Quantifying the Effects of Decoupling on Agriculture in Ireland's NUTS 3 Regions

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Abstract

In this paper we adapt the CAPRI model to facilitate an analysis of CAP reform on agriculture in Ireland's NUTS 3 regions. We make assumptions about how the Luxembourg Agreement will be implemented in the Member States and contrast the effects of this policy with that of the current policy Agenda 2000. The projection year is 2009. Comparisons are also made with the FAPRI model for Ireland as a whole. We find that with the full-decoupling of premium payments in Ireland, regional agricultural income will be 3% higher, on average, in 2009 than under the current policy. We also find that the directional movements in incomes and activity levels tend to be the same as FAPRI's predictions, but the outcomes using the CAPRI model tend to be a little less optimistic.

Keywords: Agricultural policy, Agricultural modelling, Ireland

JEL classification(s): Q18

1.

1. Introduction

On 26 June 2003, the EU Council of Ministers reached agreement on the Commission's Mid-Term Review proposals for the reform of the Common Agricultural Policy. The desire was for a new policy geared towards taxpayers and consumers and for a more market-driven production of agricultural goods. The agreement built on the Mac Sharry proposals of the early 1990s, which sought to make the level of production less dependent on heavy price subsidies and to reduce the resulting huge surplus of agricultural commodities. Essentially the Mid-Term Review aims at removing direct production incentives by abolishing premium payments coupled to production and replacing them with a single annual direct payment.

The final provisions of the agreement turned out to be more complicated than this because in the end a menu of options was offered to the national governments, the components of which allowed for differing degrees of subsidisation of activities from country to country. With regard to Ireland, our primary concern in the paper, the chosen option was known from quite early on. This option was for an almost complete elimination of premium payments linked to particular activities and their replacement by a single farm payment.

The aim of this paper is to model the effects of this decoupling of payments from production on Irish farm outputs and incomes, at a regional level. The model we use is the Common Agricultural Policy Regional Impact model (CAPRI). Comparisons are made between outcomes (in the simulated year 2009) with and without decoupling for farm income and activity levels in eight Irish regions (at NUTS 3 level). At the time of writing, we do not know the choices of all EU governments with regard to decoupling. So, in running our model, we rely on advice given to us by colleagues in June 2004 as to the most likely choices within the EU 15, as it then was. The particular mix of the options that we assume for each country (in the EU 15) are outlined in Appendix 1 and further details of exactly how the scheme will operate in Ireland can be found at http: //www. agriculture. gov. ie/ publicat/ single _pay sch.pdf.

The model is solved at a regional level for the whole EU15, but our analysis of results focuses only on Ireland. Comparisons are also made, briefly, at a national level, with results provided by the FAPRI model for Ireland for the same year. In general, we find similar results to the FAPRI model. Full decoupling is likely to have a small positive effect on

overall farm incomes compared to the continuance of the status quo ante. Suckler production will decline, as will production of cattle for fattening, as well as sheep and goat production and crop production. Our forecasts are generally for larger decreases in production than those forecast by the FAPRI model. Our regional forecasts suggest that the greatest overall income gains are in regions with both tillage and cattle farming (e.g. the south-east), but that all eight Irish NUTS3 regions gain agricultural income from full decoupling, given the assumed mix of chosen MTR options modelled for the rest of the EU 15.

We begin the paper with a brief description of the programming model used for the simulations. This is followed by national and regional results for 2009. A comparison is then made between the national results and the FAPRI results. The main results are summarised in the conclusion.

2. Background to the Model

The objective of the CAPRI (**C**ommon **A**gricultural **P**olicy **R**egional **I**mpact) project is the development of an EU-wide economic modeling system capable of providing a detailed analysis of the regional impacts of the Common Agricultural Policy (CAP). The project was co-financed by the EU under the FAIR program between 1997-1999. Funding was continued under the CAP-STRAT project between 2000 and 2004, with the aims of updating, validating and improving the model and extending its capability of simulating different policy scenarios.

Fundamentally, CAPRI is a spatial economic model that utilizes positive mathematical programming (PMP) techniques in order to maximize regional agricultural income subject to physical, biological, and political constraints. Agricultural production is decomposed into 50 activities, using 35 possible inputs, and returning 60 outputs, according to definitions specified by the European Accounts for Agriculture. The model incorporates all payment schemes and their respective ceilings, as well as set-aside obligations and production quotas. In terms of international trade, tariff rate quotas, intervention purchases, and subsidized exports are also modeled in the market component of the model.

3. The Supply Side of the Model

In the supply part of the model, each of the 200 NUTS II regions in the EU (pre-accession) has its own programming model. Each of these maximizes regional income subject to a set of constraints (e.g. on milk production or set-aside). For example:

$$\max_{x\,j \geq 0} z = \sum_{j=1}^{n} m_j x_j$$

subject to: $$\sum_{j=1}^{n} a_{ij} x_j \leq b_i \left[\lambda\right]$$

where:

z= objective value

m= margins (i.e. yield*price-variable cost)

x= endogenous variables (e.g. outputs)

a= input/output coefficients

b= constraints

λ= shadow prices of the constraints

Restrictions include fixed resources (e.g. grassland), policy variables (milk quotas), feed, fertilizer, and young animals and supply balances. As mentioned, optimization of this function requires agricultural income to be maximized. Income is defined as revenues (sales and premium payments) minus accounting costs and PMP costs for activities and feed mix. The latter are explicitly incorporated into the objective function in order to allow for substitution in the diet of the animal. The feed use of each feed component per animal is valued by its price. Yields are treated exogenously and estimated according to trends. Trends in costs generally follow those of yields.

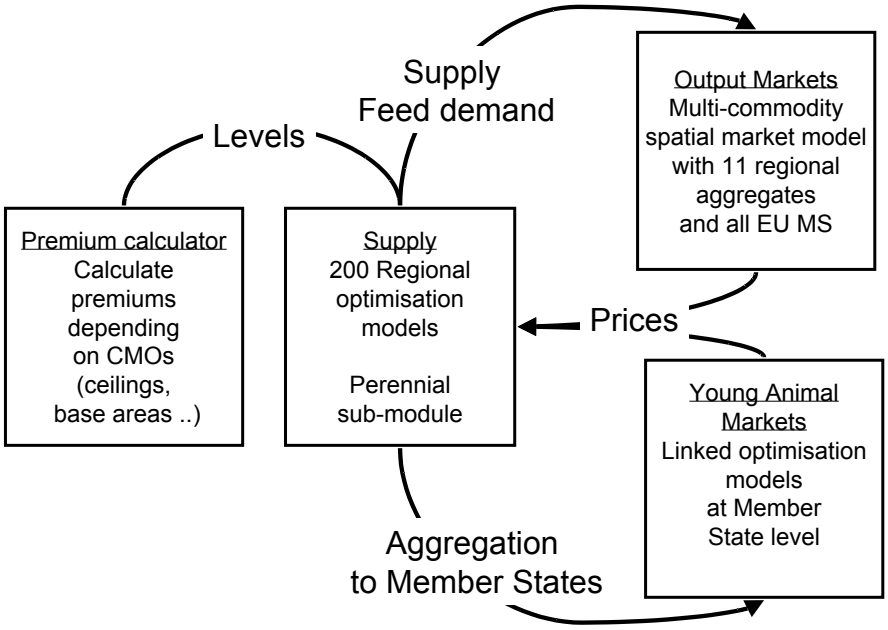
After the regional models are solved, results are aggregated to member state level, which are then calibrated using PMP (see Appendix 2 for a basic exposition of PMP). Young animal prices are determined by an EU trade model, which produces market balances for young animals.

4. The Market Model

The market model provides the demand component and comprises a world divided into 12 country aggregates. 26 primary and processed products are modeled. Systems of supply, human consumption, feed and processing functions are incorporated for each group of countries. The parameters of these functions are derived from literature and other modeling systems, and are calibrated to expected quantities and prices in the projected year. Various policy instruments are featured: bilateral tariffs, producer/consumer subsidy equivalents, tariff rate quotas, intervention sales and subsidized exports. Bilateral trade is modeled according to the Armington assumption, which postulates that internationally traded products are differentiated by their country of origin. This facilitates the reflection of trade preferences for certain country aggregates. In CAPRI, this consists of a 2-stage process: (1) demand is decomposed by imports and domestic sales, and (2) different import shares from different origins. Therefore, there is no uniform world market price for a good. Regarding trends in the market model, inflation is assumed at 1.9% per annum and growth in nominal GDP at 2.7% per annum. World market prices are trended based on long-term time-series.

Figure 1 below describes the interactions between the different sub-models in CAPRI. In solving the model, regional income, as defined above, is maximized with exogenous prices (from the market model), and then aggregated to member state level, as mentioned. The prices of young animals are calculated by linking each Member State model, thereby creating a single market, and producing a market balance. The supply and feed demand functions of the market model are set to the prices and quantities of feed use and production originating from the solution of the supply model. Thus, supply prices and quantities are now taken as exogenous. The market model (i.e. output markets) is then solved and produces a set of prices and quantities that are now exogenous to the supply model. The process repeats itself for a specific set of iterations determined by the user. Calibration of activity levels and feeding requirements in the base year (i.e. 2001) is ensured by PMP terms incorporating additional binding constraints.

Figure 1: Interactions among the sub-models of CAPRI



Source: Perez et al (2003)

After the discontinuation of EUROSTAT's SPEL database in 1999 it was decided that a new database was necessary for the CAPRI project. The COCO ("complete and consistent") database is now the primary data source at national level for CAPRI and combines physical and valued data over several domains of EUROSTAT's NEWCRONOS database of agricultural statistics. The REGIO domain in the latter provides most of the regional data usually up to Nuts 2 level. Data from NEWCRONOS is often incomplete, discontinuous, and sometimes erroneous. CAPRI takes this data, which includes physical data, data from the European Accounts of Agriculture (EAA), and price data, assigns its own data codes to it, and converts it in to gams programming files. This 'raw' data (i.e. unmodified data) can always be viewed through CAPRI's database interface. The gams files now enter as inputs in to the COCO database, where the completeness of data over time, products, and items, and the consistency of the data according to accounting definitions are ensured. This data is then combined with data on political variables, and data from national experts, which is needed to fill in gaps in the data and ensure plausible estimates. The result is a complete and consistent database at a regional level, which also incorporates political variables. This database provides the information necessary to drive the simulations.

Data for the NUTS 3 regions is taken from the June 2000 Census of Agriculture, published by Ireland's Central Statistics Office. Given that the crop and animal activities defined by the Census may not strictly translate to those used by CAPRI, approximations were used where necessary. Data for an activity were aggregated for each county in a NUTS 3 region in order to arrive at a regional estimate (see Appendix 3 NUTS 3 regions and constituent counties). As CAPRI is designed to facilitate analysis at NUTS 2 level, the structure of the database needed to be changed in order to replace Ireland's two NUTS 2 regions with the eight NUTS 3 regions. This required certain manipulations and redefinitions, the details of which are beyond the scope of the paper. As we had regional data for only one year, we applied national trends to the regions for the other years in order to calibrate the model. Once this data is incorporated into the model it is subjected to a consistency check with the national data, a process that invariably leads to solver infeasibilities. Once the national and regional data have been reconciled and the model has been calibrated, projections based on certain policy changes can be made.

The primary premium groups to be modelled for the MTR are grandes cultures, durum wheat, suckler cows, bull fattening, and sheep and goats. In addition, there are several premium payments that will continue to be coupled e.g. rice, energy crops, and pulses, although these are not relevant to our analysis. Decoupling, whether total or partial, is modeled by first taking the existing premium payments currently in operation under the agenda policy. These payments are then redefined according to the stipulations of the MTR. This includes protein payments being made only to pulse production, grandes culture no longer receiving a protein payment but coupled payments increasing to 63 euro/tonne.

In the next step, all payments, regardless of whether they are being decoupled or not, are first modulated. This step gives the total percentage of payments for each producer group and region subject to modulation, which enables a redeclaration of premium amounts and value ceilings (envelopes) according to modulation. Partial decoupling is then implemented. Firstly, historical coupled payments are calculated with the new premium amounts. Political variables such as the small producer scheme are incorporated and the value of payments per activity level is calculated down to NUTS2 level. A cut factor is applied to payments where a national ceiling is exceeded. In order to simulate the effects of decoupling on Irish agriculture we must make assumptions about the expected MTR strategies of the other 14

EU countries in the model. Given the reference payments, and the amount of payments that are to remain coupled to production, we can calculate the remaining decoupled payment.

For information on bilateral trade flows, data is taken from the WATSIM database. The Aglink model from the OECD and the Agricultural Market Database provide data on trade policy variables. Trends for population growth, GDP growth, and preferences are taken from Eurostat. Corresponding data for non-EU countries is taken from the 2030 Framework of the FAO. We now proceed to analyse the impact that CAPRI expects these reforms will have on Irish agriculture at both a national and a regional level.

5. National Results

Table 1 presents some results for total income, budget outlays, and premium payments for three scenarios. The first is the 'base year', which provides a reference point to which our projections can be compared. In CAPRI, the current 'base year' is 2001. The second scenario is the baseline or 'reference run' which, simulates the state of agriculture in 2009 using, as mentioned, Agenda 2000 policy. This can be interpreted as what would happen if agricultural policy remained as it is today until 2009. The third scenario, adopts the framework as established in the Mid Term Review. As mentioned, this scenario is based on our expectations of the implementation options particular Member States will adopt. The table also shows the percentage deviation of each projection from its base year value.

In this analysis of the effects of the MTR on agriculture in Ireland and its NUTS _ regions we have assumed that Ireland fully decouples all premium payments. Total Agricultural income in Ireland is predicted by the model to rise by over 3% in the MTR relative to the reference run. Total MTR premium payments to Ireland from the EU are expected to rise by 5% over those in the reference run, while FEOGA Pillar 1 budgetary payments to Ireland are expected to rise by over 4%. It is interesting g to report also, though it is not in the table, that global warming potential falls in Ireland by 7.7% as a direct result of decoupling. The uses of the CAPRI model for analyzing environmental issues are outlined in Perez et al (2004).

Table 1: CAPRI Projections for Ireland's share of the EU budget, Total Premium Payments to Ireland, and total Agricultural Income

	Base year [2001]	Reference Run % deviation to: Base year	MTR % deviation to : Ref run
FEOGA budget outlays First Pillar (Mio Euro)	1103.44	980.79 -11.12%	1024.08 4.41%
Premiums (Mio Euro)	854.14	928.34 8.69%	973.99 4.92%
Agricultural income (Mio Euro)	3732.09	2981.03 -20.12%	3082.18 3.39%

Table 2 shows CAPRI projections for income, activity levels, and premium payments at the national level for both the reference run and the MTR. In terms of cereal production, the two most important crops are soft wheat and barley. The number of hectares of wheat is projected to fall by 18% relative to the reference run with decoupling, with income per hectare from this activity falling by 19%. Per hectare costs of soft wheat production are expected to increase by an average of 7% in both scenarios, mainly due to a rise in fertiliser costs. Decoupling has a negligible effect on the producer and consumer price of soft wheat, which fall by 20% and 15% respectively in the reference run.

Given the proportion of premiums in income from barley, it is to be expected that there will be a greater decline than in soft wheat. This is clear from the table. Hectares of barley are expected to fall by 25% relative to the reference run. Income per hectare from this activity falls by 30% in the MTR compared to the reference run.

Sugar beet is also an important source of revenue for Irish agriculture, particularly for areas in the east of the country. A priori, one would not expect this sector to undergo much transformation given the absence of coupled premium payments. The model estimates that the number of hectares of sugar beet is expected to fall 5% compared to the reference run. In addition, per hectare income earned from this activity is projected to rise slightly in the MTR relative to the reference run, mainly because the producer price of sugar beet rises by 2%. There is no difference in consumer price movements of sugar between the scenarios.

As in many Member States, the dairy cow sector is a primary source of revenue for Irish agriculture. With the retention of the quota-system in both policies, the supply of milk will remain approximately the same. The CAPRI model separates dairy cows into those that are high yielding (DCOH) and those that are low yielding (DCOL). With the quota system still in place, there is negligible difference in dairy cow numbers between the scenarios. However, there is a substantial fall in income earned from this activity relative to the reference run, with income per head from DCOH and DCOL falling a further 13% and 21% respectively in the MTR. With the producer price of milk the same in both scenarios, the income difference is due mainly to the loss of premium payments attached to the dairy cow sector[1] in the MTR.

In addition to the dairy sector, beef producing activities are of particular importance to Irish agriculture. Given the level of coupled support that the suckler cow sector enjoys, one would expect decoupling to have a substantial effect on the profitability of the sector. CAPRI predictions confirm this. The model projects a fall of 20% in the number of suckler cows relative to the reference run, while income falls by 76% per head. As can be seen from the table, premium payments constituted approximately 85% of income derived from suckler cows. The price of beef is, however, 7% higher in the MTR than in reference run, although it is still 23% lower than in the base year.

In addition, there are significant income losses from heifer and bull fattening. For example, income from high-weight heifers for fattening (HEIH) falls a further 57% with decoupling than when premium payments are being made to the sector. There is little difference in herd size between the scenarios. Costs fall by 12% in the reference run and 16% with decoupling. In addition to the 7% increase in the producer price of beef relative to the reference run, the consumer price of beef rises by almost 5%.

[1] These payments are: direct income support to dairy cows, national envelope for dairy cows, national envelope for bovine meat cattle, and slaughter premium for adult cattle

Table 2: CAPRI Projections for Ireland for Income, Activity levels, and Premium Payments for Reference Run and MTR

Ireland	Base year [2001]			Reference run [2009] % deviation to : Base year			MTR [2009] % deviation to : Ref. run	
	Income	Hectares/ herd size	Premiums	Income	Hectares/ herd size	Premiums	Income	Hectares/ herd size
	Euro/ha or head	1000 ha or hds	Euro /ha or head	Euro/ha or head	1000 ha or hds	Euro /ha or head	Euro/ha or head	1000 ha or hds
Soft wheat	831.64	88.54	445.28	595.5 -28.39%	84.77 -4.26%	383.04 -13.98%	481.2 -19.19%	69.53 -17.98%
Barley	698.5	180.31	445.28	488.91 -30.01%	171.86 -4.69%	383.04 -13.98%	336.6 -31.15%	129.69 -24.54%
Sugar Beet	1713.93	31.51		1287.29 -24.89%	29.7 -5.74%		1322.52 2.74%	28.28 -4.78%
Dairy Cows high yield	1356.92	584.56	14.79	1288.43 -5.05%	499.02 -14.63%	181.69 1128.47%	1122.41 -12.89%	496.36 -0.53%
Dairy Cows low yield	469.99	584.51	14.79	481.06 2.36%	538.17 -7.93%	111 650.51%	381.82 -20.63%	544.36 1.15%
Suckler Cows	225.68	1160.79	190.35	198.94 -11.85%	1312.39 13.06%	167.64 -11.93%	47.19 -76.28%	1048.61 -20.10%
Heifer fattening high weight	235.47	268.11	102.52	86.48 -63.27%	267.58 -0.20%	115.05 12.22%	37.41 -56.74%	268.05 0.18%
Bulls high weight	764.46	469.25	282.47	549.38 -28.13%	471.18 0.41%	295.26 4.53%	369.9 -32.67%	418.88 -11.10%
Bulls low weight	447.88	469.14	282.47	338.61 -24.40%	500.21 6.62%	295.26 4.53%	142.23 -58.00%	407.91 -18.45%
Pork	43.95	3122.36		37.33 -15.06%	3416.03 9.41%		35.92 -3.78%	3370.42 -1.34%
Pig Breeding	193.5	182.74		64.41 -66.71%	160.53 -12.15%		95.11 47.66%	171.52 6.85%
Sheep and Goat fattening	35.68	3324.97		27.07 -24.13%	3392.1 2.02%		24.28 -10.31%	3325.59 -1.96%

Similarly, income from high-weight bull fattening (BULH) falls a further 33% with decoupling, while the herd size falls by 11%. Obviously, the loss of the special bull and slaughter payments, as well as the fall in beef prices, has a substantial impact. Total costs for this activity fall by 12% relative to the baseline, due mainly to the fall in the value of a calf, which is an imputed cost in the process of bull fattening.

The pattern of income decline is continued in other animal activities. Income from pig fattening is projected to fall by a further 4% with decoupling, while income from pig breeding actually rises by 48%. The latter is mainly due to the 10% increase in the producer price of a young piglet, which is an output of pig breeding. The consumer price of this product falls by 15%.

Lastly, the sheep and goat sector is particularly important in the more remote areas of Ireland. Income from fattening of sheep and goats is expected to fall by 10% in the MTR relative to the reference run. Herd sizes are expected to change little. The income fall is mainly due to an increase in costs caused by an increase in the value of a young lamb, which is an input in the fattening process. The model also projects that the consumer and producer price of sheep and goat meat rises by 7% in the MTR relative to the reference run.

It must be borne in mind when reading the above, and the analysis which follows, that even though the income per head or per hectare for almost all activities falls due to the MTR the fall is more than made up by the single payment to farmers. What is occurring, with regard to income, is mainly a reclassification of income sources.

6. A NUTS 3 Analysis

6.1 Border Region

Table 2 presents CAPRI projections for the reference run and decoupling policy for the Border region in 2009. Again, the table shows the percentage deviation of the reference run from the base year, and of the MTR from the reference run.

Total agricultural income in the Border region is projected to increase by 1% in the MTR relative to the reference run. The number of hectares used for soft wheat is projected to fall 20% with decoupling, while income from the activity falls 33%. As is clear from the table, premium payments constitute more than a half of income from soft wheat in the base year. In addition, the producer price of soft wheat is expected to be slightly lower (2%) in the MTR compared to the reference run.

Table 2: Capri projections for Income, activity levels, and premium payments for the Border region for Reference Run and MTR

Border	Base year [2001]			Reference run [2009] % deviation to: Base year			MTR [2009] % deviation to: Ref run	
	Income	Hectares/ Herd size	Premiums	Income	Hectares/ herd size	Premiums	Income	Hectares/ herd size
	Euro/ha or head	1000 ha or hds	Euro /ha or head	Euro/ha or head	1000 ha or hds	Euro /ha or head	Euro/ha or head	1000 ha or hds
Soft wheat	848.62	7.48	445.28	604.39 -28.78%	7.16 -4.28%	383.04 -13.98%	404.29 -33.11%	5.72 -20.11%
Barley	704.53	16.79	445.28	495.97 -29.60%	16.07 -4.29%	383.04 -13.98%	279.77 -43.59%	11.96 -25.58%
Dairy Cows high yield	1301.34	61.37	14.79	1212.12 -6.86%	52.69 -14.14%	181.69 1128.47%	1042.93 -13.96%	51.88 -1.54%
Dairy Cows low yield	446.08	61.36	14.79	446.3 0.05%	55.78 -9.09%	111 650.51%	344.35 -22.84%	57.67 3.39%
Suckler Cows	222.13	217.23	190.35	196.34 -11.61%	247.97 14.15%	167.64 -11.93%	45.47 -76.84%	203.62 -17.89%
Heifers fattening high weight	232.98	36.67	102.52	85.13 -63.46%	36.83 0.44%	115.05 12.22%	34.65 -59.30%	37.56 1.98%
Bulls high weight	763.2	53.82	282.47	551.87 -27.69%	54.21 0.72%	295.26 4.53%	374.97 -32.05%	48.68 -10.20%
Bulls low weight	449.15	53.79	282.47	337.71 -24.81%	57.47 6.84%	295.26 4.53%	137.74 -59.21%	47.29 -17.71%
Pork	44.01	881.94		37.37 -15.09%	964.76 9.39%		35.95 -3.80%	951.86 -1.34%
Pig Breeding	193.26	52.45		64.03 -66.87%	46.07 -12.16%		94.68 47.87%	49.22 6.84%
Sheep and Goat fattening	35.6	507.82		27.21 -23.57%	519.84 2.37%		24.28 -10.77%	512.88 -1.34%

Barley follows a similar pattern to soft wheat, with the number of hectares falling 26% compared to the reference run. With premium payments constituting 77% of income from barley in the reference run, income falls by 44% when they are withdrawn. In addition the producer price of barley falls 4% more than in the reference run. With income per hectare higher for soft wheat than for barley, farmers substitute away less from soft wheat. This can

explain the 5% difference between wheat and barley in activity level changes in the MTR relative to the reference run.

In terms of the dairy herd, with the continued presence of the quota-system there is little aggregate change in the number of dairy cows. Income per head from DCOH and DCOL is 14% and 23% lower than in the reference run. This is obviously due to the loss of premium payments attached to dairy cows.

One of the most acutely affected activities from decoupling is that of suckler cows. The number of suckler cows in the Border region falls by 18% with decoupling and income from this activity by 77% more. Again, this is primarily due to the loss of premiums. There is some compensation from the 7% increase in the price of beef relative to the reference run.

The pattern of income decline is continued by all of the other cattle activities. For example, income from HEIH falls almost 60% more with decoupling. Similarly, income from BULH falls by 30% more.

In terms of other animal activities, the pattern of income decline less stable. For example, income from pig breeding increases by 48% with decoupling. Again, this is due to the increase value of a piglet. In terms of sheep and goat fattening income is projected to fall by 11% more with decoupling. As above, this is due to an increase in costs caused by the higher value of a lamb.

6.2 Dublin

As can be seen from table 3, the agricultural sector is relatively small in Dublin. Total agricultural income rises by approximately 0.86% in the MTR. In terms of cereal production, the number of hectares under soft wheat is not expected to change in the reference run, but falls by 7% in the MTR. Income from the activity follows the national trend and is forecast to fall 20% in the MTR. The pattern is similar for barley production, with the number of hectares under barley falling 10% more with decoupling. Again, soft wheat production remains the more profitable activity when premium payments are removed and there will be more substitution from barley than from soft wheat.

Table 3: Capri projections for Income, activity levels, and premium payments for the Dublin for Reference Run and MTR

DUBLIN	Base year [2001]			Reference run [2009] % deviation to: Base year			MTR [2009] % deviation to: Ref.run	
	Income	Hectares/ Herd size	Premiums	Income	Hectares/ Herd size	Premiums	Income	Hectares/ Herd size
	Euro/ha or head	1000 ha or hds	Euro /ha or head	Euro/ha or head	1000 ha or hds	Euro /ha or head	Euro/ha or head	1000 ha or hds
Soft wheat	885.24	9.79	445.28	652.72 -26.27%	9.84 0.51%	383.04 -13.98%	521.04 -20.17%	9.08 -7.72%
Barley	724.1	3.67	445.28	516 -28.74%	3.7 0.82%	383.04 -13.98%	368.3 -28.62%	3.32 -10.27%
Dairy Cows high yield	1191.54	2.18	14.79	1085.68 -8.88%	1.86 -14.68%	181.69 1128.47%	952.29 -12.29%	1.83 -1.61%
Dairy Cows low yield	386.86	2.18	14.79	380.45 -1.66%	2 -8.26%	111 650.51%	300.06 -21.13%	2.06 3.00%
Suckler Cows	257.53	3.84	190.35	231.05 -10.28%	4.42 15.10%	167.64 -11.93%	80.36 -65.22%	3.7 -16.29%
Heifers fattening high weight	242.68	1.71	102.52	94.17 -61.20%	1.72 0.58%	115.05 12.22%	49.27 -47.68%	1.78 3.49%
Bulls high weight	738.81	2.98	282.47	540.18 -26.89%	3.02 1.34%	295.26 4.53%	367.53 -31.96%	2.75 -8.94%
Bulls low weight	462.89	2.98	282.47	333.45 -27.96%	3.2 7.38%	295.26 4.53%	131.64 -60.52%	2.66 -16.88%
Pork	45.21	0.06		38.61 -14.60%	0.07 16.67%		37.21 -3.63%	0.07 0.00%
Pig Breeding	211.89	0.01		82.95 -60.85%	0.01 0.00%		113.82 37.22%	0.01 0.00%
Sheep and Goat fattening	35.82	25.83		27.23 -23.98%	26.49 2.56%		24.23 -11.02%	26.36 -0.49%

As at the national level, there is little aggregate change in the number of dairy cows. Income from this activity falls considerably more with decoupling than in the reference run, with income per head from DCOH and DCOL falling 12% and 21% respectively.

In terms of suckler cows in the Dublin region, decoupling precipitates a 16% fall in herd size compared to the reference run, this being a response to the 65% fall in income per head.

As expected, income from all cattle activities declines in both scenarios but this decline is more acute with decoupling. For example, income from BULH and BULL falls by 32% and 60% respectively with full decoupling. The difference is due to the higher proportion of premium payments in income from lower weight cattle than in income from those of a higher weight. From the table, it is clear that the lower profitability of the suckler cow sector induces a substitution towards high weight heifer fattening.

6.3 Mid-East

Table 4 shows the CAPRI projections for the Mid-East region. Total agricultural income in the Mid-East region is projected to increase by 5% with decoupling. Soft wheat production is a particularly important agricultural activity in the Mid-East with more than a third of the country's wheat production taking place there. With payments attached to soft wheat expected to fall by 14% in the MTR, the number of hectares of soft wheat is expected to fall by 17% more than in the reference run. This leads to income per hectare from soft wheat falling 10% with decoupling.

The number of hectares under barley is projected to fall by 21% more in the MTR than in the reference run, while income per hectare falls 16%. Income per head from DCOH and DCOL is expected to fall 11% and 19% respectively with decoupling. In addition, the number of suckler cows is projected to fall by over 21% in response to the 72% decline in income per head. Again, the pattern of income decline pervades all of the other cattle activities. For example, income per head from BULH and BULL declines by 33% and 56% respectively more with MTR. In terms of other animal activities, there is a mixed pattern. For example, income from sheep and goat fattening falls by 11% more in the MTR even though the price of sheep and goat meat is 6% higher. Costs, however, increase by 22% with decoupling due to the higher value of lambs.

Table 4: Capri projections for Income, activity levels, and premium payments for the Mid-East region for Reference Run and MTR

MID-EAST	Base year [2001]			Reference run [2009] % deviation to: Base year			MTR [2009] % deviation to: Ref. run	
	Income Euro/ha or head	Hectares/ Herd size 1000 ha or hds	Premiums Euro /ha or head	Income Euro/ha or head	Hectares/ Herd size 1000 ha or hds	Premiums Euro /ha or head	Income Euro/ha or head	Hectares/ Herd size 1000 ha or hds
Soft wheat	832.96	32.39	445.28	598.16 -28.19%	30.93 -4.51%	383.04 -13.98%	535.54 -10.47%	25.67 -17.01%
Barley	713.79	25.75	445.28	505.02 -29.25%	24.66 -4.23%	383.04 -13.98%	425.92 -15.66%	19.54 -20.76%
Dairy Cows high yield	1328.24	41.63	14.79	1247.96 -6.04%	35.36 -15.06%	181.69 1128.47%	1109.65 -11.08%	35.1 -0.74%
Dairy Cows low yield	467.55	41.62	14.79	459.52 -1.72%	38.73 -6.94%	111 650.51%	370.41 -19.39%	39.33 1.55%
Suckler Cows	245.58	80.18	190.35	209.74 -14.59%	90.23 12.53%	167.64 -11.93%	59.02 -71.86%	71.04 -21.27%
Heifers fattening high weight	227.41	27.8	102.52	67.32 -70.40%	27.89 0.32%	115.05 12.22%	18.17 -73.01%	28.26 1.33%
Male adult cattle heigh weight	767.98	49.11	282.47	552.52 -28.06%	49.41 0.61%	295.26 4.53%	367.98 -33.40%	43.52 -11.92%
Male adult cattle low weight	445.71	49.11	282.47	348.71 -21.76%	52.32 6.54%	295.26 4.53%	152.35 -56.31%	42.42 -18.92%
Pork	43.8	165		37.2 -15.07%	180.56 9.43%		35.79 -3.79%	178.16 -1.33%
Pig Breeding	193.14	9.81		64.24 -66.74%	8.62 -12.13%		95.02 47.91%	9.21 6.84%
Sheep and Goat fattening	35.42	539.3		26.54 -25.07%	550.84 2.14%		23.74 -10.55%	542.14 -1.58%

6.4 Midlands

Table 5 shows some of the projections of the model for the Midlands region.

Table 5: Capri projections for Income, activity levels, and premium payments for the Midlands region for Reference Run and MTR

MIDLANDS	Base year [2001]			Reference run [2009] % deviation to: Base year			MTR [2009] % deviation to: Ref. run	
	Income Euro/ha or head	Hectares/ Herd size 1000 ha or hds	Premiums Euro /ha or head	Income Euro/ha or head	Hectares/ Herd size 1000 ha or hds	Premiums Euro /ha or head	Income Euro/ha or head	Hectares/ Herd size 1000 ha or hds
Soft wheat	858.02	4.01	445.28	614.6 -28.37%	3.84 -4.24%	383.04 -13.98%	478.79 -22.10%	3.15 -17.97%
Barley	715.64	22.45	445.28	507.89 -29.03%	21.53 -4.10%	383.04 -13.98%	356.19 -29.87%	16.55 -23.13%
Dairy Cows high yield	1251.41	38.37	14.79	1154.49 -7.74%	33 -14.00%	181.69 1128.47%	998.03 -13.55%	32.68 -0.97%
Dairy Cows low yield	425.78	38.36	14.79	426.77 0.23%	34.75 -9.41%	111 650.51%	329.29 -22.84%	35.49 2.13%
Suckler Cows	236.27	136.45	190.35	210.01 -11.11%	153.18 12.26%	167.64 -11.93%	59.17 -71.83%	122.49 -20.04%
Heifers fattening high weight	232.2	37.18	102.52	84.37 -63.66%	36.93 -0.67%	115.05 12.22%	33.57 -60.21%	37.52 1.60%
Bulls high weight	767.84	63.67	282.47	528.53 -31.17%	63.85 0.28%	295.26 4.53%	339.11 -35.84%	57.52 -9.91%
Bulls low weight	458.57	63.67	282.47	340.02 -25.85%	67.82 6.52%	295.26 4.53%	140.23 -58.76%	55.36 -18.37%
Pork	43.93	416.63		37.31 -15.07%	455.86 9.42%		35.9 -3.78%	449.78 -1.33%
Pig Breeding	194.04	24		64.95 -66.53%	21.08 -12.17%		95.67 47.30%	22.53 6.88%
Sheep and Goat fattening	35.61	261.3		27.18 -23.67%	266.23 1.89%		24.25 -10.78%	262.22 -1.51%

Total Agricultural income for the midlands is projected to increase by 3% in the MTR. The number of hectares under barley, the most important crop in the midlands, is expected to fall

by 23% with decoupling. Income from the activity falls by 30% per hectare when coupled premium payments are withdrawn. As in other regions, income per head from DCOH and DCOL is predicted to fall by 14% and 23% respectively with the abolishment of payments attached to dairy cows. The income from suckler cows falls 72% with decoupling. Similarly, income from BULH and BULL falls by 36% and 59%.

Again, decoupling has different effects on other animal activities. For example, income per head from sheep and goat fattening is predicted to fall by 11% with decoupling. Since this activity is not in receipt of coupled premium payments, this is due to the increase in costs caused by the higher value of a young lamb.

6.5 Mid-West

The model projects total agricultural income in the Mid-West to be 3% higher in the MTR than in the reference run. Cattle activities are obviously of primary importance in the Mid-West. Table 6 below shows the main expected changes for agriculture in the two scenarios for the Mid-West region.

The income per head from DCOH and DCOL is expected to fall by 14% and 22% more respectively in the MTR than in the reference run. In terms of suckler cows, it is projected that income per head will fall by 74% with decoupling and that the herd size will be 22% lower. Again, income is predicted to fall across all cattle activities in both scenarios. For example, income from BULH falls by 27% in the reference run and 51% in the MTR, with herd size remaining the same in the first scenario and falling by 10% in the second.

Income from sheep and goat fattening falls 24% in the reference run and 32% under full decoupling. As before, pig breeding enjoys the highest returns from decoupling with income 48% higher than in the reference run.

Table 6: Capri projections for Income, activity levels, and premium payments for the Mid-West region for Reference Run and MTR

MID WEST	Base year [2001]			Reference run [2009] % deviation to: Base year			MTR [2009] % deviation to: Ref. run	
	Income	Hectares/ Herd size	Premiums	Income	Hectares/ Herd size	Premiums	Income	Hectares/ Herd size
	Euro/ha or head	1000 ha or hds	Euro /ha or head	Euro/ha or head	1000 ha or hds	Euro /ha or head	Euro/ha or head	1000 ha or hds
Soft wheat	839.25	0.99	445.28	605.08	0.93	383.04	433.27	0.72
				-27.90%	-6.06%	-13.98%	-28.39%	-22.58%
Barley	715.54	8.78	445.28	506.92	8.32	383.04	318.13	6.05
				-29.16%	-5.24%	-13.98%	-37.24%	-27.28%
Dairy Cows high yield	1236.38	95.33	14.79	1233.45	81.3	181.69	1058.07	80.96
				-0.24%	-14.72%	1128.47%	-14.22%	-0.42%
Dairy Cows low yield	454.22	95.31	14.79	463.38	87.94	111	362.05	88.71
				2.02%	-7.73%	650.51%	-21.87%	0.88%
Suckler Cows	229.52	164.37	190.35	203.82	185.11	167.64	53.08	144.9
				-11.20%	12.62%	-11.93%	-73.96%	-21.72%
Heifers fattening high weight	227.92	33.52	102.52	80.04	33.45	115.05	30.97	33.39
				-64.88%	-0.21%	12.22%	-61.31%	-0.18%
Bulls high weight	733.07	65.61	282.47	533.24	65.94	295.26	358.01	58.78
				-27.26%	0.50%	4.53%	-32.86%	-10.86%
Bulls low weight	425.75	65.57	282.47	327.59	69.97	295.26	132.32	57.12
				-23.06%	6.71%	4.53%	-59.61%	-18.37%
Pork	43.77	208.42		37.16	228.07		35.75	225.03
				-15.10%	9.43%		-3.79%	-1.33%
Pig Breeding	192.66	12.28		63.73	10.79		94.43	11.53
				-66.92%	-12.13%		48.17%	6.86%
Sheep and Goat fattening	35.32	128.68		27.02	130.95		24.17	128.22
				-23.50%	1.76%		-10.55%	-2.08%

6.6 South East

Table 7 below presents the models projections for the main activities in the South-East region. Total agricultural income in the South East is projected to be 6% higher in the MTR than in the reference run. Agriculture in the South East is relatively more dependent on

cereal crops with more than a quarter of soft wheat and a third of barley being produced here. As in other regions, the number of hectares of soft wheat and barley are expected to be 21% and 25% lower in the MTR. This is in response to the respective 22% and 30% fall in income relative to the reference run.

Table 7: Capri projections for Income, activity levels, and premium payments for the South-East region for Reference Run and MTR

SOUTH EAST	Base year [2001]			Reference run [2009] % deviation to: Base year			MTR [2009] % deviation to: Ref. Run	
	Income	Hectares/ Herd size	Premiums	Income	Hectares/ Herd size	Premiums	Income	Hectares/ Herd size
	Euro/ha or head	1000 ha or hds	Euro /ha or head	Euro/ha or head	1000 ha or hds	Euro /ha or head	Euro/ha or head	1000 ha or hds
Soft wheat	804.85	23.48	445.28	567.65	22.21	383.04	440.64	17.59
				-29.47%	-5.41%	-13.98%	-22.37%	-20.80%
Barley	685.32	67.98	445.28	474.47	64.45	383.04	330.61	48.26
				-30.77%	-5.19%	-13.98%	-30.32%	-25.12%
Sugar Beet	1704.16	11.83		1276.97	11.13		1312.97	10.51
				-25.07%	-5.92%		2.82%	-5.57%
Dairy Cows high yield	1331.2	121.87	14.79	1252.42	103.98	181.69	1096.8	103.94
				-5.92%	-14.68%	1128.47%	-12.43%	-0.04%
Dairy Cows low yield	484.95	121.87	14.79	461.56	112.35	111	368.1	112.44
				-4.82%	-7.81%	650.51%	-20.25%	0.08%
Suckler Cows	248.81	150.65	190.35	221.53	167.33	167.64	72.19	123.83
				-10.96%	11.07%	-11.93%	-67.41%	-26.00%
Heifers fattening high weight	236.5	48.58	102.52	84.66	48.13	115.05	37.91	46.86
				-64.20%	-0.93%	12.22%	-55.22%	-2.64%
Male adult cattle high weight	785.24	90.95	282.47	558.41	90.92	295.26	381.22	79.36
				-28.89%	-0.03%	4.53%	-31.73%	-12.71%
Male adult cattle low weight	458.5	90.95	282.47	344.64	96.75	295.26	148.28	77.83
				-24.83%	6.38%	4.53%	-56.98%	-19.56%
Pork	43.91	601.48		37.29	658.06		35.88	649.28
				-15.08%	9.41%		-3.78%	-1.33%
Pig Breeding	193.14	33.77		64.04	29.66		94.79	31.7
				-66.84%	-12.17%		48.02%	6.88%
Sheep and Goat fattening	35.65	641.11		26.76	651.28		24.26	629.56
				-24.94%	1.59%		-9.34%	-3.33%

The other important crop in the South East is sugar beet, with one third of the national crop being grown here. As sugar beet production is not in receipt of any coupled support payments one would expect there to be little difference between the effects of the two scenarios. The model, however, forecasts that the number of hectares of sugar beet will be 6% lower with decoupling, but that income per hectare will be 3% higher due to a small increase in price.

Again, income per head from dairy cows is expected to be between 12% and 20% lower with decoupling. In addition, stocking levels of sucklers cows are most adversely affected by decoupling, declining by 26% relative to the reference run. Income per head from this activity falls by 60% more in the MTR relative to the reference run, a noticeably smaller decline than in other regions. Income from bull fattening is forecast to be between 32% and 57% lower with decoupling. This pattern is again prevalent in some other animal activities. For example, income from sheep and goat fattening is expected to be 9% lower in the MTR. As before, the pig-breeding activity bucks the trend of income decline.

6.7 South West

As in other regions, agricultural income in the South West is expected to be 3% higher in the MTR than in the reference run. Table 8 below shows projections from the model for the most important activities in this region. In terms of cereal production, there are large income losses in both scenarios but these are generally higher in the MTR. Income losses from cereal production in the South-West are in a slightly higher range than in other regions; income from soft wheat is expected to be 29% lower in the MTR and Barley by 39%. This induces a respective 23% and 28% fall in activity levels relative to the reference run. Income from sugar beet increase slightly in the MTR due to a slightly higher producer price, as the number of hectares of sugar beet fall by almost 5%.

The South West is particularly intensive in beef and milk. In terms of dairy cows, income per head from DCOH and DCOL is expected to be between 12% and 20% lower in the MTR. The suckler cow herd in this region follows the same pattern as the national herd, with the size expected to fall by 24% with decoupling. This is a response to a lower income per head of 67% relative to the reference run.

The income decline pervades all of the other cattle activities. For example, income per head from HEIH is 54% lower with decoupling, with negligible changes in the herd size. Similarly, income for BULH is 32% lower when coupled premium payments are removed. In other animal activities, the pattern is mixed. Again, income from pig breeding increases with decoupling, while that from pig and sheep and goat fattening falls.

Table 8: Capri projections for Income, activity levels, and premium payments for the South-West region for Reference Run and MTR

SOUTH WEST	Base year [2001]			Reference run [2009] % deviation to: Base year			MTR [2009] % deviation to: Ref. run	
	Income	Hectares/ Herd size	Premiums	Income	Hectares/ Herd size	Premiums	Income	Hectares/ Herd size
	Euro/ha or head	1000 ha or hds	Euro /ha or head	Euro/ha or head	1000 ha or hds	Euro /ha or head	Euro/ha or head	1000 ha or hds
Soft wheat	814.03	10.28	445.28	577.63	9.74	383.04	407.48	7.51
				-29.04%	-5.25%	-13.98%	-29.46%	-22.90%
Barley	690.48	31.49	445.28	480	29.92	383.04	292.78	21.68
				-30.48%	-4.99%	-13.98%	-39.00%	-27.54%
Sugar Beet	1702.17	8.83		1274.71	8.32		1309.73	7.94
				-25.11%	-5.78%		2.75%	-4.57%
Dairy Cows high yield	1485.58	190.33	14.79	1408.48	162.26	181.69	1233.31	161.6
				-5.19%	-14.75%	1128.47%	-12.44%	-0.41%
Dairy Cows low yield	482.73	190.31	14.79	526.51	175.73	111	423.29	177.27
				9.07%	-7.66%	650.51%	-19.60%	0.88%
Suckler Cows	250.34	151.22	190.35	224.12	170.15	167.64	73.31	129.09
				-10.47%	12.52%	-11.93%	-67.29%	-24.13%
Heifers fattening high weight	234.75	43.65	102.52	91.85	43.54	115.05	42.35	42.93
				-60.87%	-0.25%	12.22%	-53.89%	-1.40%
Bulls high weight	781.49	74.07	282.47	570.58	74.3	295.26	390.24	65.23
				-26.99%	0.31%	4.53%	-31.61%	-12.21%
Bulls low weight	459.84	74.03	282.47	343.47	78.93	295.26	146.14	63.75
				-25.31%	6.62%	4.53%	-57.45%	-19.23%
Pork	43.87	743.58		37.24	813.47		35.83	802.61
				-15.11%	9.40%		-3.79%	-1.34%
Pig Breeding	192.06	44.35		62.93	38.96		93.6	41.63
				-67.23%	-12.15%		48.74%	6.85%
Sheep and Goat fattening	35.57	358.97		27.34	365.89		24.45	355.73
				-23.14%	1.93%		-10.57%	-2.78%

6.8 West

Table 9 presents the model's forecasts for the West region. Total agricultural income in the West is expected to be 2.5% higher in the MTR than in the reference run. The most important activities in the West region are suckler cows, and sheep and goats.

Table 9: Capri projections for Income, activity levels, and premium payments for the West region for Reference Run and MTR

WEST	Base year [2001]			Reference run [2009] % deviation to: Base year			MTR [2009] % deviation to: Ref. run	
	Income	Hectares/ Herd size	Premiums	Income	Hectares/Herd size	Premiums	Income	Hectares/ Herd size
	Euro/ha or hd	1000 ha or hds	Euro /ha or hd	Euro/ha or hd	1000 ha or hds	Euro /ha or hd	Euro/ha or hd	1000 ha or hds
Soft wheat	852.92	0.13	445.28	609.06 -28.59%	0.12 -7.69%	383.04 -13.98%	402.85 -33.86%	0.09 -25.00%
Barley	705.93	3.39	445.28	497.48 -29.53%	3.21 -5.31%	383.04 -13.98%	274.99 -44.72%	2.33 -27.41%
Dairy Cows high yield	1306.65	33.5	14.79	1228.98 -5.94%	28.57 -14.72%	181.69 1128.47%	1073.23 -12.67%	28.36 -0.74%
Dairy Cows low yield	456.79	33.49	14.79	467.59 2.36%	30.89 -7.76%	111 650.51%	372.85 -20.26%	31.38 1.59%
Suckler Cows	194.35	256.85	190.35	168.96 -13.06%	294 14.46%	167.64 -11.93%	18.27 -89.19%	249.94 -14.99%
Heifers fattening high weight	243.49	39.01	102.52	95.5 -60.78%	39.07 0.15%	115.05 12.22%	46.57 -51.24%	39.76 1.77%
Bulls high weight	741.31	69.03	282.47	540.32 -27.11%	69.53 0.72%	295.26 4.53%	364.74 -32.50%	63.03 -9.35%
Bulls low weight	434.65	69.03	282.47	330.24 -24.02%	73.76 6.85%	295.26 4.53%	139.66 -57.71%	61.48 -16.65%
Pork	44.12	105.24		37.53 -14.94%	115.18 9.45%		36.12 -3.76%	113.65 -1.33%
Pig Breeding	197.59	6.08		68.66 -65.25%	5.34 -12.17%		99.4 44.77%	5.71 6.93%
Sheep and Goat fattening	35.99	861.97		27.36 -23.98%	880.6 2.16%		24.43 -10.71%	868.49 -1.38%

In the case of suckler cows, it is projected that income will be 90% lower with decoupling than if coupled premium payments remained. Income from sheep and goat fattening falls a further 10% with decoupling with a negligible change in activity levels.

As in all other regions, the trend of income decline persists in all cattle activities. For example, income from BULL is 58% lower and herd size 17% lower with decoupling. Similarly, income from HEIH is 51% lower in the MTR, with little change in the herd size.

7. A Comparison with FAPRI

As described in Binfield et al (2000), the FAPRI model of agriculture comprises individually estimated commodity models, which are inter-linked and simultaneously solved. It is also capable of making long-term projections up to a 10-year horizon. Essentially it is a recursive dynamic partial equilibrium model, whereas CAPRI is a comparative static programming model. Thus, CAPRI and FAPRI are quite different in terms of modelling methodology. Each modelling system has advantages and limitations. Direct comparisons of results from both models are likely to be divergent. Definitions of activities may differ and therefore different data will be used. However, excepting the problems of analysing absolute numbers in projections, it may still be instructive to examine projected percentage deviations from base year data. It must be stressed that these comparisons are tenuous, and by no means have implications for the accuracy of either model's predictions.

Table 10 below presents a sample set of projections for agricultural income and input expenditure from FAPRI and CAPRI for both a Reference Run[2] (Agenda 2000 as policy) scenario and an MTR (decoupling) scenario for Ireland. The table shows deviations of reference run projections from base year values and also deviations of MTR projections from the reference run. FAPRI results are taken from Binfield et al (2003). The FAPRI decoupling scenario that is used in this analysis assumes that all EU Member States fully decouple premium payments from production, whereas the CAPRI decoupling scenario, as mentioned above, represents the CAPRI team's expectations of how individual Member States will implement the policy

[2] The Reference Run in CAPRI corresponds to the 'Baseline' scenario' in FAPRI

Table 10: CAPRI and FAPRI projections for Agricultural Income and Input Expenditure for Reference Run and MTR Scenarios (in Millions euro)

	€ Millions					
	Base Year[3] [2001]		Reference Run[4] [2009]		MTR [2009]	
	FAPRI	CAPRI	FAPRI	CAPRI	FAPRI	CAPRI
Agricultural Income	2614	3732.09	2350	2981.03	2578	3082.18
			-10.01%	-20.12%	9.70%	3.39%
Input Expenditure	3056	4947.44	3091	4567.26	2893	4188.48
			1.15%	-7.68%	-6.41%	-8.29%

Source: Binfield et al (2003) and the CAPRI Model

It is clear from table 10 that decoupling is a good policy option for Irish Agriculture in terms of changes in total agricultural income, with FAPRI projecting more optimistic outcomes than CAPRI. Whereas CAPRI expects income to increase by over 3%, FAPRI expects this increase to be almost 10%. Both models however project input costs to fall by between 6% and 8% with decoupling.

Table 11 below presents a sample set of projections for activity levels from FAPRI and CAPRI and deviations from base year values. Differences in base year data are largely due to differences in activity definitions, and also to the fact that base year that in CAPRI is a three-year average around 2001. In any case, similarities and divergences are clear from the table.

In terms of wheat production, CAPRI expects a much greater decline in the number of hectares under soft wheat when coupled payments are withdrawn, projecting an 18% fall compared to FAPRI's 3%. This divergence is slightly larger in the case of barley, where FAPRI projects a 3% fall in the number of hectares used for barley with decoupling, while CAPRI projects a fall of 25%.

Not surprisingly, with the retention of the quota system in the MTR, the projections of the respective models for dairy cows do not change when compared to the reference run. Although projections for suckler cows differ substantially in the reference run, both models

[3] Average of 2000/2001 and 2001/2002 where 2001 data not given for FAPRI
[4] Average of 2008/2009 and 2009/2010 where 2009 data not given for FAPRI

project decoupling to have a severe effect on the suckler cow herd size, with CAPRI projecting a 20% fall and FAPRI projecting a fall of 15%.

Projections for pig slaughter are very similar; both models expect a negligible reduction in herd size with decoupling.

Table 11: CAPRI and FAPRI projections of Activity Levels for Reference Run and MTR scenarios for Ireland

Levels	Activity Levels ('000 heads/hectares)					
	Base Year [2001]		Reference Run [2009]		MTR [2009]	
	FAPRI*	CAPRI	FAPRI	CAPRI	FAPRI"	CAPRI
Wheat	84	88.54	82 -2.38%	84.77 -4.26%	79.5 -3.05%	69.53 -17.98%
Barley	181.5	180.31	180 -0.83%	171.86 -4.69%	174 -3.33%	129.69 -24.54%
Dairy Cows	1150	1169	1060 -7.83%	1037 -12.73%	1060 0.00%	1041 0.39%
Scow	1160	1160	1100 -5.17%	1312.39 13.06%	930 -15.45%	1048.61 -20.10%
Pigs for Slaughter	3250	3122.36	3210 -1.23%	3416.03 9.41%	3220 -0.31%	3370.42 -1.34%
Lambs	4010	3324.97	3120 -22.19%	3392.1 2.02%	3030 -2.88%	3325.59 1.96%

Source: Binfield et al (2003) and the CAPRI Model

Although projections for lambs are highly divergent in the reference run, the divergence is considerably smaller for the impacts of decoupling; CAPRI projects a 2% increase in the MTR while FAPRI projects a 3% reduction.

Table 12: CAPRI and FAPRI Projection of Prices for Reference Run and MTR Scenarios

Prices	€ per Tonne					
	Base Year [2001]		Reference Run [2009]		MTR [2009]	
	FAPRI	CAPRI	FAPRI	CAPRI	FAPRI	CAPRI
Wheat	111.6	113.6	95.55 -14.38%	90.48 -20.35%	95.9 -0.37%	89.32 -1.28%
Barley	102.9	116.14	91.75 -10.84%	92.34 -20.49%	92.05 0.33%	88.84 -3.79%
Milk	280.45	325.4	230.07 -17.96%	260.52 -19.94%	220.36 -4.22%	257.97 -0.98%
Pig Meat	1479	1552	1242 -16.02%	1292.48 -16.72%	1246 0.32%	1289.79 -0.20%
Sheep Meat	4271	3531.16	3302 -22.69	2823.51 -20.04%	3683 11.53%	3001.32 6.30%

Source: Binfield et al (2003) and the CAPRI Model

It is clear from table 12 that decoupling will generally have little impact on commodity prices. The largest difference in both models' predictions is in the price of sheep meat with a 4% higher price increase projected by FAPRI. FAPRI also projects a 3% higher price level in the MTR, while CAPRI forecasts a 2.5% higher price for barley.

Due to the many differences in the methodology employed by both models, and the high probability of differences in product/activity definitions and in data used, it is not surprising that CAPRI and FAPRI arrive at differences in supply side projections. A consensus is at least apparent in the movement of commodity prices with both polices.

8. Conclusion

Using the CAPRI programming model, this paper has provided the first attempt at an analysis of the regional effects within Ireland of the MTR. The overall results suggest that the decoupling of agricultural payments is likely to lead to an income increase for Irish agriculture of about 3% in 2009 compared to what it would have been without a change in policy. Some regions do better than others, but income is projected to increase in all 8

regions analyzed in the paper. The projected increase is largest in those regions where agriculture is most mixed, and smallest in those regions most dependent on suckler cows. Production for all the main activities, except dairying, is down, with suckler cow levels falling the most of all in percentage terms.

When the national results for the MTR using CAPRI are compared to those already in the public domain from the FAPRI model, we find that the directional movements in incomes and activity levels tend to be the same for both models, but the outcomes using the CAPRI model tend to be a little less optimistic for farmers than the results in FAPRI. There are larger differences between the models when we compare results for the reference runs of both models (baseline runs up to 2009 assuming a continuation of AGENDA 2000 policies). These differences are at least partly due to differing activity definitions, economic assumptions and trend estimations, and are not particularly relevant when comparing the policy scenarios such as the MTR.

Finally, it is interesting to note that decoupling is expected to lead to a 7.7% decrease in global warming potential due, mainly, to the decline in sucklers. This has important implications for Irish policy in relation to the Kyoto agreement. It also has important implications when it comes to estimating the global benefits and costs of the MTR.

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Appendix 1

Mid-Term Review

TABLE: Coupling Degree of each Member State for each Premium (%)

	Bel/Lux	Denmark	Germany	Greece	Spain	France	Ireland
DPGRCU	25	25					
DPPULS	100	100	100	100	100	100	100
DPDWHETR	40	40					
DPPARI	100	100	100	100	100	100	100
DPSCOW	100	100	100				
DPSHGM	50	50	50	50			
DPSL_ADCT	40	40	40				
DPSL_CALV	40	100	40	40			
DPNATMILK	100	100	100	100	100	100	100
DPENERCRP	100	100	100	100	100	100	100
+	**Italy**	**Holland**	**Austria**	**Portugal**	**Sweden**	**Finland**	**UK**
DPGRCU	25	25					
DPPULS	100	100	100	100	100	100	100
DPDWHETR	40	40					
DPPARI	100	100	100	100	100	100	100
DPSCOW	100	100					
DPBULF	75						
DPSHGM	50	50	50				
DPSL_ADCT	100	40	40				
DPSL_CALV	100	40	40				
DPNATMILK	100	100	100	100	100	100	100
DPENERCRP	100	100	100	100	100	100	100

DPGRCU	Direct payment to cereals
DPPULS	Direct payment to protein crops
DPDWHETR	Traditional durum wheat premium
DPPARI	Rice premiums
DPSCOW	Suckler cow premium
DPBULF	Special premium to bulls and steers where all are assumed to be bulls
DPDCOW	Direct income support to dairy cows
DPSHGM	Direct payment for sheep and goat
DPNE_SHGM	National envelope for sheep and goat
DPNE_DCOW	National envelope dairy cows
DPNE_MEAT	National envelope bovine meat cattle
DPSL_ADCT	Slaughter premium for adult cattle
DPSL_CALV	Slaughter premium for calves
DPENERCRP	Energy crops
DPNATMILK	National premium to dairy cows in northern Sweden and Finland

The MTR provides options for fully decoupling premium payments or partially decoupling, thereby protecting economically sensitive sectors. Among the options/derogations offered to Member States are[5]:

-25% of hectare payments, or, alternatively, up to 40% of supplementary durum wheat aid.
-50% of sheep and Goat Premium
-100% of Suckler Cow Premium and up to 40% of the Slaughter Premium **or** 100% of Slaughter Premium or 75% of the Special Male Premium

grant 10% of the National Ceiling as sector-specific payment so as to promote activities important for improving the environment etc.

There are also cross-compliance measures that ensure that agricultural land is kept in good condition as a condition for the receipt of the direct payment. More funds are available for environmental quality and animal welfare programmes by reducing the direct payments made to bigger farmers.

[5] http//:europa.eu.int/comm./agriculture/public/caprep/prospects2003b/fullrep.pdf

In the case of Ireland, the government has decided that the decoupling of premium payments from productions is the best policy option for Irish agriculture and single direct payment to farmers will be introduced in 2005. This payment will be calculated using the number of animals/hectares that had received premiums during a reference period (2000-2002 in most cases) multiplied by the value of the premiums. Therefore, farmers will not be required to farm the land but must keep it in 'good agricultural condition' and meet other environmental and animal welfare conditions. Farmers who possessed a milk quota on 31st of March of 2004 receive a premium of 5.5 cents per gallon on approximately 97% of their milk supplied. This will increase to 11 cents per gallon fro those holding a quota on 31st March 2005. This premium will then be decoupled and become a standard entitlement. It will be included in the single payment from 31st March 2005. Farmers can sell or lease out the entitlements.

Appendix 2

Positive Mathematical Programming

As Paris (1997) describes, the initial use of Linear Programming models in the 1950s and 60s led to solutions that tended to be over-specialised and didn't reproduce observed activity levels. In most cases, over-specialisation of the solution was due to the fact that the number of structural constraints was often considerably less than the number of observed activities. This problem is even more severe in aggregate models than in farm level models. This lead to the incorporation of additional constraints on the possible activity levels in addition to the usual structural constraints. Thus, by combining information on total resources, farm technology, output prices, and unit accounting costs, with information on actual activity levels, mathematical models tended to be more 'positive' or realistic.

In the 1970s, Richard Howitt saw that data on actual activity levels would provide better information on production costs on a farm than the data on pure accounting costs. In addition to the latter, farmers must take other costs in to account like those relating to technology, the environment, or risk, in formulating their production decisions. Because the cost function is 'dual' to the production function, the estimation of the former will provide an approximation for the latter. Thus, as Heckelei (1997) states, Positive Mathematical Programming (PMP) is a methodology designed to calibrate linear programming models to observed quantities by utilising information contained in dual variables to specify a non-linear objective function, z, so that activity levels are reproduced without bounds. The result is a more exact calibration and a more flexible model. The incorporation of quadratic cost functions result in a smooth supply response to changes in economic conditions.

As explained by Paris, the PMP methodology consists of 3 steps. The following paragraphs present a basic outline of this process.

In step one, we begin with the objective function to be maximised.

$\max Z = p`x - cx$ subject to $Ax \leq b \quad [\pi]$, and $x \leq 0$

$x \leq (x^{o} + \varepsilon) \quad [\lambda]$

where:

z= value of objective

x= vector of activity level

p=vector of output prices

c= vector of accounting costs

A= input/output coefficients

b= vector of structural constraints

π= vector of dual variables on resource constraints

The vector of dual variables associated with calibration constraints, λ, forces the solution of the objective function to reproduce the observed activity levels, x^o, if the structural constraints, b, permit this. The accuracy of the solution will be within the range of positive perturbations, ε, which ensure that all remaining binding b remain binding. The perturbation parameter is used because of the need to distribute net revenue between the structural and the calibrating constraints. Otherwise, the dual variable of a structural constraint would be zero while the dual variables of the calibrating constraint would be positive. This ensures that the former will be positive while at least one of the latter will be zero, thereby revealing marginal crops. This leads to the specification of the dual problem:

$$\min w = b`y + \lambda`x^o \quad \text{subject to: } A`y + \lambda \geq p-c,\ \lambda \geq 0,\ y \geq 0$$

The first term on the right hand side of the cost function gives the total cost of inputs, while the second term gives the variables costs over and above $c`\ x^o$ in the primal objective function. Any dual constraint in mathematical programming can be interpreted as the marginal cost being greater than or equal to marginal revenue. Therefore in the dual constraint above, A`y is the marginal cost associated with fixed inputs, (λ+c) is the marginal cost of observed activity levels, and p is the marginal revenue. 'c' now becomes a component of marginal cost.

In step two of the PMP procedure, the marginal cost function is specified and its parameters estimated. This step is similar to an econometrician specifying an econometric model. For example if a quadratic total variable cost function is assumed, the marginal cost function can be specified as:

$\lambda_{LP} + c = Q\, x^o$

where λ_{LP}, c, and x^o are known, and Q is a symmetric positive semi-definite matrix of non-linear costs.

The task is to recover Q. An integral can be taken of Q from 0 to x^o to give $1/2\ x`^oQx^o$. This term is used in calibrating the non-linear model in step 3. Q can be estimated given a vector of marginal cost observations and observed activity levels. Technically, this usually involves the estimation of the diagonal elements in the matrix Q, assuming that non-diagonal elements are zero.

In the final step of PMP, a non-linear model is constructed which is consistent with Q. Again, if a quadratic form is assumed, this gives

Primal Model: max $z=p`x-1/2x`Qx$ subject to $Ax \leq b$, and $x \geq 0$

Dual Model: min $w=b`y+1/2x`Q`x$ subject to $A`y+Qx \geq p$, $x \geq 0$, $y \geq 0$.

The Lagrange function of the dual model has the same derivatives as the primal model. Therefore, as the first order conditions are equal, the objective values will be equal also.

Appendix 3

Ireland's NUTS 3 Regions and constituent Counties:

Border	Donegal, Leitrim, Louth, Monaghan, Sligo, Cavan
DublinDublin	Dublin, Dun Laoghaire-Rathdown, Fingal, South Dublin
Mid-East	Kildare, Wicklow, Meath
Midland	Laois, Longford, Offaly, Westmeath
Mid-West	Clare, Limerick City, Limerick County, Tipperary North Riding
West	Galway City, Galway County, Mayo, Roscommon
South-East	Carlow, Kilkenny, Tipperary South Riding, Waterford City, Waterford County, Wexford
South-West	Cork City, Cork County, Kerry