the values of these elasticities of transformation has been carried out, based on the method developed by Davis and Espinoza (1998) and Griffiths and Zhao (2001) and already used in OECD (2001*b*) and Dewbre *et al.* (2001). As very little empirical information is available, we have assumed uniform and independent distribution for each of these parameters. The limits within which these parameters may vary are based on minimum and maximum values for the direct and cross price elasticities of supply of each type of land, as given in the literature review conducted for the initial calibration of the PEM model (OECD, 2001*b*).

21. Matrices of direct and cross price elasticities corresponding to the minimum and maximum values given to the elasticities of transformation are reported below.

22. For maximum values, i.e. $\sigma_1 = 0.3$ and $\sigma_2 = 0.8$, the obtained matrix is the following:

	Price	Wheat	Coarse grains	Oilseeds	Rice	Other uses
Supply						
Wheat		0,44	-0,32	-0,07	0	-0,05
Coarse grains		-0,39	0,50	-0,07	0	-0,05
Oilseeds		-0,39	-0,32	0,76	0	-0,05
Rice		-0,12	-0,09	-0,02	0,28	-0,05

23. Whereas for minimum values $\sigma_1 = 0.01$ et $\sigma_2 = 0.12$, it becomes:

	Price	Wheat	Coarse grains	Oilseeds	Rice	Other uses
Supply						
Wheat		0,06	-0,05	-0,01	0	0

Coarse grains	-0,06	0,07	-0,01	0	0
Oilseeds	-0,06	-0,05	0,11	0	0
Rice	-0,006	-0,005	-0,001	0,01	0

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