Modelling CAP Reform: Consensus or Conflict?

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The reform of the CAP has been analysed using a number of different sector level models such as those operated by FAPRI, the OECD, EuroCARE and the European Commission. The results of these different studies are broadly consistent in many cases, despite the radical nature of the reform in changing the relationship between payments and production. In some instances there are important differences. In this paper the approach that FAPRI has taken to decoupling in the US and the EU is discussed. The results from various analyses of CAP reform are compared to determine the extent to which results are driven by assumptions regarding the extent of decoupling of the EU payments, and how much can be attributed to different model specification.

Key words: CAP reform, decoupling, policy modeling.

The proposals regarding changes to the mechanism of direct payments in the EU in the Mid Term Review (MTR) (European Commission, 2003a) placed the issue of decoupling at the centre of the policy analysis debate in the EU. Understandably, the question of to what degree the single farm payment (SFP) is coupled to production has dominated much of the discussion until now. The impact of the introduction of the SFP in the models, however, depends not only on the degree of decoupling assumed for the payment, but also on the manner by which payments were included in the models previously, and the structure of those models. In this paper the approach that FAPRI (Food and Agriculture Policy Research Institute) has taken in dealing with the introduction of increasingly decoupled payments in the US and the EU, and the results of the studies of the recent CAP reform are compared along with the models that produced them.

The Federal Agriculture Improvement and Reform (FAIR) Act of 1996 changed the way in which support is provided to farmers in the US. The introduction of the fixed production flexibility (PFC) contract meant that some of the payments that farmers’ receive are no longer directly tied to the production of a particular crop. In considering the potential impact of these payments on their analysis, FAPRI had to acknowledge the fact that these payments were likely to have some impact on production decisions. A similar challenge is posed by the SFP, which has much in common with PFCs, and FAPRI has taken an analogous approach to its incorporation into the modeling process.

Decoupling in the US

Prior to the 1996 FAIR Act there already existed some separation between market conditions and the level of payments that farmers received due to the use of historical yields, land idling schemes or conservation programs. The vast majority of support, however, was directly linked to the prevailing market price. In 1996 PFCs, as part of the Agricultural Market Transition Act (AMTA), marked a new approach for support in the

1 Food and Agricultural Policy Research Institute, University of Missouri – Columbia.
USA. Although the marketing loan program remained intact ensuring that a large part of support continued to be linked to market conditions, PFCs facilitated full planting flexibility including the idling of land. As PFCs were linked to historical support eligibility the link to the market was almost completely broken, although some restrictions remained on how the land upon which the payment was claimed was operated.

While the introduction of PFCs in 1996 is often portrayed as a revolutionary step in US farm policy, the truth is that although there were those pushing for major reform in farm policy (for example Pat Roberts in the Senate, or Richard Lugar in the House of Representatives) the introduction of PFCs was partially motivated by a desire to maintain agricultural spending. The debate occurred against a background of high commodity prices, which reduce expenditure under the marketing loan program, and also reduced projected expenditure under the Congressional Budget Office’s (CBO) all important baseline.

As prices fell in the late 1990s the US authorized additional “emergency” payments – MLAs. These payments were paid as top-ups on PFCs, justified on the basis of “low prices”. Payments were not linked to actual market prices in any formal way, and the level of payments was ultimately a political decision. The production influencing effects of these payments was limited by that lack of a formal process in place for their payment, although it became clear that producers could count on them to offset some of the risk that they faced from a reduction in prices. The payments under MLAs that a producer received were not related to the quantity produced by that individual in a given year (except to the extent to which that producer’s output depressed prices and therefore increased the MLA).

FAPRI recognized that both PFCs and MLA could have an impact on production and that the payments had to be incorporated into the modeling framework. Sources of production effects are outlined by Young and Westcott (2000):

i) Lower risk of default by farmers makes borrowing money easier
ii) PFCs provide funds that can be invested in the farming enterprise
iii) Farmers may be more willing to undertake production of riskier crops or bring marginal (more riskier) land into production
iv) In addition farmers may feel that future access to payments may depend on current production decisions.

Early work by FAPRI sought to quantify these effects (Adams et al, 2001), using annual state-level data for 11 states. The short duration that the payments had been in place necessitated using data only from the period 1997-2000. The study concluded that there was weak evidence that the payments do indeed increase total area devoted to crop production. The paper emphasized the importance of uncertainty regarding the future

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2 This perceived “back tracking” has been pointed to by some in the EU as a likely scenario in the aftermath of the introduction of the SFP. However, budget restrictions will mean that any re-coupling of payments would have to be financed by reducing the SFP – which seems unlikely.
composition of policy, in particular whether current production decisions would influence the ability to claim future payments. Those who did suspect that this would be the case were proved to be correct with the enactment of the U.S. Farm Security and Rural Investment Act (FSRIA) in 2002 where farmers were allowed to recalculate the base areas upon which payments would be made.

In the FSRIA the US continued the use of PFC type payments, now referred to as “direct payments” (USDP). MLA was replaced by the new counter cyclical payment (CCP) which formally linked the payment to prices but not to production. CCPs provide farmers with more certainty as although the actual payment is difficult to predict, there is legislation outlining that the CCP will be paid and how it will be calculated.

**Incorporating US policy into FAPRI’s models**

FAPRI’s models for the U.S. crops sector reflect judgments about the supply-inducing effects of various government programs. For each of nine U.S. regions, area planted to particular crops is a function of expected net returns per acre for the crop in question and competing crops and a separate term reflecting “less-coupled” payments such as USDP. For each crop, expected net returns include both market returns and those from the marketing loan program, as well as a portion of expected CCP per acre. The separate less-coupled payment term includes both USDP (PFCs pre-2002) and expected CCP.

Model parameters are established using a combination of econometric estimation and analyst judgment. The key econometric result underlying the model is that the total area planted to 10 major field crops is relatively unresponsive to changes in expected net returns, with elasticities ranging from 0.02 in the Corn Belt to 0.15 in the Northern Plains, with a weighted average of 0.06. Own-return elasticities for particular crops are much larger, but strong substitution effects are assumed (e.g., between corn and soybeans in the Corn Belt) so that increasing all returns by the same proportion has only a modest impact on supply.

The relative impacts of payments can be summarized as follows:

1) Expected marketing loan benefits are treated the same as net returns from market sales. In other words, $1 of expected loan deficiency payments or marketing loan gains has the same effect on crop supply as $1 of expected market returns.

2) At the other extreme, USDP (and the PFCs that preceded them) have only a small, non-commodity specific effect on supply. A $1 increase in direct payments does not affect crop shares and increases total crop area by the same proportion as a $0.25 increase in market returns. Since total area planted is very inelastic, this implies that the supply elasticity with respect to direct payments is very small, generally less than 0.01.

3) Expected CCPs are assumed to have both a small, less coupled, payment effect, following the same approach used for direct payments, and a modest commodity-specific effect as well. The latter is accomplished by defining crop-specific expected net returns to include 25 percent of the expected counter-cyclical
payment. Thus a $1 increase in expected counter-cyclical payments would have the same effect on total area as $0.50 of expected market returns, and half of that effect would be crop-specific.

The particular parameters selected to represent the degree of coupling of various programs are somewhat arbitrary, but reflect what FAPRI considers to be reasonable judgments. Since loan program benefits can only be obtained by producing the crop in question, it seems reasonable to assume that they will have as large an impact on supply as market returns. USDP are tied to neither prices nor production (apart from a relatively minor restriction on fruit and vegetable production), and so are likely to have at most modest effects on production. While CCPs are also not affected by current production decisions, they are tied to market prices, and thus may have insurance effects beyond the wealth effects associated with USDP. Finally, it should be noted that concerns about base-updating and the design of future programs may result in USDP and CCPs having larger supply inducing effects than might have been assumed had only wealth and insurance effects on risk-taking behavior been considered.

Incorporating the SFP into the GOLD model

FAPRI maintains several models of the EU, with the team at Iowa State maintaining the model that is used in the global baseline produced each year. The GOLD (grains, oilseeds, livestock, and dairy) model is maintained at the University of Missouri and developed in conjunction with the FAPRI-Ireland and FAPRI-UK partnerships (see Hanrahan, 2001, for more details). In this paper the GOLD model is discussed but the approach that is taken is similar to that taken in Iowa.

The GOLD crops model covers wheat, barley, maize, rye, rice, oilseed and oilseed products. The crops model interacts with the livestock sector through feed demand relationships. The number of sheep, pigs and cattle are tracked, and the production of pork, poultry, lamb and beef are modeled. Milk production is allocated through a fat and protein balance into butter, cheese, skimmed milk powder (SMP), whole milk powder (WMP) and an ‘other’ category.

The model is a system of single equations simulated in Excel. The equations have not been estimated with parameter selection guided by theory and expert feedback. The GOLD model has recently undergone some significant changes with coverage expanded to the EU-25 (Binfield, 2005). A reduction in the amount of EU data from the USDA has also prompted a move to sourcing most of the data for the model from EUROSTAT. The equation structure is the same as that model used in the analyses of CAP reform.

There are many similarities between the USDP and the SFP introduced in the EU. In both cases the payment that is made is unrelated to the type of crop planted, or the market prices of any agricultural product. The SFP is larger in scope as a result of the fact that the payments that the SFP replaces were paid on a bigger variety of products and were generally larger than their US counterparts. Implementation of the SFP is more complex due to the re-nationalisation that has taken place, with countries allowed to re-couple
some payments (by paying some portion in the manner of the pre-reform direct payments), with further diversity introduced by allowing payments to be calculated regionally, historically, or through a hybrid approach.

The SFP can be expected to have an impact on production for the same reasons as outlined above for the payments in the US. In addition to the wealth and risk effects, the cross compliance conditions attached to the payment of the SFP must also be considered. In order to receive the payment producers must meet a number of food safety, animal welfare and environmental standards. Farmers must also keep their land in “good agricultural condition”, which will mean that farming of some type will have to continue in most cases. Meeting these standards will mean more costs and this will reduce any production increasing effect.

There are, therefore, many reasons to expect that the SFP has some influence on production levels in whatever form that it is implemented. In determining the impact that its introduction will have it is also necessary to take account of the production influencing impact of the payments under Agenda 2000.³ Beginning with the MacSharry reforms the EU has moved from price support towards a regime where an increasing proportion of payments come from direct payments. Studies into arable area aid payments have generally confirmed a priori expectations that these payments are partially decoupled (e.g. Moro and Sckokai, 1999; and Cahill, 1997). Since the producer may choose between several crops or sometimes choose to idle the land in voluntary set aside and still get the payment then it is reasonable to assume that an increase in payment would not have the same effect as a proportionate increase in market receipts, as would be the case in a more coupled program such as the US loan program.

It is clear that the arable area aid payment is partially decoupled from the production of individual crops. Agenda 2000 payments made in the livestock sector are also partially decoupled from production. As with the arable payments, livestock payments are placed in the “blue box” for WTO purposes reflecting the fact that quantitative limits on claims are based on historical levels of production. There is therefore an upper limit on the positive impact that these payments can have. In addition changes to the payments since the MacSharry reforms have broken the link with production further. For example, the need for ewes or cows to have offspring in order to claim their respective payments was relaxed. Nonetheless, Agenda 2000 payments in the livestock sector require an animal to claim and so are more coupled than payments in the arable sector.

³ These will be referred to as Agenda 2000 payments for simplicity with acknowledgement that some of these payments predated Agenda 2000 and some will continue after the latest reforms.
The benefit of using a simple system of equations as FAPRI does is that there is flexibility regarding the incorporation of policy levers. Figure 1a and 1b show the outline of the supply component of the FAPRI model for wheat (which is representative of all cereals) and beef. The role that payments play in each sector is very different, reflecting the different regulations governing the payments and the different biological processes in each.

In the cereal sector the arable area aid payment is used in the calculation of a total return in the sector. This variable is actually the deflated weighted (wheat, barley, maize, rye where appropriate) expected return to cereal production. It is calculated on the basis of lagged prices, trend yields, and the payment multiplied by the relevant reference yield. The payment term is further multiplied by 0.5 in order to capture the fact that the payment is only partially coupled to production, as discussed above. This variable appears in both the total cereal area equation, and the total oilseed equation. As in the US model the elasticity of area in relation to this returns variable is low, around 0.05. The response of total area to changes in payments is lower than this would suggest given the 0.5 factor employed. As the share of wheat area is determined solely by the returns from the market the coupling of payments to wheat area itself is further weakened.

Table 1: Response of GOLD model in 2009 to 10 per cent increase in cereals and oilseeds price and 10 per cent increase in arable area aid payment from 2004.

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
<th>Premia</th>
<th>Price</th>
<th>Premia</th>
<th>Price</th>
<th>Premia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>Wheat</td>
<td>0.53%</td>
<td>0.09%</td>
<td>0.29%</td>
<td>-0.03%</td>
<td>0.82%</td>
</tr>
<tr>
<td></td>
<td>Barley</td>
<td>0.77%</td>
<td>0.10%</td>
<td>0.16%</td>
<td>-0.02%</td>
<td>0.91%</td>
</tr>
<tr>
<td></td>
<td>Maize</td>
<td>0.92%</td>
<td>0.06%</td>
<td>0.50%</td>
<td>-0.02%</td>
<td>1.43%</td>
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<tr>
<td>Yield</td>
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<tr>
<td></td>
<td>Wheat</td>
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<td>0.09%</td>
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<td>-0.03%</td>
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</tr>
<tr>
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<td>0.06%</td>
<td>0.50%</td>
<td>-0.02%</td>
<td>1.43%</td>
</tr>
<tr>
<td>Production</td>
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<td></td>
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<tr>
<td></td>
<td>Wheat</td>
<td>0.53%</td>
<td>0.09%</td>
<td>0.29%</td>
<td>-0.03%</td>
<td>0.82%</td>
</tr>
<tr>
<td></td>
<td>Barley</td>
<td>0.77%</td>
<td>0.10%</td>
<td>0.16%</td>
<td>-0.02%</td>
<td>0.91%</td>
</tr>
<tr>
<td></td>
<td>Maize</td>
<td>0.92%</td>
<td>0.06%</td>
<td>0.50%</td>
<td>-0.02%</td>
<td>1.43%</td>
</tr>
</tbody>
</table>

*BEEF herd number does not include dairy cows, but production includes beef sourced from the dairy herd.
There are a number of ways that the degree of decoupling of the arable area aid payment could be measured, but in this paper just a simple increase in 10 per cent of both the payment and the price are compared. In one scenario the price of all crops is increased by 10 per cent from its baseline value in every year from 2004 onwards. In a second scenario the arable area aid premia is increased by 10 per cent for every year from 2004 onwards. The results of this simulation are given in Table 1.

In thinking of the degree of decoupling the link to area, or to production itself can be considered. Here, both are reported. Thus the increase of the arable area aid payment has a small increase in the area of different crops of less than a tenth of a percent for each. The increase in area reduces yield slightly as the model adjusts for the assumed lower productivity of the additional land, and this reduces further the impact of the payment on production of cereals. The impact of increasing all prices by 10 per cent has a much larger impact on area, yield and production. Production increases by about 1 percent, about ten times the increase from the higher premia scenario. Increasing the arable area aid payment has little impact on the livestock sector. Increasing crop prices reduces production as a result of the higher feed cost.

Table 2: Response of the GOLD model in 2009 to 10 per cent increase in beef price and 10 per cent increase in beef payments.

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
<th>Premia</th>
<th>Price</th>
<th>Premia</th>
<th>Price</th>
<th>Premia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area</td>
<td>Yield</td>
<td>Production</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>-0.01%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Barley</td>
<td>0.04%</td>
<td>0.00%</td>
<td>0.01%</td>
<td>0.00%</td>
<td>0.02%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Maize</td>
<td>0.19%</td>
<td>0.01%</td>
<td>0.02%</td>
<td>0.00%</td>
<td>0.21%</td>
<td>0.01%</td>
</tr>
<tr>
<td></td>
<td>Breeding herd</td>
<td>Slaughter Weight</td>
<td>Production</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef*</td>
<td>4.75%</td>
<td>1.45%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>2.11%</td>
<td>0.42%</td>
</tr>
<tr>
<td>Lamb</td>
<td>0.39%</td>
<td>-0.02%</td>
<td>0.05%</td>
<td>-0.01%</td>
<td>0.44%</td>
<td>-0.03%</td>
</tr>
<tr>
<td>Pork</td>
<td>0.45%</td>
<td>-0.04%</td>
<td>0.04%</td>
<td>0.00%</td>
<td>0.47%</td>
<td>-0.04%</td>
</tr>
</tbody>
</table>

*Beef herd number does not include dairy cows, but production includes beef sourced from the dairy herd

The simulation was repeated for the beef sector where the beef payments were increased by 10 per cent in one simulation and the price of beef was increased by 10 per cent from 2004 in another. The increase in the price of beef spurs an expansion of the breeding herd of cows but also for other meats through the knock on effects on price. Increasing payments has a smaller effect on production which is restricted by the limit on claims. The changes under either scenario are not large enough to impact on the cereals sector although the production increases under the price increase scenario do increase the production of maize.

If we believed that the SFP was completely decoupled having no impact on production decisions then modeling CAP reform would be more straightforward, as the SFP could be ignored and the payments terms only retained where countries chose the relevant re-coupling option. Given that we believe that the SFP is not fully decoupled the challenge is to incorporate the payment into the modeling framework, and to do so in a way that we
could perform a policy analysis that would allow us to determine the impact of reform, and also retain Agenda 2000 payments where re-coupled.

The incorporation of the SFP into the GOLD model is relatively simple and did not require the structure of the model to change. In the model the Agenda 2000 payments are replaced with a new payment term that is calculated in this way:

Types of Payment:
A = SFP payment
B = Re-coupled Agenda 2000 payment
C = New coupled payment
x = “decoupling coefficient”
m = (1 - modulation rate)
s = stocking density

Historic = (A*x+B)*m + C
(where A = old payment not re-coupled)

Regional Crops = (A*x+B)*m + C
Regional Livestock = (A*x*s+B)*m + C
(where A = total payment/area or new payment)

Where countries, such as England, are moving between historic and regional schemes the calculation is adjusted accordingly. Since the details of countries plans so far are limited, there are no “C” payments, coupled schemes funded from modulated payments, currently in the model.

The advantage of this approach is that it is simple and transparent. It also allows for the various different choices of the different countries to be incorporated. It allows many scenarios to be run, including CAP reform or future changes that might be made, say if countries opted for full decoupling, or if the modulation rate changed.

Much debate regarding the GOLD model and other models that have been used to analyse CAP reform has centered on the choice of “x”. In the GOLD model a value of 0.3 was chosen – which implies that one euro spent as part of the SFP has 30 per cent of the impact of the Agenda 2000 payments. In the absence of research that would guide the choice of this coefficient the 0.3 was chosen, in part to be consistent with the US model which had proved reliable in the projections of both baseline values and when used in policy simulation.

The arbitrary choice of this variable is not ideal, and the approach is open to criticism from a number of angles. In reality the coefficient would be different between different countries, and also within countries between different commodities, especially given the different size of farms. The apparent drawbacks prompt questions as to the importance of the level of the coefficient. In order to assess this, a number of scenarios were run.
Table 3 presents the results of a crude sensitivity analysis over the choice of the decoupling coefficient in the GOLD model. The results from the analysis produced for the impact study are listed under the 0.3 coefficient value. The scenarios were re-run with the only difference being that the coefficient value was set at either 0.1 or 0.5, with the other provisions of the MTR held constant. In the cereal sector given that the arable area aid payment was treated as partially decoupled and the structure of the model it is not surprising to see that the impact on area and production does not vary greatly between the three different values of the decoupling coefficient.

<table>
<thead>
<tr>
<th></th>
<th>0.1</th>
<th>0.3</th>
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<th>0.1</th>
<th>0.3</th>
<th>0.5</th>
<th>0.1</th>
<th>0.3</th>
<th>0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>-0.85%</td>
<td>-0.53%</td>
<td>-0.22%</td>
<td>0.90%</td>
<td>0.74%</td>
<td>0.59%</td>
<td>0.05%</td>
<td>0.21%</td>
<td>0.37%</td>
</tr>
<tr>
<td>Barley</td>
<td>-3.09%</td>
<td>-2.98%</td>
<td>-2.85%</td>
<td>0.29%</td>
<td>0.26%</td>
<td>0.24%</td>
<td>-2.55%</td>
<td>-2.44%</td>
<td>-2.32%</td>
</tr>
<tr>
<td>Maize</td>
<td>-0.47%</td>
<td>-0.39%</td>
<td>-0.31%</td>
<td>0.12%</td>
<td>0.09%</td>
<td>0.06%</td>
<td>-0.35%</td>
<td>-0.30%</td>
<td>-0.25%</td>
</tr>
<tr>
<td>Beef*</td>
<td>-14.69%</td>
<td>-11.61%</td>
<td>-8.49%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>-3.93%</td>
<td>-3.06%</td>
<td>-2.20%</td>
</tr>
<tr>
<td>Lamb</td>
<td>-6.76%</td>
<td>-5.52%</td>
<td>-4.27%</td>
<td>1.24%</td>
<td>0.95%</td>
<td>0.67%</td>
<td>-5.61%</td>
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<tr>
<td>Pork</td>
<td>0.53%</td>
<td>0.42%</td>
<td>0.31%</td>
<td>0.06%</td>
<td>0.05%</td>
<td>0.03%</td>
<td>0.61%</td>
<td>0.48%</td>
<td>0.36%</td>
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*Beef herd number does not include dairy cows, but production includes beef sourced from the dairy herd

The beef and sheep sectors, however, show significant changes between the different scenarios, since the payments are modeled as being more coupled to production. In the beef sector, however, although the impact on cow numbers is large with a 6 per cent difference between the most and the least decoupled scenario, the impact on beef production itself is reduced by the importance of calves sourced from the dairy herd.

In undertaking these scenarios the authors do not want to belittle the importance of the decoupling coefficient in models of the agricultural sector. Rather, the analysis is carried out in order to highlight how the GOLD model works, and to put the importance of the coefficient into perspective. Gaining a better understanding of the link between so-called decoupled payments such as the USDP and the SFP is a priority for policy analysts in agricultural economics.

In the future generation of the baseline, it is clear from the results that are presented above that projections in the cereal sector will be influenced more by things such as world prices and the exchange rate rather than the choice of decoupling coefficient. In the livestock sector the situation is viewed as less clear, indeed the December 2004 enumerations for EU livestock do not show signs of a drop in breeding herd numbers, probably as a result of the fact that in the EU-15 producers had to retain their animals to receive payments in 2004. Plantings of cereals did not show any great reduction from 2004 if the change in set aside rate is considered. The only crop where area fell

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4 Remember that the original MTR proposal that was the subject of the impact analysis did not include the various re-coupling provisions of the final compromise, and so therefore under all these scenarios the SFP is implemented in full.
dramatically was for durum wheat the size of which the FAPRI analysis failed to emulate, with the drop in area for that crop much higher than for the rest of the major cereals.

Results from CAP reform studies

As part of the review process the European Commission carried out and commissioned a number of analyses into the potential impact of the MTR. In this paper we compare some of these studies and attempt to explain some of the similarities and differences in the results. The studies that are reported here are four of the impact studies of the MTR proposals plus an analysis of the final agreement by the OECD;

i) **GOLD**, (FAPRI, 2003),  
ii) **ESIM**, (European Commission, 2003a),  
iii) **CAPSIM**, (EuroCARE, 2003a)  
iv) **CAPRI**, (EuroCARE, 2003b)  
v) **AGLINK**, (OECD, 2004).

These do not provide an exhaustive list of partial equilibrium analyses of CAP reform but do represent a broad overview. All the analyses are of the EU-15. A more comprehensive examination of the various analyses form different types of models is carried out in Balkhausen et al (2005), which particularly focuses on the relationship (or lack of it) between crops and pasture and fodder area in area allocation in the models.

Both AGLINK and GOLD are dynamic partial equilibrium models. ESIM and CAPSIM are comparative static. The CAPRI model uses a two step approach with a linear programming component iterating with a market model. For the crop sector all the models derive yield and area separately. The models vary in the specification of the area allocation specification. CAPRI and CAPSIM have more coverage in their area allocation as they account for silage maize and other fodder, with CAPRI also covering pasture. The GOLD model does not address restrictions on total agriculture area, ESIM and AGLINK scale area allocated according to the total area available. CAPSIM models the land market endogenously, and CAPRI incorporates a land balance.

Most of the models use some combination of lagged output and input prices with ESIM using just current period variables. Direct payments are included in all of the models. How the SFP decoupling issue is handled varies between them. In the CAPRI and CAPSIM models payments are decoupled from the production of commodity and instead linked to land. The ESIM model completely decoupled payments. Only the FAPRI and OECD models account for wealth, insurance and other such effects. In the GOLD model these are implicit in the 0.3 decoupling coefficient. The OECD adjusts market prices with risk premia based on payments.

The results of the CAP reform analysis for crop area from the different models are shown in Table 4. Regarding cereals, all the models show the same direction with cereal area falling as a result of the changes (introduction of the SFP and fall in intervention price).
CAPRI shows the largest fall, followed by CAPSIM and ESIM. Both FAPRI and the OECD show more moderate changes.

The results for oilseeds are mixed, with increases in area for CAPSIM and ESIM, and reductions projected in FAPRI and CAPRI. The larger magnitude of drop for oilseeds versus cereals in the FAPRI analysis is justified on the basis that the MTR excluded the production of industrial crops on set-aside land. In CAPSIM the increase in oilseed area is driven by an increase in sunflower area, primarily in Italy where durum area is projected to fall. The ESIM study cites the introduction of the carbon credit payment as a positive factor on oilseed area.

Table 4: Results of CAP reform analyses for crop area

<table>
<thead>
<tr>
<th></th>
<th>CAPRI</th>
<th>CAPSIM</th>
<th>ESIM</th>
<th>FAPRI</th>
<th>OECD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>-</td>
<td>-6.0</td>
<td>-5.4</td>
<td>-0.6</td>
<td>-0.5</td>
</tr>
<tr>
<td>Barley</td>
<td>-</td>
<td>-1.7</td>
<td>-</td>
<td>-2.7</td>
<td>-</td>
</tr>
<tr>
<td>Maize</td>
<td>-</td>
<td>-1.3</td>
<td>-</td>
<td>-0.4</td>
<td>-</td>
</tr>
<tr>
<td>Total cereals</td>
<td>-8.7</td>
<td>-4.0</td>
<td>-5.4</td>
<td>-1.7</td>
<td>-0.7</td>
</tr>
<tr>
<td>Rapeseed</td>
<td>-</td>
<td>-0.6</td>
<td>7.1</td>
<td>-3.0</td>
<td>-</td>
</tr>
<tr>
<td>Total oilseed</td>
<td>-4.8</td>
<td>1.5</td>
<td>6.0</td>
<td>-3.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Silage maize</td>
<td>-5.2</td>
<td>-5.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Other fodder</td>
<td>15</td>
<td>9.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Vol. set aside</td>
<td>-7.9</td>
<td>-</td>
<td>7.1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

CAPRI and CAPSIM both show silage maize area falling, as a result of the introduction of the SFP. Other fodder area (and therefore total fodder area) is shown as rising.

The impact on beef cows is larger for all the analysis than that on crop area, which is not surprising given the sector’s reliance on direct payment and the direct link between these payments and animal numbers. The OECD study impacts are much smaller than the other studies, with FAPRI showing smaller production impacts than the rest. Projected production impacts for the rest of the meats are broadly similar.

Table 5: Results of CAP Reform analyses for livestock production

<table>
<thead>
<tr>
<th></th>
<th>CAPRI</th>
<th>CAPSIM</th>
<th>ESIM</th>
<th>FAPRI</th>
<th>OECD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef cows</td>
<td>-17.5</td>
<td>-19.3</td>
<td>-</td>
<td>-11.6</td>
<td>-3.2</td>
</tr>
<tr>
<td>Ewes</td>
<td>-</td>
<td>-3.1</td>
<td>-</td>
<td>-5.5</td>
<td>-</td>
</tr>
<tr>
<td>Beef</td>
<td>-6.4</td>
<td>-9.3</td>
<td>-5.7</td>
<td>-3.1</td>
<td>-0.6</td>
</tr>
<tr>
<td>Lamb</td>
<td>-6.0</td>
<td>-3.1</td>
<td>-</td>
<td>-4.6</td>
<td>-</td>
</tr>
<tr>
<td>Pork</td>
<td>0.1</td>
<td>0.2</td>
<td>-</td>
<td>0.5</td>
<td>0.1</td>
</tr>
<tr>
<td>Poultrymeat</td>
<td>0.2</td>
<td>0.2</td>
<td>-</td>
<td>0.6</td>
<td>-</td>
</tr>
</tbody>
</table>
What is really driving the results?

Given the radical nature of the reforms that were proposed in the MTR it could be argued that the differences between the studies are small. Qualitatively they are very similar, but even the magnitude of the projected responses are not great. In the crop sector two possible sources of the higher estimates of area reduction for cereals come from the fact that the three studies that have the largest effect also assume that the SFP is completely decoupled. The fact that CAPSIM and CAPRI both have pasture and/or fodder components in the land area allocation mechanism is also likely to increase response. Larger shifts between the crop sector and livestock sector are also a feature of GTAP analyses (e.g. Frandsen et al, 2003; Conforti, 2003).

The scale of the model is clearly an issue for the modeler decided by the aims with regard to the extent of the analysis to be undertaken and the resources available as central determinants of the choice. At present the GOLD model does not include area that is devoted to livestock production in the area allocation system. In some of these models it appears that the introduction of the SFP is increasing the gross margin of some fodder production, thereby increasing area. The price of fodder in the models may drop, and thereby the SFP can have a positive effect on livestock production although this is offset by the decoupling of the livestock headage payments themselves.

The SFP introduces area payments for land uses, such as some types of fodder production, where no area payment was payable under Agenda 2000. However, pasture and fodder area comprised the area that was used in the calculation for stocking density requirement for the headage payments made for livestock. In Agenda 2000 this link was strengthened in countries with extensive production systems with the introduction of the extensification premia. Therefore, the link between land and the payment occurred not only through the impact on gross margins of livestock production but also through the direct restrictions that surrounded the payment. In many cases the livestock payments were virtually area payments and this was reflected in land values (and rent).

Therefore, while the GOLD model might understate the pull effect of paying the SFP on fodder and pasture area, modeling the situation as one where the area payment goes from zero to some proportion of the SFP, will probably overstate it. In the CAPSIM model the introduction of a payment on fallow and grassland (EuroCARE, 2003a, Table 4) is responsible for some of the shift out of crops and into fodder area. Some in the US thought that decoupling there would lead to a significant increase in hay area, which subsequently failed to materialize.

The low estimates of cereal area the FAPRI model projects is also a result of the fact that the Agenda 2000 payments in that sector are treated as more decoupled than in the other models.

The above arguments illustrate the complexity of the decoupling issue. Even before we discuss the appropriate “coupling coefficient” to use one needs to consider the coupled nature of the Agenda 2000 payments, and establish exactly what we are assuming the
payments are coupled to. For example, in the livestock sector payments are linked to breeding animals (either directly or through transmission to calf prices) rather than to meat with their positive influence restricted by ceilings. Stocking density restrictions link the payments to land. Moving to the SFP certainly reducing the production effect on meat, but may not establish a greater link to forage or pasture usage.\footnote{Consider a cattle farmer who under Agenda 2000 claimed extensification premia and was close to his stocking density limit. The value of an extra acre of land in terms of payments that it generated may have been very high (extensification premia on his whole herd). The full introduction of the SFP would dramatically reduce the payment generating income of that land.}

Differences between the model results can be explained by factors other than just differences in assumptions regarding the degree of coupling of the SFP. The treatment of the Agenda 2000 payments is important. Also, the way that land allocation is handled appears to explain much of the difference between the CAPRI and CAPSIM approaches.

**Conclusions**

The introduction of increasingly decoupled payments in the USA and the EU has resulted in modeling challenges to FAPRI. Only recently in the USA has there been sufficient data in order to conduct analyses of the impact of the PFCs and USDP, and FAPRI attempts to incorporate evidence that comes from both its own studies and those that are carried out at other institutions in order to improve the quality of its projections and policy analysis.

The work that has been carried out in the USA provides some guidance as to the appropriate way to incorporate the SFP into models for the EU. In the EU the analysis is made more difficult by the complications that surround the implementation of the SFP arising out of the nature of the final political compromise, and from the fact that the payments are spread over more commodities. Payment regimes under Agenda 2000 differ in their production impacts between commodities and this must be acknowledged. It is not possible for the model to reflect the complexity of the SFP, which is incorporated into the GOLD model in a rather \textit{ad hoc} fashion. The production influence of the SFP is an area of great importance for future research and this is an area where it is hoped that there can be much improvement in future.

Differences in assumptions regarding the production inducing impact of the SFP are one explanatory factor for the different results of the studies of the MTR (and the final compromise). However, the different structure of the models, and the way that the Agenda 2000 payments were incorporated is also important. The results of the different studies that have been carried out have been, on the whole, qualitatively similar. Where there have been differences for the cereal sector it appears that an important contributor has been the land allocation mechanism, with models that have pasture or fodder components showing larger shifts out of cereals. In these models the assumptions of the SFP as an area payment are key drivers of the results.
The GOLD model does not currently have a pasture or fodder component. It could be argued that as the type of historical restrictions on production patterns imposed by policy (ceilings on payments, base areas, stocking density restrictions) become less relevant a more comprehensive land allocation mechanism is required. The issue of how the SFP impacts production decisions for cereals or for fodder crops is illustrative of the overall complexity of the decoupling problem.

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