Farm Level Adjustment in Ireland following Decoupling

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Summary
The paper is a case study of how the Luxembourg Agreement of the Mid-Term Review of the Common Agricultural Policy may affect the structure of dairy and beef farming in the Republic of Ireland over the period 2002 to 2012. It describes the process used to assess some structural implications of a policy change. The data source for the paper is the Irish National Farm Survey. Prices of inputs and outputs following the policy change are obtained from a dynamic partial equilibrium model of the agricultural sector. Linear Programming is used to calculate the maximum profit on different farm types. Labour allocation on farms is estimated using a logit function. Exit from dairy production is also estimated. Some example results on dairy and beef farms are presented.

Key Words: Adjustment; policy; labour allocation; logit function

1 Introduction

This paper describes analysis that was conducted to assess the effect of the implementation of the Mid-Term Review of the CAP as agreed in Luxembourg in June 2003. Specific objectives were to examine the effect of the agreement on farm incomes in Ireland and to project the farm level adjustments that are likely to occur in response to the decoupling of direct payments from production. Changes on dairy farms are the focus of this paper.

The farm level models described in this paper are part of a larger modelling system used for policy analysis that is operated by the FAPRI-Ireland Partnership.[1] The FAPRI-Ireland Partnership operates a set of individual econometrically estimated commodity models, e.g. beef, dairy, sheep, pigs and cereals that are linked and solved simultaneously under different policy scenarios as well as a baseline, i.e. a no policy change scenario. These aggregate models project the potential impact over a ten-year period of a policy scenario on Irish agricultural markets and consequentially on input and output prices. The consequences of the projections of output and input prices at the farm level are examined using a number of modelling techniques, including budgetary modelling, linear programming and econometric modelling. A Computable General Equilibrium (CGE) model has also been developed to estimate the economy wide effects of changes in agricultural policies and markets.

The FAPRI-Ireland Partnership has produced analysis of policy reforms for a number of years at the aggregate level (Binfield et al.2001, 2002) and the farm level (Hennessy, 2001, 2002, 2003). This paper focuses on the analysis conducted at the farm level only and for expositional purposes discusses the application of the farm level models to the analysis of decoupling.

[1] The FAPRI-Ireland Partnership is a joint venture between Teagasc, the Irish Universities, other groups in Ireland, and the Food and Agriculture Policy Research Institute (FAPRI) in the USA.

2 Data

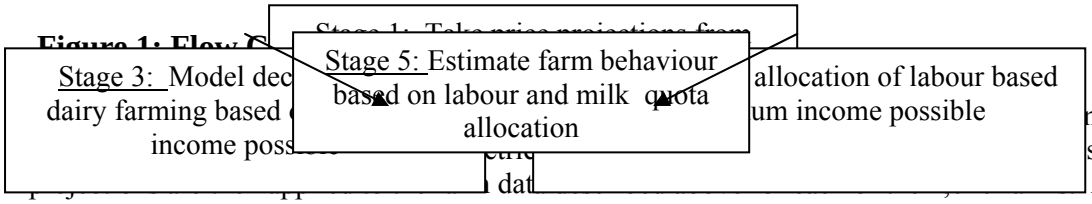
The analysis was conducted using Ireland's National Farm Survey (NFS) data for the year 2000.[2] The Irish National Farm Survey is a member of FADN, the farm accountancy data network of the EU. The NFS dataset includes 1,040 observations that are weighted to represent 117,243 farms, which represent about 95 per cent of the farming population in Ireland in the year 2000.

During the course of the analysis, some outliers were excluded. Data on resources such as land, labour, animal numbers and crops planted are available for each farm as are financial data on prices received, quantity and cost of inputs along with the value of overhead costs and demographic data such as the farmer and spouse's age, employment and marital status. The total dataset includes 162 variables for each observation.

3 Method

The analytical process used to estimate the farm level effects of policy changes begins by initially estimating the effect of the projected prices, costs and policy changes from the aggregate models on the profitability of the various enterprises operated on each farm in the base year. Once the effect on farm profitability has been examined in a static sense, the likely response of each farmer to the changing profitability is simulated. The micro economic adjustments that are simulated include labour allocation between agriculture and other employment, exit from dairy production, switches in farm enterprise specialisation and the decision to destock the land.[3]

The process of simulating farmer behaviour uses a number of techniques and follows five main stages as demonstrated for dairy farms in Figure 1.



this stage a budgetary model can be applied to show the effect of the new policy on income in a static sense, i.e. if the farmer does not change the farm plan.

Stage 2: Estimating the Maximum Farm Income

The second stage involves estimating the highest possible income for each farm in the dataset using a simple linear programming model. For each of the 1,040 farms a multi-period profit maximising linear programming model is constructed.

For each farm in the NFS sample a simple model is specified in MS EXCEL. With this model, net farm profit is maximised subject to the quantity of land and labour available to each farm, the policy constraints associated with 'cross compliance' and the observed levels of technical ability. Using this model, the most profitable farm plan is identified and the associated level of income is calculated.

Linear programming models have attracted criticism because of their normative nature. It has been argued that such models merely inform us on how farmers should behave rather than on their actual behaviour. These criticisms are not applicable in this analysis because the LP models are not used to simulate behaviour but to estimate the maximum possible income

[2] The year 2000 was chosen as it was indicated by Department of Agriculture officials that 2001 was an atypical year due to the de-stocking of a number of farms as a consequence of the Foot and Mouth outbreak. Data for 2002 was not available at the time of publication.

[3] The decision to destock but retain the land in order to activate the decoupled payment is simulated.

levels associated with a particular farm in a given policy scenario. The maximum farm income as calculated by the LP model is used as *the opportunity cost of not farming*. The income figure is used as a measure of the return to labour in the model of labour allocation decisions and as the return to milk quota in the modelling of dairy farmer's decision to exit milk production.

Stage 3: Simulate the decision to exit dairying

The estimation of exit from dairying is based on a profitability analysis. If data were available on the types and number of farms and characteristics of the farmer that have exited over the last number of years, it would be possible to develop an econometric model that could estimate the probability of exit for each active producer. However, in the absence of such data, other methods must be used.

Anecdotal evidence suggests that dairy farmers cease milk production mostly for personal reasons, such as retirement and lack of a successor, and sometimes for economic reasons. In the absence of verifiable empirical data on these personal reasons, we have assumed that the propensity to cease milk production is **solely** dependent on profitability.

Historical levels of profitability and the rate of exit from dairying are examined to identify a minimum level of profitability below which exit has occurred historically. Maximum dairy enterprise income is projected for each farm using the linear programming model as outlined in Stage 2. Producers operating below the minimum level of profitability are projected to exit production. While it may be argued that certain producers will continue a loss making enterprise, it is difficult to incorporate this in the absence of the appropriate data. However, it is important to stress that the methods used to identify the rate of exit from dairying is the same in both the baseline and scenario analysis therefore it is possible to argue that the effect of a particular policy reform on the rate of exit from dairying is effectively analysed.

Milk quota transfer in Ireland is operated through an administered system. All producers that have privately leased out their quota for three years or more are required to sell their quota into a central restructuring pool at an administratively determined price. Sale of quota from the restructuring scheme is operated on a priority basis, where priority will is determined by quota size, with top priority going to producers with a quota of less than 157,000 litres.

It is assumed that if producers cease milk production, their milk quota will enter the milk quota restructuring scheme and be reallocated according to the priority system. The reallocation of quota in Ireland is spatially ring-fenced and co-operative based. This means that quota belonging to an exiting farmer from Lakeland Creameries (a dairy co-op located in the North Eastern part of the country, for example, cannot be reallocated to a Dairygold producer (a dairy co-op located in the South). While these regulations are difficult to account for in a national study such as this one, we have endeavoured to allow for regional ring-fencing has been made. Each farm in the NFS has a regional code[4], in this study it has been assumed that quota belonging to exiting producers can only be reallocated to other producers in the same region. While the regional representivity of farms in the NFS may be questionable and may not lend itself to accurate regional analysis, it is assumed here that the regional codes are sufficiently representative for this exercise. Maximum farm income for farms that have purchased milk quota is re-estimated.

In our analysis similar restructuring prices to those operating at present are assumed to prevail. The future allocation of restructured milk is assumed to follow a similar pattern to 2002. In 2002, 50 per cent of the milk that entered the restructuring scheme was allocated to the first priority group, i.e. those with quotas less than 44,500 (202,300 litres) gallons, 35 per

[4] Regional classifications are based on the NUTS (Nomenclature of Territorial Units) classifications used by Eurostat. A full explanation of NUTS codes are available from the CSO, www.cso.ie.

cent of the quota was allocated to the second group, those between 44,500 and 66,000 gallons (300,041 litres) and the last 15 per cent was allocated to those exceeding 66,000 gallons.

Within the model it is assumed that farmers who sell their milk quota will continue to farm some other farm enterprise. The allocation of their labour is modelled using the labour model described above and once the level of farm labour is identified then the farm plan and income can be estimated.

Stage 4: Model the allocation of Labour
The allocation of farm labour is econometrically estimated using a logit function. Historic data are used to identify which factors influence the elasticity of farm labour supply to off-farm employment.

The logit model is of the general form:

$$\text{Logit}(p) = \log(p/(1-p)) = \alpha + \beta_1 X_1 \qquad (2)$$

Table 1 lists the statistically significant variables, their co-efficients and marginal effects.

Table 1: Results of the Logit Model for Off -Farm Employment

Variable	Coefficient	Marginal Effect
INTERCEPT	1.1184	
DIFF	-0.0017**	-0.00017
<45	0.5838**	0.059
>60	-2.5178**	-0.2582
MILK	-1.6476**	-0.1689
HOUSE	0.21635**	0.0221
LUS	-0.01521**	-0.00156
REPS	-0.000049*	
UNEM	-0.36740**	-0.0376
Likelihood Ratio Statistic = -326.94		
Percentage of correct predictions of WORK = 88%		

*P<0.10, ** P<0.05

The dependent variable 'WORK' is binary where 1 indicates that the probability of taking an off-farm job is 100 per cent.

The explanatory variables are:
-DIFF: the wage differential between the average industrial wage and the return to labour from farming;
<45 is the age of the farm holder;
>60 is the age of the farm holder;
-MILK is the amount of milk sold from the farm in gallons;
-HOUSE is family farm income;
-LUS is total livestock units on the farm;
-REPS is the REPS payment to the farm and
-UNEM is the appropriate regional unemployment rate.

The effect of the wage differential on the level of labour supply for off-farm employment is particularly important with decoupling. Following the decoupling of payments from production, the returns to farm labour should decrease considerably as the activation of the entitlement and receipt of payment is not dependent on the supply of farm labour. Hence, payments are removed from the calculation of the wage differential in the scenario, which changes the differential significantly towards favouring off-farm employment.

Wealth may have a negative effect on the elasticity of labour supply, ie wealthier farmers are less inclined to take off-farm employment. Other studies of decoupling, (USDA, 2003) have considered the decoupled payment as an increase in wealth. The wealth effect was also examined in this study. Historical data on the receipt of payments received by farmers under the REPS (Rural Environment Protection Scheme), were taken as a proxy for wealth[5]. Projections of off-farm labour supply in the scenario included the decoupled payment as an increase in wealth.

The projection of the future allocation of farm labour is made using the parameters from the econometric model along with the farm incomes estimated using linear programming. The outcome of the econometric model determines the availability of labour to the farm when the final farm plan and income are estimated. Information about labour allocation feeds into Stage 5 of the analysis.

Stage 5: Estimate Farm Behaviour

The final stage of the analysis involves the estimation of farmer behaviour or adjustment in response to policy change. For dairy farms, a revised level of farm labour and milk quota is estimated for each farm using the labour model and the dairy profitability analysis. Once labour and quota has been allocated it is then assumed that farmers are profit maximisers and will allocate their farm labour, land and other resources to the most profitable activity. Within the policy proposals on decoupling, farmers are required to retain their land in order to activate their decoupled payment. Therefore we have assumed that farmers will allocate their labour in a utility maximising manner but that if they have to retain their land they will allocate it in a profit maximising manner within the constraints of their labour. A new linear programming model is re-estimated with the new levels of labour and quota and a new farm plan and income is estimated.

4 Results and Application

This modelling system provides useful information to policy makers on the effects of a specific policy on, dairy farm numbers, full-time and part-time farm numbers, farm activities and enterprises and farm incomes. This section presents some example results produced by the model. Examples are given first for dairy and then cattle farming.

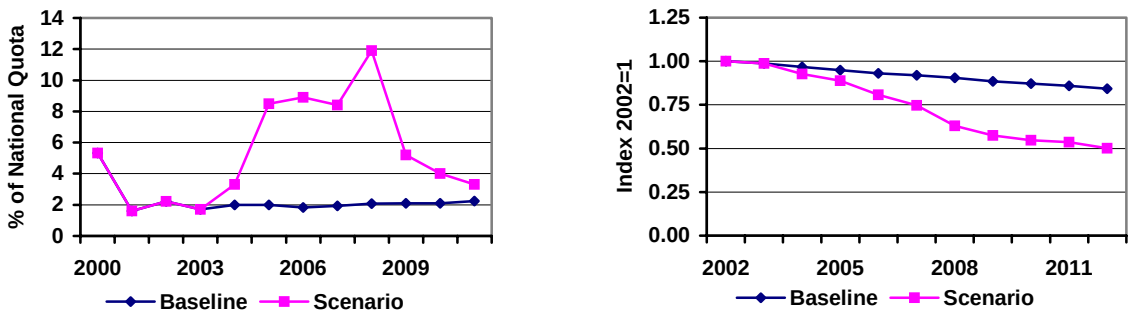
4.1 Dairy farming

Figure 2 presents the percentage of national milk quota projected to enter the restructuring scheme over the next ten years.

Percentage of Quota Entering Restructuring Scheme

Projection of Dairy Farm Numbers

[5] While REPS may not be an ideal indicator of wealth, it was difficult to identify another variable in the NFS that could represent an income stream that is generated independently of farm activity. A more appropriate variable may be spousal income but unfortunately this was not available. Nevertheless, the parameter co-efficient on the REPS variable was very low at –4.9E-5.



Source: FAPRI-Ireland Farm-Level Model (2003).

Figure 2: Projections of Restructured Quota and Changes in Supplier Numbers

The 'baseline' scenario is where Agenda 2000 continues, the milk quota is unchanged, and there are no new trade agreements, ie the Uruguay Round Agreement is unchanged. The UK'over thirty months' slaughter scheme is assumed to end in mid 2004.

The 'Luxembourg Agreement' scenario is where the maximum amount of decoupling that is provided for in the Agreement is done; ie no payments are left coupled where there is an option to do this. The trade agreement in place is the EU Proposal on Modalities for Agriculture under the Doha Round. The UK 'over thirty months' slaughter scheme is assumed to end in mid 2004.

The quantity of quota entering the restructuring scheme is projected to be approximately 2% per annum in the baseline throughout the projection period. The quantity projected under the scenario is much higher due to the declining profitability of dairy farming. From 2004 onwards, compensation proposed under the Luxembourg Agreement is decoupled from production and therefore is not considered in the profitability analysis. Any dairy farmer exiting production in 2005 will still receive the decoupled payment. This provides the incentive for many farmers to cease production, thereby increasing the quantity of milk quota available for restructuring from 2005 to 2008. From 2008 onwards the amount of 'restructured' milk returns to historical levels.

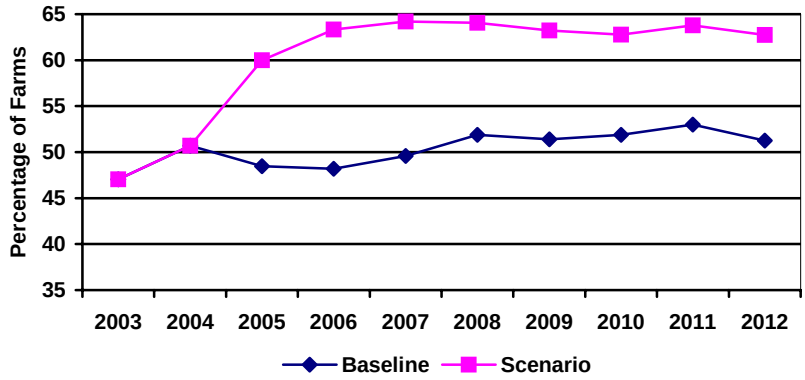
Figure 2 also shows projections of dairy supplier numbers in the baseline versus the scenario. In the baseline, approximately 2 per cent of farmers are projected to exit production each year. This results in a 15 per cent decline in dairy suppliers over the projection period. The decline is greater following the Luxembourg Agreement. Farm supplier numbers are projected to be 35 percentage points lower in 2012 following the Luxembourg Agreement than under the baseline.

Data from the Department of Agriculture and Food, there were approximately 28,000 dairy farmers in 2001, the projected number of dairy farms in 2012 under the baseline is 23,000 compared to just 15,000 in the scenario. A decrease in farm numbers results in an increase in the average quota per farm for the remaining farms from 46,000 gallons (209,120 litres) in 2004 to just over 70,000 gallons (318,226 litres) in 2012 under the scenario compared to just over 50,000gallons (227,304 litres) in the baseline.

4.2 Cattle farming

Figure 3 presents projections of the percentage of cattle farmers working off-farm. Under the baseline, the number of 'part-time' cattle farmers is projected to increase by 5 to 10 percentage points. The projected increase under the scenario is more significant. More farmers are likely to work off-farm under the scenario as the returns to farm labour declines considerably relative to the returns to off farm labour. By 2012, the proportion of part-time

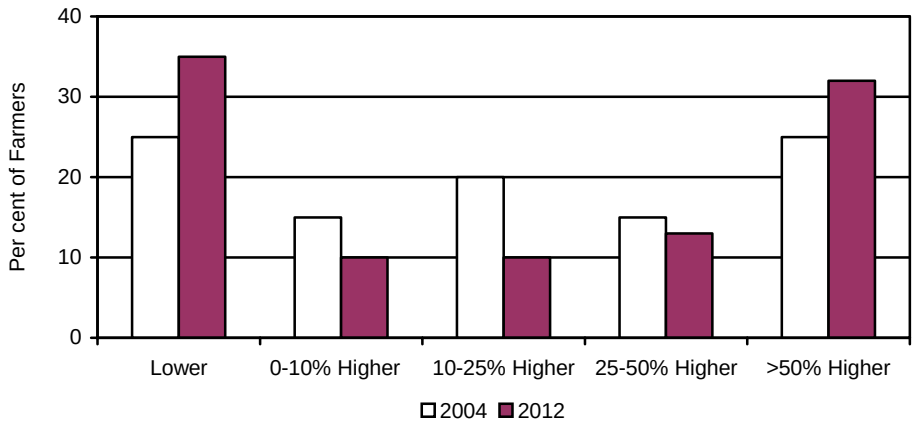
cattle farmers is projected to increase to 60 per cent, that is approximately 10 per cent more than the baseline.



Source: FAPRI-Ireland Farm-Level Model (2003).
Figure 3: Projections of Participation of Cattle Farmers in Off-farm Employment

The results of the labour allocation model suggest that, despite the deterioration in returns to farm labour relative to off farm labour, a complete shift to part-time cattle farming will not occur because of the farmer age structure. Although, retirement and succession is occurring during the projection period, the number of farmers aged 60 and over increases from 23 per cent in 2002 to over 30 per cent in 2012. While the historical data shows that farmers are unlikely to work off-farm when they are aged 60 or over, it also shows that they are unlikely to retire from farming at the age of 60 Farmers can work to an older age on the farm than off it and therefore, the presence of these 'retirement farmers' poses an impediment to rapid increases in part-time farming.

The farm level modelling system can also show the number of farmers that benefit financially from such a policy choice. Figure 4 shows the income effects of decoupling on Irish cattle farms.



Source: FAPRI-Ireland Farm-Level Model (2003).
Figure 4: Income Effects Due to Decoupling on Full-time Cattle Farms

In 2004, 25 per cent of full-time cattle farmers have lower incomes under the Luxembourg Agreement scenario than in the baseline. The majority of farmers that have lower incomes are those that are specialising in calf production. While total direct payment receipts on these farms are unchanged in the baseline versus the scenario, the market margin is falling. Calf prices are projected to be 15 per cent lower in the scenario in 2004 than in the baseline.

Another group of farms have lower incomes in the scenario in 2004 than in the baseline because they are projected to increase their premium claim from 2002 to 2004. In the baseline, some farmers are projected to change their farm plan to maximise their premium claim. The additional premia that would be claimed in the baseline in 2004, are not claimed in the scenario, as they do not feature in the 2000 to 2002 reference period for decoupled payments. In short, those farms that are specialising in calf production and those that have not yet fully maximised their premium claims are likely to be worse off in the scenario in 2004 than in the baseline. However, this group constitutes 25 per cent of cattle farmers or less.

Discussion

This paper describes a modelling system which was developed to show the effects at the farm level of a policy change. While the model has been fairly successful and has informed the policy debate in Ireland for a number of years, like all models continued development is required. There are a number of weaknesses that need to be addressed.

There is scope for major improvement in the labour allocation model. The labour model as it currently operates is a logit model, i.e. it is a binary indicator of whether a farmer will participate in off farm work or not. A second model is required that would produce projections of the number of hours worked off farm once the logit model indicates that the farmer would participate in off farm employment. With the number of hours estimated, the labour constraint in the linear programming model can be adjusted more accurately. It is envisaged that this improvement will be made in the near future.

There is also scope for improvement in the modelling of when, and why farmers cease farming, (exit). Exit is currently specified as a function of profit in the dairy model. Such an assumption attracts all the criticisms associated with normative studies. In the absence of any further empirical data on the exit decision, it is difficult to foresee how this element of the model can be improved. Furthermore, the issue of exiting from farming altogether has been ignored in the system. Appropriate methods of modelling the exit decision need to be explored.

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