CAP Reform and the Re-balancing of Support for Cereals and Oilseeds: A Farm Level Analysis

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Abstract

This paper assesses the impact of current market conditions and Agenda 2000 CAP reforms, particularly the 'rebalancing' of support between cereals and oilseed crops, on crop gross margins and hence on the incentive to produce oilseed rape on three representative farm types in eastern England. Results indicate that under a conventional rotation, oilseed rape area falls substantially on two of the farm types considered. However, the incentive to plant break crops more frequently increases after the reform; under a two-break crop rotation, oilseed rape area remains at pre-reform levels. Oilseed rape prices of circa £100 per tonne, particularly when combined with unrestricted set-aside rates, conventional rotations and low cereal prices, would give farmers in eastern England substantial incentives to reduce the area of the crop grown.

Keywords: Agenda 2000, rebalancing, oilseed rape, mixed-integer programming model, crop rotation.

JEL classification: Q12, Q18

1. Introduction

In March 1999 the European Union (EU) agreed a package of reforms to the Common Agricultural Policy (CAP) as part of the Agenda 2000 programme. Although the reforms were motivated by the need to prepare the EU for enlargement, they are also expected to enhance the negotiating position of the EU in the World Trade Organisation (WTO) Millennium Round. As part of the reform package, it was agreed that the level of direct payments for oilseeds production should be cut to fall in line with those for cereals. This was done to remove a constraint on EU oilseeds area imposed as part of the URA. However, given the lower margins available on oilseeds production, it is believed such 're-balancing' of support could have an impact on cropping decisions, with farmers switching from oilseeds to cereal crops. HGCA (1999a) suggest that producers in the UK will reduce the area of oilseed rape (*Brassica napus*), the main UK oilseed crop.

To consider this hypothesis further, 'Farm-adapt', a farm-level, mixed integer-programming (MIP) model is used in this paper to examine the impact of the arable sector reforms on three types of farm growing oilseed rape in the East Anglia region of England. The model has been developed to capture the complexity of the farm situation, particularly the constraints imposed by crop rotations. Integer programming allows us to assess whether the reforms provide an incentive for farmers to reduce labour and machinery inputs. The extent to which these reductions are possible is linked to the availability of set-aside: the paper also investigates whether the impact on farm income of a fall in crop margins can be offset by increasing the area of land set aside and reducing labour and machinery levels. The Agenda 2000 reforms require compulsory set-aside to be 10 per cent of the area on which direct payments are claimed; however "Producers may be granted the set-aside payment on land

voluntarily set aside in excess of their obligation" (European Communities, 1999a). A combined voluntary set-aside, labour/machinery-reduction farm plan, if adopted by sufficient farmers, could have a significant impact on the area of oilseed rape grown in the UK. Note that while it is possible to grow industrial or "non-food" oilseed rape in the UK, this paper only considers rape produced for human or animal consumption, grown on conventional (i.e. not set-aside) land.

The paper is arranged as follows. Section 2 explains the policy background to rebalancing of support for oilseeds and cereals and the adoption of the Agenda 2000 reforms. Section 3 discusses the selection of appropriate farm types for modelling the impact of reform; Section 4 the calculation of pre- and post-reform enterprise gross margins. Sections 5 and 6 respectively provide an overview of and results from the Farm-adapt model; Section 7 concludes.

2. The reforms - an overview

The 1999 CAP reforms focused on three key sectors - arable, beef and dairy. In all three, the shift from price support to direct payments, a feature of the 1992 reforms, has been continued. Cereal support prices have been cut by 15 per cent, although in contrast to the 1992 reforms the direct payments offset only 50 per cent of this cut, rather than 100 per cent. The aim was partly to limit budget costs and partly to avoid the 'over-compensation' that occurred after 1992, when farmers received a fixed level of compensation on top of exceptionally high market prices. Compensation increases from £54 to £63 per ton[1] over the

[1] Metric tons are used throughout this paper. In the calculations presented below, we use the currency conversion rate Euro 1= £0.629, which prevailed in mid-2000.

two-year transition period; in England, this results in a cereal area payment of €371 per hectare, at the historic regional yield of 5.89 tons per hectare. In addition to the changes to cereal support, support for oilseeds will be 're-balanced', so that existing direct payments for oilseeds will be reduced to the same level as cereals. Oilseeds are thus brought within the cereals regime and no longer receive an oilseed-specific payment. Protein crop payments also fall, but with a premium (€9.5 per ton; €55.96 per hectare) over that paid for cereals and oilseeds.

This re-balancing is explicitly linked to a bilateral deal on oilseeds made with the US in 1993 in order to facilitate the Uruguay Round Agreement (URA). Under the Blair House Accord, the EU agreed to limit the support granted to oilseed producers. The limit took the form of a Maximum Guaranteed Area of 5.482 million hectares less set-aside of at least 10 per cent. Plantings beyond this result in a financial penalty in the current year and a reduction in guaranteed area the following year. However, re-balancing means that:

> For oilseeds, this non-specific payment eliminates the basic condition for production area constraints imposed by the Blair House agreement and enables the EU to abrogate all specific oilseeds provisions (European Commission, 1998: 9).

A feature of the reform was that two agreements were reached, the first by the Council of Agricultural Ministers in mid March 1999, the second by the European Council two weeks later in Berlin. This adjustment was motivated ostensibly by the need to reduce CAP spending by the 2 per cent required to bring projected budget outlays within the previously-agreed 'stabilised' limit for the period 2000-2006 (for a detailed analysis, see Ackrill, 2000a;

2000b). The main changes in the second agreement were made to arable support. By agreeing a smaller price cut for cereals (15 per cent as compared with 20 per cent), not only was there a smaller rise in the direct payment for cereals, but re-balancing therefore meant a larger cut in oilseed payments.

A further consequence was that the smaller price cut was less likely to remove price support and the need for export refunds. Set-aside has therefore had to be retained, at 10 per cent (the first agreement kept the option of set-aside, but the rate was normally to be set at zero).[2] With the constraint on subsidised cereal exports under the URA remaining effective, set-aside is needed to contain demand for intervention and the attendant budgetary consequences, which will increase if producers switch from oilseeds to cereals production.

The impact of the changes outlined above is complicated by the UK's decision not to adopt the euro. The rise of sterling against the euro since 1999 has meant lower direct payments and intervention prices for UK farmers; these exchange rate effects are included in our post-reform analysis.

3. Regional production of oilseed rape in the UK and choice of farm types

After France and Germany, the UK is the third largest producer of oilseed rape in the EU. The majority of the crop is grown in the drier, lower-lying eastern part of England, where it is an important part of arable rotations on farms growing combinable crops (Table 1). These farms are often associated with heavier, clay-based soil types, which are less suitable for growing the higher value root crops, potatoes and sugar beet.

Table 1 here

Table 2 shows the percentage area of oilseed rape on farms in the East Anglia region of the UK's Farm Business Survey, results from which are supplied to the European Farm Accountancy Data Network. Within this region, there is a marked variation in distribution of the crop, with the lighter soils of the north supporting much lower levels of oilseed rape than the clay and chalk-based soils of the south. Cambridgeshire and Hertfordshire are the core oilseed rape-growing areas, with limited opportunities for alternative enterprises. The north and south Essex regions have similar characteristics, but with a greater proportion of livestock farming. Of the oilseed rape-growing areas, central Suffolk has the greatest potential for alternative enterprises, the loam-based soil giving a greater proportion of root crops (mainly sugar beet), as well as supporting livestock production.

Table 2 here

These three regions provide a basis for modelling the impact of Agenda 2000 on oilseed rape production: they cover the main rape-producing areas of East Anglia and reflect different degrees of flexibility for adaptation, depending on soil type and location. We use the west Cambridgeshire region to represent farms that are limited in their choice of enterprise mix to combinable crops only, north Essex to represent farms that can change their mix of combinable crops and livestock and central Suffolk to represent farms that can adapt by changing combinable crop, livestock and root crop mix. Restricting the analysis to East Anglia is not entirely satisfactory - as shown in Table 1, the East Midlands region has a greater area of oilseed rape. However, the data required, particularly the breakdown of output into enterprise gross margins, are only available for the East Anglia region.

[2] See Ackrill, 2000b for a discussion of world price forecasts and the likely need for export refunds.

4. Enterprise gross margins

Enterprise gross margin is defined as the annual output value of an enterprise, plus direct payments, minus the associated variable costs of production. Our objective in modelling the Agenda 2000 agreement is to compare farm plans that were appropriate under conditions typical of the period of 'over-compensation', referred to in section 2, with those that are appropriate for conditions post-Agenda 2000. Therefore, pre-reform crop gross margins, in real terms, for each region were taken from the Farm Business Survey covering East Anglia (Murphy, 1998, 1999; Lang, 2000). Three years of data (relating to harvest years 1996-1998) were used to average out seasonal effects (Table 3).[3] A beef enterprise was also included as an alternative to field crops. However, beef gross margins for the north Essex and central Suffolk farms are not available by region and represent a range of different production systems with differing outputs and input requirements. Therefore beef gross margin was modelled using Farm-adapt, which assumes an '18-month system', with male calves bought at age 3 months and culled for sale at 18 months. Farm-adapt determines the optimal combination of forage and cereal-based feed for a given weight of animal at culling; forage production (hay or silage) requires labour and machinery (contract or owned) for fertilising and cutting of grass. Beef variable costs not determined by the model (veterinary and bedding costs) are taken from Nix (1996), as are fertiliser, feed, animal sale and purchase prices and headage payments. The latter are limited by sex (male animals only), a stocking rate of 2 livestock units per forage hectare and the number of claims per producer (maximum 90 per year).

[3] Arguably a longer time period should have been used, however large farms (> 400 hectares) were excluded from the Survey results in the 1995-96 crop year, but included subsequently.

Post-reform crop gross margins were calculated using values for intervention prices and direct payments applicable in the 2002/2003 marketing year (i.e. after the Agenda 2000 transition period). An exchange rate of £0.629 to the euro, current in mid-2000, was used in all calculations. Crop yields for the 2002 harvest are linear trend projections for each region, based on 15 years of data (1984-1998). Variable costs are assumed to remain unchanged for all crops; prices for sugar beet and potatoes on the central Suffolk farm are also assumed to remain at pre-reform levels. For beef, Agenda 2000 also redirects support away from end-product prices: the intervention price falls by 20 per cent and farmers are compensated directly in the form of increased headage payments and a new 'slaughter premium', paid on each eligible male animal. It was assumed that beef sale prices fall by 20 per cent from the pre-reform level and that cereal-based feed prices fall by 15 per cent, in line with the fall in the cereal intervention price.

As there is no price support for oilseed rape and protein crops pre- or post-reform, it is initially assumed that prices for these crops continue at the levels prevailing in the pre-reform period (i.e. oilseed rape price is independent of cereal price). Sensitivity analysis is used to assess the impact of falling oilseed rape price on crop mix and farm profitability.

The assumption that cereal prices fall to the 2002 intervention price can be criticised: low cereal prices reflect current (2000) market conditions and exchange rate disparities, not just the Agenda 2000 reform. However, the complementary nature of oilseed area (or other break crops such as legumes) with first winter wheat means that cereal price changes may affect farm net margin but are less likely to affect crop mix. However, we explicitly address the impact of variation in cereal prices by conducting further sensitivity analysis for the North Essex farm type.

Tables 3 pre- and post-reform gross margins

5. A farm level model

A full, algebraic description of the model, which contains both arable and livestock components, is given in Ramsden *et al.* (2000). The model is designed to capture the complexity of UK farming systems, which are typically characterised by:

1. a wide choice of available enterprises
2. the complementary nature of some of these enterprises e.g. break crops and cereal crops
3. as a consequence of 1., the competition for labour and machinery that occurs between different enterprises at different times of the year
4. the differing and often overlapping time periods available for optimal and sub-optimal establishment and harvesting of crops
5. substitution effects, particularly the substitution of contract machinery and labour for farmer-owned machinery and hired labour.

Figure 1 shows in schematic form how these features are incorporated into the model. There are two types of skilled labour available, the *farmer* and full-time *labourers* who supply 'ordinary' and 'overtime' labour hours; both these categories are adjusted for social (normal working week, illness) and seasonal (soil workability) factors. Additionally, *casual* and *contract labour* can be supplied, up to pre-specified limits; contract labour is supplied with machinery. These five items make up the total weekly labour supply, in hours, available to the farm. Skilled labour is needed to operate *machines*; these, together with any contracted machines and machines not requiring an operator, make up the *total machines* on the farm. Full-time labour and owned machinery are costed as full employer costs and annual ownership costs (depreciation, maintenance, interest, tax and insurance) respectively. Fuel

and oil costs vary with the amount of machine (tractors and combines) use. Contract work is limited to the field time that can be supplied by one contractor for each operation (e.g. combining, ploughing) per week.

(Approximate position of Figure 1)

Jointly, labour and machinery supply *field time*: the weekly hours available at different times of the year for field operations. There must be sufficient machines (with field equipment in the case of tractors) and labour to meet field operation requirements (i.e. the workrate coefficients): for example, the model cannot draw on additional casual labour if there is insufficient machinery capacity to utilise this additional labour. The time-frame available for different operations corresponds to normal conditions in the south-eastern half of Britain (Nix, 1996); crop operational requirements cannot be met from field time weeks outside these boundaries. The model can select between average and premium workrates for labour and machinery operations. Following Nix (1998), premium workrates require larger field sizes (minimum 8 hectares), farm size (minimum 200 hectares) and tractors (minimum 75 kW) and associated equipment. Tractors and equipment associated with premium workrates incur larger annual ownership costs. Transfer variables ensure that surplus field time labour can be used for indoor tasks (*barn labour* and *animal labour*) and that there is a distinction between indoor and outdoor tasks, with the time-frames for the latter being determined by seasonal and social factors and the former being determined only by social factors.

Total land is assumed to be of equal quality: only rotational restrictions limit the area of *crops* (including set-aside) *and grass* that can be grown. In the case of wheat, the crop is divided into first, second and third-crop winter wheat, depending on the crop grown

previously in the rotation (see below). Crops and grass generate *output*, either through being processed by animals (grass and forage crops) or directly through farm-gate sales.

A section of a model input file is shown in Figure 1 to demonstrate the field times, time-frames and workrates for a selection of crops and operations during spring. Weekly available ordinary and overtime hours supplied by one full-time worker increase from 35.2 to 41.2 hours as soil workability increases; together these give the maximum field time available from this worker (with appropriate machinery). The winter wheat and winter barley time-frame for applying fertiliser starts in week 9 and continues beyond the section shown; the workrate for winter wheat is greater than for winter barley because of the greater number of fertiliser applications (three rather than two). The cultivation time-frame for spring peas ends in week 10; cultivation, drilling and application of fertiliser on spring barley take place within weeks 9-13. Competition for labour and machinery (tractors, cultivators and fertiliser spreaders) is greatest in week 10, where all 6 crop and field operation combinations overlap.

Rotations

A crop rotation is a sequence of crops that is repeated after a certain interval of time. The length of the rotation is determined by the crops grown on the farm. In the UK, farmers growing potatoes are recommended to grow the crop on the same land only once every four or five years; oilseed rape is recommended to be grown no more than once every four years (Soffe, 1995). The delay in repeat planting prevents the build-up of soil-borne diseases. The implication of a four-year rotation – assuming that producers are risk averse and wish to diversify – is that the maximum area of the break crop in each year is 25 per cent of the

arable area of the farm. However, there is evidence to show that farmers are not following recommended practices, particularly with respect to oilseed rape. For example, in the 1996 harvest year, 49 out of the 62 farms in the East Midlands Farm Business Survey 'mainly cereals' category grew oilseed rape; 10 of these farms had oilseed rape areas greater than 25 per cent of total combinable crop area, the maximum being 38 per cent, suggesting more frequent cropping than one year in four. Farmers in other EU countries are also growing break crops more frequently: for example, it has been estimated that 11 per cent of the sunflower crop in France is planted immediately after a preceding crop of sunflowers (European Commission, 1999). Specifying fixed rotations in farm-level models has been criticised as being overly restrictive (Jacobsen *et al.*, 1998), particularly as it can prevent transition from one rotational sequence to another, a possible adaptation response to price- or policy-induced change. Therefore, a flexible approach to modelling rotations is required to adequately capture the impact of Agenda 2000 policy and market conditions on oilseed rape production.

In the standard model, a four-year gap is maintained between *break crops*, under the assumption that this is the minimum acceptable agronomic practice. Break crops are non-cereal crops, such as beans, peas and oilseed rape that provide a yield benefit to cereal crops (winter wheat) that follow in the rotation. The model contains four 'blocks' of land, A,B,C, and D, each equal to 25 per cent of the total farm area. Crop areas cannot exceed the available land in each block and sequencing constraints ensure that certain crops can only be grown in combination with other crops. This applies to 'first' winter wheat (WW1), which in practice can only be planted on land on which a break crop was planted previously. For example, on a 100 hectare farm, if the model allocates 20 hectares of block A to winter beans and 5 hectares to winter barley, up to 20 hectares of WW1 can be grown in block B. Following Bacon *et al.* (1998), wheat following other cereals (second winter wheat, WW2) is

assumed to yield 15 per cent less than WW1; third winter wheat (WW3) is assumed to yield 15 per cent less than WW2. WW1 can follow any break crop or rotational set-aside land. WW2 can follow WW1 and any non-cereal but not itself; WW3 can follow WW2 or itself. Therefore, the model can, for example, choose a continuous rotation of winter wheat by allocating all blocks to WW3. Other cereals can enter at any stage of the rotation. Thus, the model does not restrict cropping to a fixed four-year rotation: a number of different rotations can be chosen, subject only to the sequencing constraints noted above.

As already mentioned, some UK farmers grow break crops more frequently than once every four years despite agronomic advice to the contrary. This allows the area of first winter wheat to be increased and may also be a result of the area payment policy: the financial consequences of diseases caused by repeated growing of one crop are reduced, as a smaller proportion of revenue accrues from the crop itself. Thus, a second rotation is specified in which two break crops are allowed. This allows the model to put up to 50 per cent of the available land into oilseed rape, spring peas, winter beans or (within the constraints outlined below) rotational set-aside, or some combination of these crops. We calculate the incentive to adjust to the two-break rotation by comparing the profitability of the two rotations under pre- and post-reform conditions.

Further differences between farm types

For combinable crops, storage is assumed not to be a constraint. Expansion of potato area requires additional investment in storage (and machinery) facilities. Livestock housing in the north Essex and central Suffolk regions is initially assumed to be adequate to house the average beef or sheep herd for the whole survey region, additional livestock housing can be

purchased if profitable. Sugar beet is assumed not to require storage facilities (much of the crop is stored outdoors in 'clamps'). Worktime availability for the heavier clay soil regions is reduced by 33 per cent in March, October and November; 20 per cent in April and 10 per cent in September (Nix, 1998).

Pre- and post-reform and analysis

The available crops for the pre-reform and Agenda 2000 analysis are drawn from Table 3, for each of the 3 regions. The west Cambridgeshire farm type can grow combinable crops only. Field beans and oilseed rape are assumed to be winter sown (approximately 90 per cent of oilseed rape and 70 per cent of beans are winter sown in the UK (Nix, 2000)). In addition to these crops, the north Essex farm can grow and conserve grass to support beef production. The central Suffolk farm can grow all the previously described crops, grass and sugar beet and potatoes. Sugar beet production is set equal to available quota (below quota production is undesirable, as farmers lose quota entitlement in subsequent years), thus expansion of root crop area is assumed to take place through a change in potato area only.

Two set-aside constraints are modelled: 'restricted set-aside', corresponding to the Agenda 2000 requirement that 10 per cent of the area on which compensation is claimed be removed from production, and 'variable set-aside', with the set-aside area free to vary between 10 and 50 per cent of the compensatable area. The maximum area of set-aside is constrained to be less than 50 per cent, because of the requirement that land voluntarily set-aside must not exceed the cropped area on which direct payments are claimed (Nix, 2000). Set-aside land can occur anywhere in the rotation and can act as a break crop for first winter wheat.

6. Results and discussion

The optimal solution is given in terms of the farm *net margin* and associated resource, crop and animal allocations. Net margin is net of variable, labour (full-time, casual and contract) and machinery (owned and contract) costs of production.

Pre-reform

Under a one-break crop rotation with restricted set-aside, all farm types include the maximum possible area of oilseed rape (Table 4). Note that sugar beet and oilseed rape compete for the same land area, hence 19 per cent is the maximum area of oilseed rape for the central Suffolk farm. Winter cereals are favoured on the west Cambridgeshire farm; the north Essex farm, with its higher workrates and the central Suffolk farm, with competition for autumn labour and machinery from sugar beet, include a greater area of spring cereals. Integer levels of labour and tractors are the same for each farm; variation occurs in the amount of overtime, contract and casual hours used. Despite its small size, the north Essex farm uses a relatively large amount of overtime, a result of the slower workrates assumed for farms of less than 200 hectares and lower field worktime availability on clay soils.

Table 4 here

Post-reform

The assumed prices and subsidy levels under Agenda 2000 result in a range of farm net margin reductions: from 24 per cent on the central Suffolk farm under a two-break rotation, to 49 per cent on the north Essex farm under a one-break rotation and restricted set-aside (Table 5). Under the restricted set-aside, one-break crop rotation oilseed rape is eliminated on the west Cambridgeshire farm and reduced to 8 per cent on the north Essex farm: in both cases spring peas substitute for oilseed rape. On all farm types, the most profitable strategy is to shift to a two-break crop rotation whilst maintaining set-aside at 10 per cent. This strategy both increases the area of (high-yielding) first winter wheat and has the effect of maintaining

or increasing the area of oilseed rape relative to the pre-reform position. The incentive to use a two-break rotation increases on the clay-soil farms and falls on the loam-soil farm; in all cases the percentage reduction in net margin caused by not adopting the more intensive rotation increases under Agenda 2000 policy and assumed market prices. Accepting this financial penalty and following the recommended one-break rotation results in an increase in area of spring cereals on all farm types; on the higher workrate, clay-based north Essex farm, the one-break rotation is marginally improved by increasing the area of set-aside to 15 per cent. Where allowed, beef production or additional potatoes are not included under the Agenda 2000 scenario.

Table 5 here

Three conclusions can be drawn from this analysis. First, at the prices, direct payments and predicted yields assumed for each farm type, the ability to change set-aside and labour and machinery levels does not prevent farm net margins from falling substantially under the Agenda 2000 assumptions. Second, confirming *a priori* expectations, farms on heavy soils with reduced time available for cultivations and/or with field sizes that prevent 'premium' workrates from being achieved will be less able to adapt profitably to the reform scenario. Third, on two of the farm types, oilseed rape area declines when the farm is restricted to follow current agronomic advice by adopting a one-break rotation. However, the profit incentive to move away from accepted practice increases, resulting in similar or greater areas of oilseed rape than the pre-reform, one-break crop results. Thus, oilseed rape area will be maintained or may increase if farmers incorporate this incentive into their decision-making.

Sensitivity analysis

A range of oilseed rape gross margins were generated by varying the assumed rape price from £117 to £228 per tonne (note that due to differences in yield and variable cost, each of

the different farm types requires a different price to generate the equivalent gross margin). In addition, for the North Essex farm, a range of cereal gross margins were generated by varying assumed cereal price between £64 and £96 per tonne. These gross margins were run with the one- and two break models, with restricted and unrestricted set-aside and Agenda 2000 gross margins for other enterprises and set-aside. Results for the oilseed rape analysis are summarised in Figures 2-4.

A relatively small reduction in oilseed rape price is necessary to reduce oilseed area on the west Cambridgeshire farm: with a one-break rotation, oilseed rape is eliminated from the solution at a gross margin of £672; this falls to £510 per hectare if a two-break rotation is allowed. These gross margins correspond to oilseed rape output prices of £204 per ton and £157 per ton respectively (Table 6; note that the assumed pre-reform price was £160 per ton). The reason for the generally low area of oilseed rape at these relatively high prices is the high gross margin for spring peas on this farm type - £703 per hectare, compared to £620 per hectare and £532 per hectare on the north Essex and central Suffolk farms respectively.

Table 6 here

The north Essex farm is the only farm type where set-aside area varies with oilseed rape gross margin, with, as would be expected, lower margins associated with greater levels of set-aside and smaller areas of oilseed rape than with restricted set-aside. Oilseed rape area on this farm type drops below 8 per cent at a gross margin of £545 per hectare (£159 per ton) for all set-aside/rotation options except for one-break, restricted set-aside. This combined restriction excludes oilseed rape from the solution until gross margin reaches £681 per hectare (£199 per ton).

Sensitivity analysis on the north Essex farm shows that oilseed rape area is relatively unresponsive to changes in cereal price. An increase from £64 to £73 per ton is sufficient to replace the area of peas with oilseed rape under the one-break rotation with restricted set-aside; an increase to £76 per ton is required for the same change with one break crop and unrestricted set-aside. No further changes in oilseed area occur for these rotations within the price range considered (£64 to £96 per ton). Oilseed rape area is unaffected by cereal price under the two break crop rotation, with both restricted and unrestricted set-aside. Under the two-break rotation first winter wheat replaces half of the pea area at a price per ton of £66. These changes can be attributed to the larger gross margins of winter wheat: higher cereal prices favour higher yielding crops, leading to a substitution from spring to winter cropping. Note that higher cereal prices do not lead to lower oilseed rape area.

The central Suffolk farm is the most robust to changing oilseed rape price - a gross margin of £510 per hectare, equating to an oilseed rape price of £140 per ton, is sufficient to induce the maximum area of oilseed rape possible under the one break rotation (19 per cent), assuming that the farm makes full use of its sugar-beet quota.

The elimination of oilseed rape from the west Cambridgeshire farm at a relatively high gross margin is surprising, particularly as this farm has the greatest pre-reform area of oilseed rape (Table 2). As noted, this result partly reflects the relatively high gross margin for spring peas predicted on this farm. However, it is possible that this figure is not a true representation of what the average farmer could achieve in this region: the historical area of spring peas is relatively small in west Cambridgeshire and yields may reflect the expertise of a small number of specialist spring pea producers.

If we take the Essex farm type as being representative of the typical oilseed rape-producing farm, gross margins below £549 per hectare (£159/t), *ceteris paribus*, result in large reductions in oilseed rape area under the conventional one-break crop rotation. Assuming that 1999 oilseed rape harvest prices (close to £100/t: HGCA, 1999b) persist into the 2001-2002 marketing year, gross margins would fall to *circa* £320, £340 and £350 per hectare on the west Cambridgeshire, north Essex and central Suffolk farms respectively: levels at which oilseed rape area falls to zero under all the rotational and set-aside combinations considered in this paper.

Approximate position of Figures 2-4

7. Conclusions

The CAP reforms agreed in March 1999 have continued the process started in 1992, but still maintain a price margin between EU and world markets for most products. The decision to re-balance support between cereals and oilseeds within the arable regime has, however, removed from the EU a constraint on oilseed production dating from the 1994 Uruguay Round Agreement. Re-balancing will strengthen the hand of the EU in the next WTO round of multilateral trade negotiations, in particular by enabling the EU to defend its oilseed production better. The decision that keeps some EU cereal intervention prices above world levels will, however, leave it vulnerable to attack regarding the continued use of export refunds.

One consequence of the arable sector re-balancing is that the level of support granted to oilseed production is much reduced. Model results for the west Cambridgeshire and north Essex farms suggest that oilseed rape area would fall if farmers maintained conventional one-break crop rotations. Analysis of oilseed rape gross margins for the three farm types suggests

that oilseed rape area under a conventional rotation is relatively sensitive to changes in gross margin, particularly if set-aside area is allowed to increase above 10 per cent, cereal prices are at intervention levels and where competing break crops such as spring peas have relatively favourable gross margins. Where alternative break crops perform less well (north Essex) or compete with existing spring-sown crops (sugar beet, central Suffolk) oilseed rape maintains its position in the rotation at lower prices These findings hold under higher cereal prices: within a realistic range, higher cereal prices do not lead to substitution of cereals for oilseed rape; indeed higher cereal prices tend to increase the area of oilseed rape relative to other break crops.

Agenda 2000 has increased the incentive for farmers to abandon standard agronomic practice and plant break crops more frequently: if this shift in farming practice occurs the results suggest that oilseed rape areas will remain at levels similar to pre-Agenda 2000 areas at prices between £133 and £177 per ton, depending on farm type. This incentive to move to two-break rotations has been exacerbated by the general shift of policy mechanisms away from end-price support to area subsidies: output penalties resulting from more frequent cropping are substantially less when between 30 and 50 per cent of break crop output value is in the form of area payments.

Although beyond the scope of this paper, the lack of scope for adaptation through changing enterprise or resource mix and the resulting fall in farm profitability between the pre- and post-reform scenarios is likely to lead to changes in farm structure as farmers choose, or are forced, to move out of the industry. This will lead to an increase in the average size of farms growing combinable crops. The implications for other oilseed producing EU countries are

also worthy of further research, with Germany and France (oilseed rape) and Spain, France and Italy (sunflowers) being major producers.

In conclusion, the analysis presented here suggests that under full implementation of the Agenda 2000 agreement, at an exchange rate of £0.629 to the euro and an oilseed rape price of £160 per ton, area of oilseed rape grown on east of England combinable crop farms will decline where competing break crops exist and where farms are not already growing spring-sown root crops such as sugar beet. In the UK, Agenda 2000, together with poor market conditions for cereals, increases the importance of break crops generally relative to cereal crops, providing farmers with an additional incentive to increase the area of break crops in a rotation. Where this occurs, oilseed rape area will be maintained at lower prices than if farmers choose to follow conventional agronomic practice. However, if world prices for oilseeds continue at 1999/2000 levels and cereal prices remain low, we can expect substantial reductions in the area of oilseed rape grown in the east of England, particularly if farmers are allowed to set aside more than 10 per cent of the land on which they claim direct payments.

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Table 1. *Regional production of oilseed rape in England (1997)*

Region	Total No. of holdings	No. of holdings with OSR	Total agricultural area in each region ('000 ha.)	Area of OSR in each region ('000 ha.)	% of total agricultural area cropped with OSR
North East	5178	1017	24	1.5	6.4
North West	17397	225	4	0.04	1.1
Yorkshire and Humberside	16042	2372	50	6.7	13.3
East Midlands	15799	2988	92	22.2	24.1
West Midlands	18871	1118	27	1.9	7.0
East Anglia	17326	2539	82	17.7	21.6
South East	18161	1876	69	12.5	18.1
South West	35603	1196	33	2.8	8.5

OSR = Oilseed Rape

Source: MAFF, 1998.

Table 2. Cropping characteristics of farms in the East Anglia Farm Business Survey, 1998/99

Region	Cereals	Legumes †	Potatoes & sugar beet	Oilseed rape	Set-aside	Forage area ‡	Other ††	Area available for arable cropping Hectares	Soil type	No of Farms in the survey
	Percentage of total farm area									
West Cambridgeshire	**55.4**	**5.6**	**0.8**	**18.4**	**4.7**	**10.1**	**5.8**	**210**	**Clay**	**34**
South Cambridgeshire and Hertfordshire	61.9	7.7	1.4	11.1	5.3	6.6	7.7		Chalk	30
North Essex & south west Suffolk	**58.1**	**4.8**	**3.9**	**10.1**	**4.4**	**11.4**	**8.4**	**188**	**Clay**	**48**
South Essex	61.2	7.6	0	9.7	6.4	9.9	5.8		Clay	28
Central Suffolk	**57.7**	**3.1**	**6.2**	**7.8**	**3.5**	**11.2**	**11.0**	**224**	**Loam**	**45**
South east Lincolnshire	53.0	6.1	14.5	5.1	3.6	4.9	14.8		Silt	26
'Breckland'	38.6	1.4	17.0	1.8	4.7	23.6	14.3		Sand	18
Central Norfolk	53.7	2.0	17.1	1.7	3.6	14.5	8.2		Loam	59
North Cambridge Fen	50.4	6.9	25.0	1.3	3.6	6.0	6.9		Peat	28

† Includes field peas and beans, but excludes vining peas.

‡ Includes land let to other farmers.

†† Horticultural crops, orchards and fruit crops, vining peas, seed crops, other cash crops, buildings and roads.

Percentage figures may sum to more than 100 due to double cropping.

Source: Lang, 2000.

Table 3. *Pre- and post-reform crop gross margins*

	West Cambridgeshire		North Essex		Central Suffolk	
Year	1996-98	2002	1996-98	2002	1996-98	2002
			£ / ha.			
Winter wheat	751	517	741	521	682	515
Spring barley†	545	447	698	455	608	450
Winter barley	669	475	660	446	629	484
Field beans‡	615	539	643	567	604	528
Spring field peas	728	703	670	620	589	532
Oilseed rape‡	733	620	739	630	713	624
Potatoes	n.a.	n.a.	n.a.	n.a.	1209	1524
Sugar beet	n.a.	n.a.	n.a.	n.a.	1266	1399
Set-aside	291	218	291	218	291	218

All figures adjusted to 1998 values before averaging

† No distinction made between feed and malting varieties

‡ No distinction made between spring and winter varieties

†† After deducting £15 per hectare variable costs

n.a. Not available as an option in the model for this farm location

Source: Murphy (1998,1999), Lang (2000), Nix (1996); authors' estimates (see text).

Table 4. *Pre-reform results*

	West Cambridgeshire	North Essex	Central Suffolk
	1998 10% set-aside, 1 break crop		
Farm size (hectares)	210	188	224
Net margin (£)	77,813	71,962	73,023
	% cropped area	% cropped area	% cropped area
First winter wheat	35	35	28
Second winter wheat	10	0	0
Spring barley	0	17	20
Winter barley	20	13	18
Total cereals	65	65	66
Oilseed rape	25	25	19
Set-aside	10	10	9
Sugar beet	n.a.	n.a.	6
Total	100	100	100
Farmer (number) †	1	1	1
Hired labour (number) ‡	1	1	1
Tractors (number)	2	2	2
Overtime (hours)	292	334	195
Contract (hours)	0	0	17.5
Casual (hours)	35	0	0
Two-break incentive (£)††	5,479 (7%)	2,269 (3%)	7,292 (10%)

Note Field beans, spring peas and grassland for beef were not included in any of the optimal solutions

† Hired labourer supplies 1762 hours per year (adjusted by weekly available field time)

‡ Farmer supplies one third of the field time supplied by one hired labourer

†† Optimal farm net margin under the two-break crop rotation less optimal farm net margin under the one-break crop rotation; pre-reform gross margins. Percentage figure is the increase from the one-break rotation farm net margin.

n.a. Enterprise not available for this farm type.

Table 5. *Post-reform results*

Category	West Cambridgeshire			North Essex			Central Suffolk		
	2002 10% set-aside 1 break crop	2002 10% set-aside 2 break crops	2002 10-50% set-aside 1 break crop	2002 10% set-aside 1 break crop	2002 10% set-aside 2 break crops	2002 10-50% set-aside 1 break crop	2002 10% set-aside 1 break crop	2002 10% set-aside 2 break crops	2002 10-50% set-aside 1 break crop
Net margin (£)	44,030	51,789	42,501	36,976	42,795	37,842	49,816	55,467	49,816
% fall in net margin (from 1998)	45	33	45	49	41	47	32	24	32
					%				
First winter wheat	35	40	35	35	40	36	28	25	28
Spring barley	15	0	15	23	0	16	26	16	26
Winter barley	15	0	15	7	0	7	12	0	12
Total cereals	65	40	65	65	40	60	66	41	66
Spring peas	25	28	0	17	14	17	0	0	0
Oilseed rape	0	22	25	8	36	8	19	44	19
Set-aside	10	10	10	10	10	15	9	9	9
Sugar beet	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	6	6	6
Farmer (number)	1	1	1	1	1	1	1	1	1
Hired labour (number	1	1	1	1	1	1	1	1	1
Tractors	2	2	2	2	2	2	2	2	2
Overtime (hrs.)	266	308	266	238	360	237	194	252	194
Contract (hrs.)	0	0	0	30.5	29.5	0	17.5	17.5	17.5
Casual (hrs.)	0	0	0	0	0	0	0	7.3	0
Two-break incentive (£)		9,288 (22%)			5,822 (16%)			5,651 (11%)	

Note Field beans, second and third winter wheat, potatoes and grassland for beef were not included in any of the optimal solutions. Other definitions are as in Table 4.

† Optimal farm net margin under the two-break crop rotation less optimal farm net margin under the one-break crop rotation; post-reform gross margins. Percentage figure is the increase from the one-break rotation farm net margin.

Table 6: *Price (£ / tonne) at which oilseed rape is eliminated from the optimal solution*

	West Cambridgeshire	North Essex	Central Suffolk
1 break crop rotation	204	118	137
2 break crop rotation	157	118	131
1 break crop, unrestricted set-aside	204	199	137
2 break crops, unrestricted set-aside	157	142	131