

# The Estimation of Policy Impacts on Farms

Thia Hennessy

Rural Economy Research Centre, Dublin

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## Summary

The purpose of this project is to examine the impact of the Berlin agreement on EU agricultural policy reform at farm level and to estimate how farmers are likely to respond to new policy changes. Eight Representative farms in the cattle and dairy sectors are developed in order to analyse the different sectors of the farming community. Linear programming models are constructed to estimate how these farmers are likely to respond to the changing policy. Estimates of farm income are also produced.

The impact of Agenda 2000 on these representative farms was analysed. The key findings showed that all farms will be subjected to a price-cost squeeze over the next ten years. By responding to policy changes farmers will be able to maintain farm net margins and in some cases increase them modestly. The key to success for dairy farmers is expansion of milk quota. Purchasing of currently leased quota and additional quota, where possible, allows larger dairy farms to maintain profits. However, smaller dairy farms, 20,000 gallons of quota or less, are pushed and pulled out of farming. Rising production costs, static milk prices and unaffordable quota push them out, while attractive sale prices for quota and potentially high off farm incomes pull them out of dairy farming.

In relation to cattle farming, results show that the key to success is the maximisation of direct payments. Small and part-time farms will find extensification schemes increasingly more profitable over the coming years. While larger farms can expand operations following the changes in premia limits set out in Agenda 2000. Off farm employment will continue to be a major issue for cattle farmers to consider. It is projected however, that margins can be maintained at a sufficiently high level on large cattle farms to keep them in business.

## Introduction

The work described here has been developed under the auspices of the FAPRI-Ireland Partnership, a research consortium between Teagasc, the Irish Universities and the Food and Agriculture Policy Research Institute (FAPRI) in the USA. The objective of the Partnership is to project the impact of agricultural policy scenarios on agricultural markets, farms and other related industries.

The projection process begins at the macro level with an econometric model of Irish agriculture. The model is comprised of a set of individually estimated commodity models, e.g. beef, dairy, sheep, pigs and cereals that are linked and solved simultaneously under different policy scenarios. The individual commodity models for Ireland are linked to the FAPRI-USA constructed EU and world models. This allows the simulation of policy changes at a national, EU, and international level. There are companion reports that outline the details of commodity modelling at the macro level.

The projected agricultural prices derived from the macro models are linked into a number of farm level models. Using these models it is possible to estimate the impact of a policy scenario on different types of farms and furthermore to project farmers' likely response to the policy scenario. This report focuses on the farm level stage of the analysis. An explanation of the methodology applied is presented along with some of the key findings to date.

## Methodology

### Representative Farms

The main objective of this project is to estimate the impact of policy scenarios on Irish dairy and cattle farms. As it is not possible to model the total farming population individually it was decided to adopt a representative farm approach. Representative farms are farms, which are typical of different sectors of the farming community.

It was necessary to develop a number of representative farms that characterise different groups of the farming population. These were chosen from the 1996 Irish National Farm Survey. Groupings were determined by using a clustering technique, where clusters were generated according to a farm's technological homogeneity. This is defined as similar resource endowments and constraints, similar levels of efficiency and managerial abilities. The average farm in each group was chosen as the representative farm. Through the National Farm Survey's weighting system it was possible to determine how many farms each representative farm characterises nationally according to the 1996 records.

### Structural Change

Structural change was a fundamental issue which needed to be addressed in the context of representative farms. From the National Farm Survey it was possible to estimate the representivity of farms in 1996, however it could not be assumed that this would remain constant. Markov Chain models were developed to tackle this structural change problem.

This analysis in its simplest form is based on the assumption that historic trends will continue into the future. For example, if in the period 1990 to 1996, 10% of full-time cattle farms became part-time farms then the methodology suggests that in the 6 year period from 1996 to 2002 a further 10% of the full-time cattle farming population will become part-time. This methodology was used to project the future representivity of the representative farms chosen.

### Static Analysis

As mentioned, the main objective of the project is to analyse the impact of a policy scenario on the various representative farms. The first form of analysis is static analysis, which assumes no response by the farmer to the new situation. Therefore, it highlights the effect on farm net margin if current farming practices are continued indefinitely. The analysis involves a simple budgetary re-pricing model, i.e. the farm plan remains unchanged over the projection period while the prices vary annually.

### Dynamic Analysis

On examination of historical data, it is apparent that farmers react to external forces such as policy change. Following the McSharry reforms farmers adjusted to the new policy environment by restructuring in order to maximise revenue per hectare. Hence, the static analysis seems unrealistic and it is necessary to develop models that can project how farmers will react to new policy scenarios. Linear programming models were developed for this purpose.

Linear Programming (LP) models were constructed for each of the representative farms. LP is a method of constrained optimisation; it maximises an objective function subject to specified constraints. In this context, LP is applied to maximise farm net margin over a 10 year projection period, subject to the resources on the farm and policy regulations. A set of multi-period linear programming models was constructed. Models are multi-period in that

they analyse each year of the projection period. Multi-period LP can demonstrate growth and development of a farm business over a number of years.

## Key Findings

To reiterate, the main objective of this project is to estimate the impact of the Berlin Agreement on Agenda 2000. The key findings are presented below.

### Representative Farms

Four dairy farms were considered to represent the various sectors of the dairy farming community; a brief description of each is presented in Table 1.

<b>Descriptors as per 1996 (No. of Farms Nationally)</b>	<b>Static (10 800)</b>	<b>Developer (7 900)</b>	<b>Large (1 000)</b>	<b>Typical (13 200)</b>
Farm Net Margin (£)	11 150	14 500	65 750	22 650
Utilised Agri. Area (hectares)	45	41	123	45
Milk Quota Farmed (gallons)	19 500	22 000	96 000	37 000
Change: Milk Sold (92-96)	0	+55%	+5%	+10%
Yield per Cow (gallons)	825	1 000	1 075	1 025

Source: Irish National Farm Survey

The representative farms are named according to their most discriminatory characteristics, the number of farms that each represent nationally is shown in brackets. The first two representative farms although of similar size, differ significantly on their development path over time and also on their technical efficiency. The large group is differentiated from the other three by its size and level of technical efficiency. Finally the last is the typical dairy farm. Farms remained in this group because they did not have any other significant distinguishing factors.

Table 2: Representative Cattle Farms

Descriptors as per 1996  <i>(No. of Farms Nationally)</i>	Off-Farm Employment		No Off-Farm employment	
	Minimalist <i>(15 000)</i>	Efficient <i>(8 200)</i>	Large <i>(4,700)</i>	Moderate <i>(28 300)</i>
Utilised Agri. Area (hectares)	33	36	74	33
Family Farm Income (£)	1 900	7 250	18 250	5 071
Gross Margin per Hectare (£)	300	469	545	406
Change in Agricultural Area	-10%	+9%	+8%	+2%
Labour supplied Versus Required <sup>1</sup>	0.3	0.6	1.3	0.5

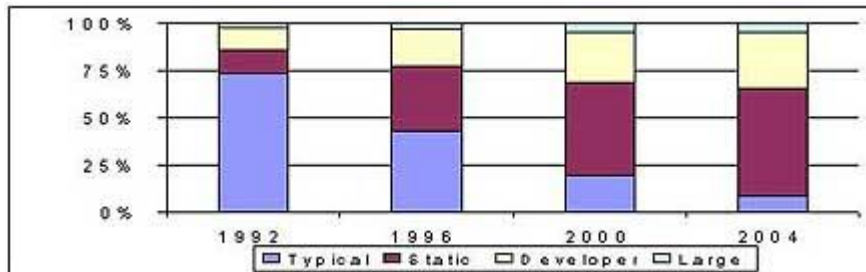
Source: Irish National Farm Survey

Table 2 shows four representative cattle farms. The Irish cattle farming population consists of two main sub-populations, namely those with off-farm employment and those without. These sub-populations are also subdivided. As shown in the table both the minimalist and efficient farms have off farm income and both households are described as `young'<sup>2</sup>. However, they are differentiated, as one is a minimalist farmer. The minimalist farmer derives a significantly lower income from the same resource base as the efficient farmer. Differences also exist in technical efficiency and the operators' time allocated to farming. It is important to segregate these two farm types, as they are likely to follow different development plans.

Those without off farm employment are also easily differentiated, as they differ in size and efficiency. Demographics on these farms are also very different. The average age of the large farm operator is 48 and the household is young. In contrast 50% of moderate cattle farmers are over 60 years of age and in the majority of cases the household is defined as `old'.

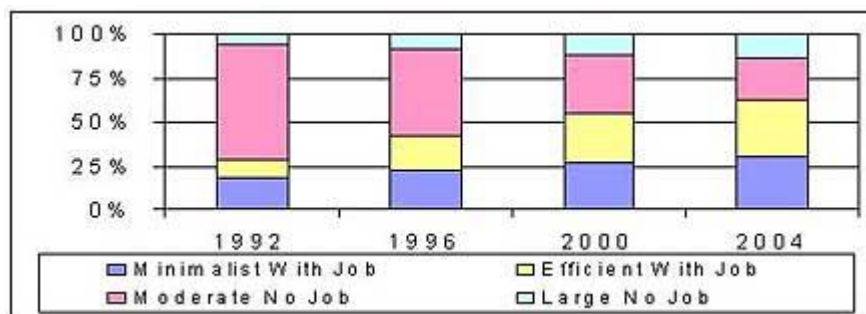
## Structural Change

The tables show the number of farms represented by each cluster in 1996. However, as discussed the representivity of farms may change over time. Results of the Markov Chain analysis are presented below.



Source: Derived from Irish National Farm Survey

Figure 1 shows the observed movements from 1992 to 1996. Through the analysis it is assumed that the same rate of movement will continue in the future. Therefore it is projected that the representivity of the typical dairy farm will continue to decrease while the static and developer dairy farms become more representative. Literature on structural change indicates that such polarisation of farm structure is typical of developed countries.



Source: Derived from Irish National Farm Survey

Figure 2 shows the observed movements in representivity of the cattle farms from 1992 to 1996. It is projected that the representivity of farms with off farm employment will increase. By 2004 it is projected that over 60% of all cattle farmers in Ireland will have off-farm employment. As this analysis is based on a balanced panel data set it only includes farmers that remained in farming. As yet there is no provision made in the methodology for calculating or projecting exits from farming. In addition, projected changes are based on those occurring in the 1992-1996 period. The dramatic increase in the growth of the overall economy means that these projections are likely to be conservative.

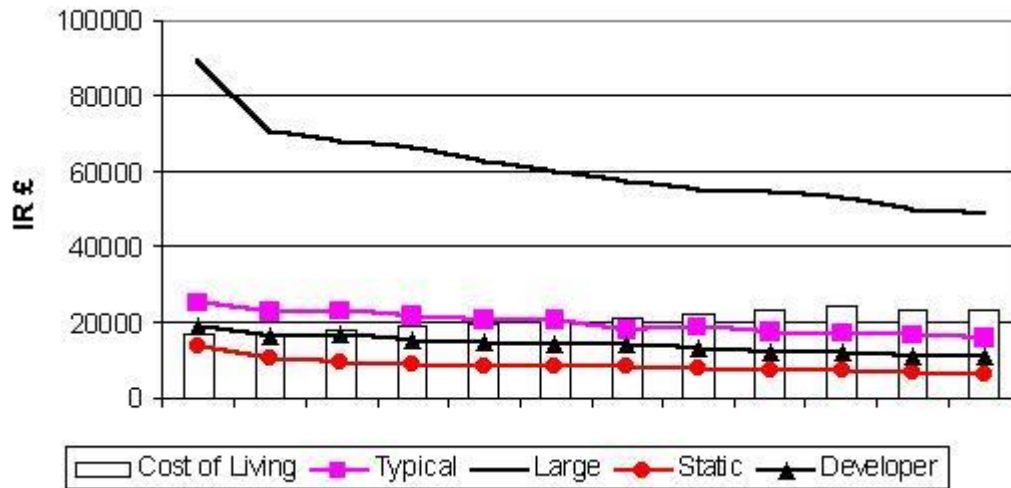
## Static Analysis

Static analysis assumes no response by the farmer to the new situation. Therefore it highlights the effect on farm net margin if current farming practises are continued indefinitely.

Figure 3 presents the results of static analysis for the representative dairy farms. Results are expressed in real terms to show the effect of inflation on income. If there is no farmer response to new agricultural policies, net margin will fall considerably. To put farm margins in context the average cost of living of a rural household is also presented. In 1996, three of the four farms earned farm margins higher than the cost of living. In a no response situation farm net margin in 2007 is below the average cost of living for three of the farms analysed.

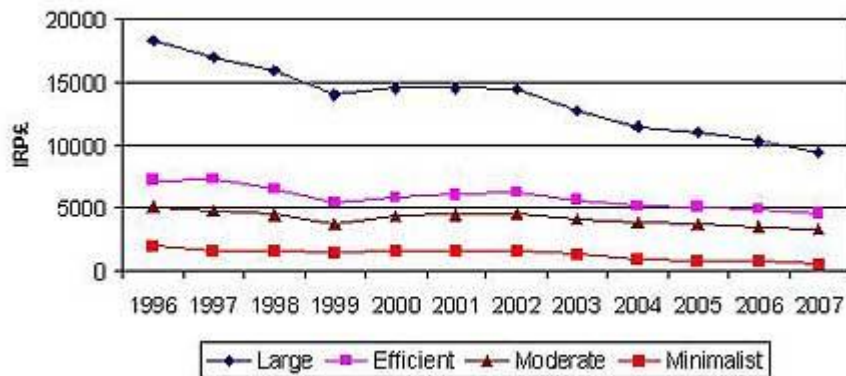
Furthermore, the gap between the cost of living and farm net margin of the large dairy farm diminishes considerably.

Declines in net margin are mostly due to rising costs. Revenue, i.e. output value plus value of subsidies, is maintained as direct payments agreed in Agenda 2000 largely compensate for price decreases. With revenue remaining static and costs rising, farms are subject to a price-cost squeeze. This is particularly true in relation to fixed costs. Costs such as labour, energy, machinery, and maintenance of land and buildings are all projected to increase substantially. In relative terms farm net margin on the large farm is decreasing most rapidly. This is because large farms tend to have high overhead costs.



Source: FAPRI-Ireland farm level model

Figure 4 shows similar results for cattle farms. Real farm net margins fall considerably over the projection period.



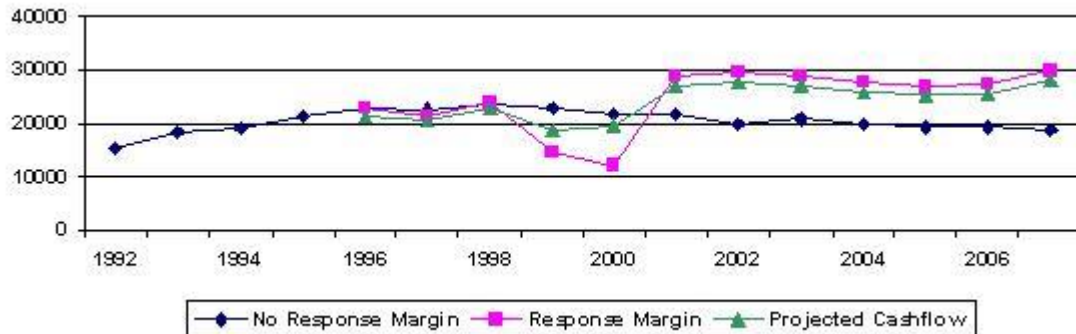
Source: FAPRI-Ireland farm level model

## Dynamic Analysis

As explained earlier, dynamic analysis involves projecting farmers' response to Agenda 2000. For the analysis of dairy farm incomes there was a further policy scenario to consider. The impact of the quota transfer rules introduced by the Department of Agriculture, Food and Rural Development in 2000 were also considered. The main results of the dynamic analysis are outlined below.

## Typical Dairy Farm

Figure 5 shows if there is no response to the new agricultural policy and the economic climate, farm net margin falls by approximately 20% from 1996 to 2007, in nominal terms. With a dynamic response it is possible to increase long-term farm net margin.



Source: FAPRI-Ireland farm level model

In the base year 1996, the typical dairy farm has a milk quota of 32,000 gallons owned and 5,000 gallons leased. In 1999 the farm net margin falls considerably. The reasons for this are three-fold. First, cattle margins were very poor in 1999. Second, extra heifers are reared in anticipation of increasing the dairy herd and additionally, investment in housing is made, dry-stock housing is renovated to accommodate dairy cows.

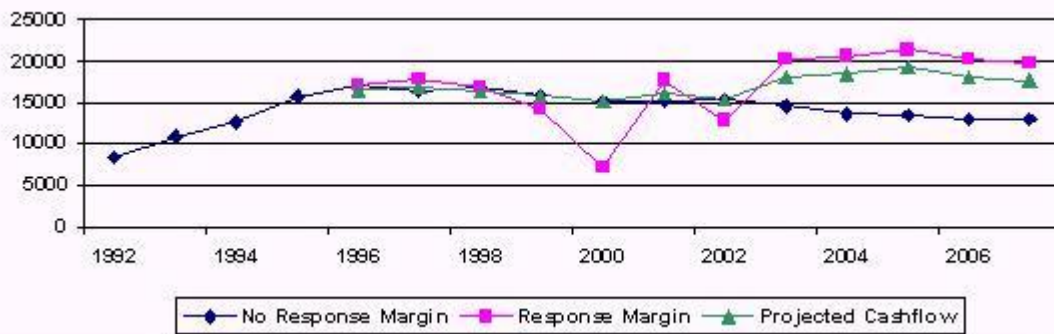
In 2000 this farm avails of the new regulations with regard to quota transfer. The 6,000 leased gallons are purchased at £1.36. An additional 4,000 gallons are also purchased from the restructuring pool. Thus, the quota owned on this farm increases from 32,000 to 42,000 gallons. Initially, this has a negative impact on farm net margin because of the associated cost, the purchase of quota and investment in housing requiring a loan of £11,000, which is repaid over 7 years.

Farm net margin recovers after 2000. However, as a large investment has been made, it is more realistic to consider farm cash flow rather than margin. Net margin accounts for repayment of interest on borrowings only, cash flow on the other hand allows for repayment of principal and interest. Therefore, it may be considered a better measure of income. In 1999 and 2000, funds are borrowed to cover living expenses, this is reflected by the cash flow line in Figure 5. Following this, funds are repaid annually and thus cash flow does not increase by the same magnitude as farm net margin.

From 1996 to 2007 this farm increases total quota owned by 30% and total quota farmed by 15%. As a consequence of this increase in quota, farm net margin increases by 30% in nominal terms and 11% in real terms. To put this increase in context, farm net margin in 2007 is 10% above the average cost of rural living in that year.

## Developer Dairy Farm

For the developer dairy farm, if there is no response, farm net margin falls by approximately 25% from 1996 to 2007 in nominal terms. By responding to the new agricultural policies and economic situation it is possible to increase farm net margin, although not immediately.



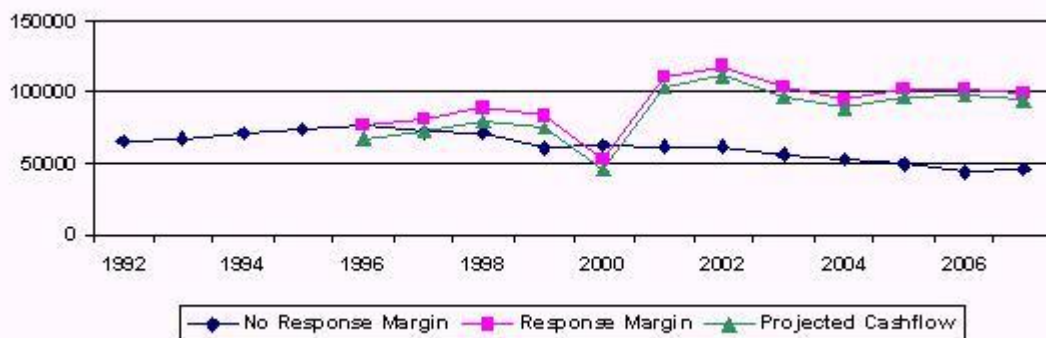
Source: FAPRI-Ireland farm level model

In the base year 1996, this farm has a milk quota of 19,000 gallons with another 3,000 gallons leased. In 2000 this farm purchases a total of 9,000 gallons, 3,000 of which were previously leased. This has a negative impact on farm net margin, as highlighted in Figure 6. The purchase of quota at £1.36 and the conversion of housing require an investment of £10,000, which is repaid over 7 years. Again, farm cashflow may be considered more indicative of the expansion effect on income.

Farm net margin recovers in 2001. However, it falls considerably again in 2002. This is because further investment in quota is made. This requires an investment of £3,000 for both the purchase and the associated housing costs. By 2003, 33,000 gallons of milk quota is being farmed. This is a 35% increase in quota farmed from 1996. The farm net margin is 21% above its 1996 levels, while cash flow is 12% higher. Cattle operations in these years are store rearing only.

### Large Dairy Farm

Figure 7 shows, farm net margin falling by 30% in nominal terms, in a no response scenario. By responding the new policy framework it is possible to maintain long term farm net margin.



Source: FAPRI-Ireland farm level model

In the base year 1996, this farm has a milk quota of 81,000 gallons owned and 15,000 gallons leased. The cattle operation involves selling both stores and finished animals. It is constrained by the 90-head limit on special beef premia.

In 2000 all leased quota is purchased at £1.36. As the farm earns such a large net margin it does not need to borrow any funds for this investment. The fall in net margin in 2000 is not overly dramatic. This is because some of the loss incurred is absorbed by the increase in special beef premia limit to 180 head. It is projected that this farm would acquire currently leased quota. However, as it does not qualify as a priority group it is unlikely that any



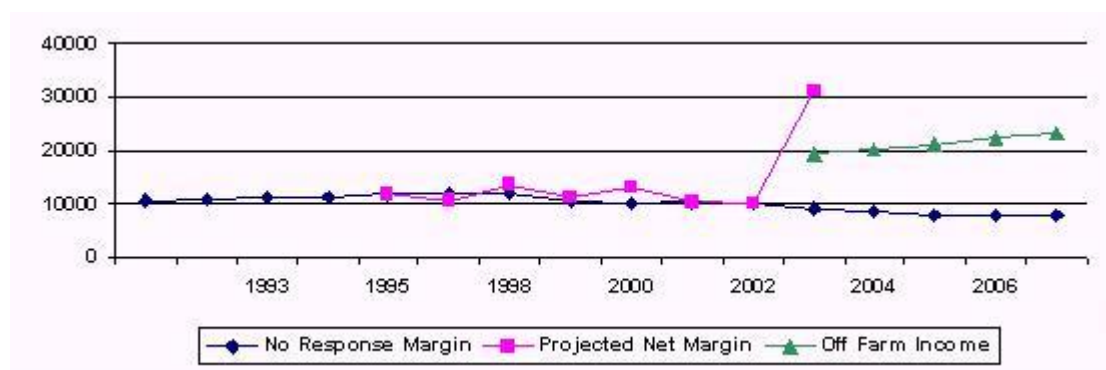
additional quota would be available. Through purchase of currently leased quota, it is possible to increase farm net margin. Farm margin begins to fall after 2003. This is due to falling cattle margins and milk prices. It recovers marginally later in the period as milk direct payments are introduced.

### Static Dairy Farm

This farm has a very poor cost structure and thus farm net margin falls by approximately 40% from 1996 to 2007 if there is no farmer response.

From 1996 to 2000 the base farm plan continues to be operated, i.e. there is very little farmer response. The farm continues to supply its own 19,500 gallon quota and the 1,000 gallons leased. A two-year old steer beef system is operated. Any gain over the no response scenario in these years is due to optimisation on cattle premia collection. In 2000 this farm has the option to purchase leased quota at £1.36. It does not avail of this option and ceases leasing quota. This causes farm net margin to fall which can be seen in Figure 8.

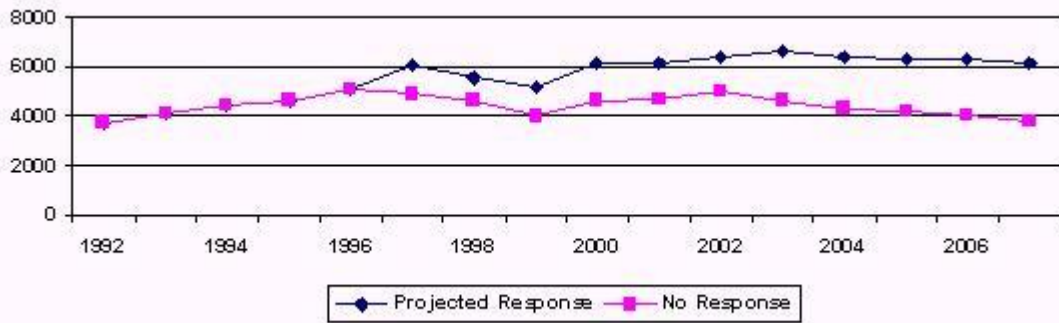
In 2003, total milk quota is sold into restructuring and the dairy herd is also sold. The motivation for this can be attributed to a combination of factors. Milk price continues to fall with no sign of future recovery, costs continue to escalate and finally off farm employment is persistently more profitable. The net margin in 2003 of £32,000 reflects funds received on sale of livestock and quota. In this year, the farm also ceases dry-stock production. The farmland is let at the market rate for dairy land and labour is employed off-farm. Off-farm earnings combined with rental income are more profitable than a dry-stock system. Earnings achieved off farm are also displayed on the graph. As illustrated, off farm income in 2003 is considerably higher at £19,800 than farm net margin in 2002.



Source: FAPRI-Ireland farm level model

### Moderate Cattle Farm

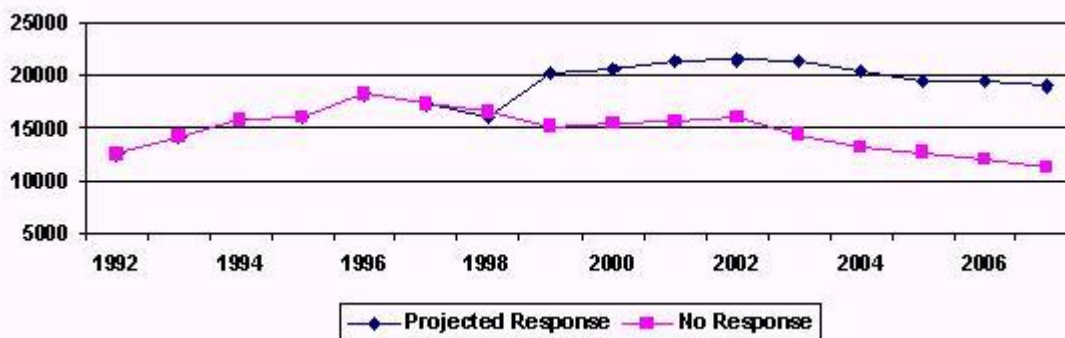
Farm net margin falls by approximately 25% in nominal terms from 1996 to 2007 if there is no farmer response. The option of off farm employment is not a viable one for this farm because of the age profile. Fifty per cent of farmers represented by this group are over 60 years of age. Therefore it is projected that this farm will continue full-time farming.



Source: FAPRI-Ireland farm level model

When the farm responds to this new situation, it is possible to maintain margins over the period. In the base year, this farm has a stocking rate of less than 1.4 livestock units per hectare. Thus, it qualifies for the higher rate of extensification in both scenarios. It is projected that from 1996 to 1999 such a farm will reduce heifer numbers to replacement requirements only. In this period, the farm continues to stock a sufficient number of suckler cows so as to claim all 11 of the available suckler cow premium rights. The remaining land is allocated to rearing stores, some of which are purchased as weanlings and sold off the farm after the first year. Post 2000, farm net margin increases marginally to 2004 as indicated in Figure 9. There are two reasons for this, first the value of premia payable are increasing especially extensification. Second it is possible to claim 20% of the suckler cow premia on heifers. This enhances the margin, as heifers are more economical to stock than cows especially on an extensification farm. Hence, more extensification premia can be collected as heifers count as less of a livestock unit.

### Large Cattle Farm



Source: FAPRI-Ireland farm level model

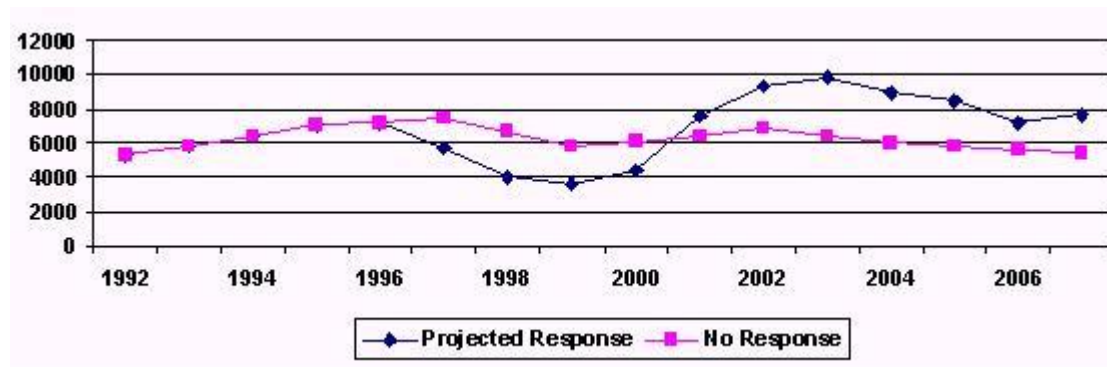
Farm net margin falls by approximately 40% from 1996 to 2007 if there is no farmer response. A dynamic response boosts margins initially and later maintains it at current levels. In the base year this farm rears heifers surplus to those required for replacement. All heifers in excess to requirement for replacement are shed from the farm. In the base year, 15% of animals were finished on the farm. The farm shifts to store rearing only. Stores have become relatively more profitable as the margin for finished animals is decreasing. Although the second special beef premia is not payable on a store, a large proportion of it is bid into the market price received. Furthermore, the resources on the farm can accommodate more animals in the form of stores.

Farm net margin rises considerably from 2000 onwards. With the 90-head limit on special beef premia increased to 180, the farm extends operations. Ten hectares are rented and the store rearing enterprise is expanded. In addition to this the farm stocks three less suckler cows and the premia are collected on heifers.

It is possible to maintain this higher margin until 2004. Following this, costs begin to increase. In addition, the increase in premia agreed in Agenda 2000 is fully realised by 2002, however, the price of beef continues to fall after this date. Therefore margins are higher in the early years as full compensation is being distributed before full loss is realised. The effect of this is falling farm net margin after 2004. The farm operator for this large farm is only 48 years of age. Therefore, off farm employment is a viable option. It is projected that large cattle farmers will continue to farm full-time. Through response it is possible to increase farm net margins on these farms above the wage such a farmer is likely to earn on average off the farm.

### Efficient Cattle Farm With Off-farm Employment

Farm net margin falls by approximately 25% in nominal terms from 1996 to 2007 if there is no farmer response. Following producer response, farm net margin falls further in the initial years.



Source: FAPRI-Ireland farm level model

From 1997 to 1999 labour employed on the farm is reduced. The motivation for this is the growing profitability of off farm employment in conjunction with poor cattle prices and static premia. Farm operations are downsized and 6 hectares are leased out. The suckler cow quota of 17 continues to be filled. Male calves are reared for one year and sold as stores. Farm labour is reduced to half a labour unit. The labour unit that is working off the farm can increase earnings by approximately £8000 by reducing time allocated to farm work.

As displayed in Figure 11, a gradual increase in farm net margin is realised from 2000 to 2003. In 2000, this farm responds to the Agenda 2000 policy changes by repossessing land leased out in earlier years. It then qualifies for the high rate of extensification. With increases in extensification, special beef and suckler cow premia the farm net margin begins to increase. All male steers are finished as they collect two special beef, two extensification and a slaughter premia in their lifetime. The margins continue to rise until 2003 as the premia are increasing at a faster rate than the fall in prices. The farm can achieve this increase in margin without increasing livestock units or labour employed.

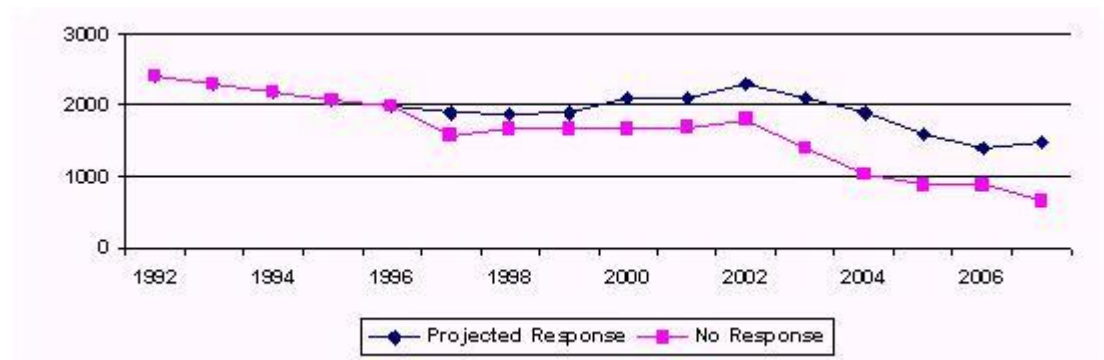
Following 2003 the farm net margin begins to fall. This is due to falling cattle prices and static premia. Margins could be maintained by opting for store beef only as it would be possible to carry more animals and therefore qualify for additional premia. However, store beef is more labour intensive. In a situation of rising off farm incomes, it is projected that this farm will not opt for a more labour intensive system. Thus, a less profitable but less labour

intensive system is sustained. Although farm net margin is falling from 2004 to 2007 off farm income is increasing significantly . In 1997 off farm employment was increased and farm operations were scaled down. By 2007, this increase in off farm employment is valued at approximately £11,000.

### Minimalist Cattle Farm

The consequences are severe if this farm does not respond to the new economic environment and agricultural policy. Cost structure on this farm is poor, as the fixed costs per unit of output are very high. In 1996 70% of the farm gross margin was consumed by fixed costs. These costs are projected to increase considerably over the projection period. If the farm does not respond then by 2007 farm net margin will have fallen by 70% in nominal terms on its 1996 levels.

In an economically optimal situation, this farm would let all land and work completely off the farm. However, it is noted from historical data that this farm did not make this optimal adjustment previously and therefore it is projected that it will not in the future. It is assumed that reasons exist, other than profit, for this farm to remain in business.



Source: FAPRI-Ireland farm level model

By responding to the new situation, it is possible to recoup some of the loss associated with a no response scenario. It is not possible however, to maintain net margins at 1996 levels. This is due to the crippling effect of high overhead/fixed costs. In the base year this farm qualifies for the higher rate of extensification. The increase in extensification payments in 2000 and thereafter contribute to the rising farm net margin. In the response scenario it is possible to boost farm net margin further by adjusting stock. In the base year this farm finished heifers at 21 months. However, it is likely to sell off all heifers as weanlings and substitute them with extensification eligible animals. The system operated on this farm is similar to the previous part-time farm. Due to its cost structure and labour availability, it opts for a calf to beef system.

### Summary of Key Findings

Results of the static analysis have shown that if there is no farmer response and current farming practises are continued, the effects on farm margins are drastic. Projections show that all farms regardless of size or system, will be subjected to a price-cost squeeze. Value of output remains constant over the period analysed. However, fixed costs increase by 15 to 20% thus impacting negatively on farm net margin. Large and part-time farms are worst affected. This is because these farm types tend to have high overhead costs per unit of output.

However, results also show that through response it will be possible to maintain or increase margins in most cases by responding to the new policy package. For dairy farms this

response is mostly in the form of expansion of milk quota. It is projected that farms will avail of the option to purchase currently leased quota and will seek additional quota. Through modest expansion of quota, it is possible to achieve increases in margin. Projections differ for dairy farms that currently have a small quota, 20,000 gallons or less. Farms with a small base and poor cost structure especially fixed costs are projected to experience tight margins. It is projected that such farms can not profitably expand quota. Without expansion of quota margins are projected to become even tighter. By 2003, it is projected that such farms will sell quota into restructuring and exploit the economic attractiveness of off farm employment.

Take-up of extensification on cattle farms is projected to be substantial. Extensification farms are likely to shed all non premia eligible animals, i.e. two year olds, heifers etc. All farms are projected to avail of new suckler cow premia rules in relation to claiming on heifers. Through a combination of these factors it is projected that farm net margin on cattle farms can be maintained and increased in most cases. Off farm employment will continue to be a major issue for cattle farmers to consider. It is projected however, that margins can be maintained at a sufficiently high level on large cattle farms so that farming remains more attractive than off farm employment.

## Acknowledgements

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## Outputs

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Hennessy T (2000) Projected Farmer Response to the Agricultural Outlook for Ireland. **FAPRI-Ireland Outlook 2000** conference, 22nd March. Royal Dublin Society, Dublin

## Footnotes

<sup>1</sup>This variable reflects the amount of labour supplied on the farm relative to what is required given the size of farm operation. For example 0.3 shows this farm only requires 30% of the amount of labour it is actually supplying. In other words it is operating at only 30% of the standard level of labour efficiency.

<sup>2</sup>A household is described as young if the operator is less than 55 years of age and at least one other member of the household is under 45 years