FORESTRY COMMISSION
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Forestry Expansion – a study of technical, economic and ecological factors

The Agricultural Demand for Land: Its Availability and Cost for Forestry

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INTRODUCTION

An increase in the area of forestry in the UK must involve the reduction in land used for other purposes, largely agriculture. This chapter analyses the consequences of agricultural change on the availability and cost of land for forestry purposes. The major objective is to estimate the social opportunity cost of transferring land from agriculture to different uses, including forestry, and analyse how this is likely to change in the future.

The cost of land to the farmer is the price he has to pay for it or the value it would make on the open market. However, it is well known that agricultural policy influences the prices received for farm products. These farm support policies will also affect the value of land in agriculture. The effects of agricultural policy on the farm sector and the returns which are generated by the use of land in agriculture thus form the major focus of this chapter.

There are four important questions which are capable of reasonably firm answers:

1. How much land is currently surplus to agricultural requirements and therefore available immediately for forestry?

2. Is this idle or surplus agricultural land area likely to increase in the future?

3. What determines the value of land to agriculture: that is: how much will foresters have to pay to attract additional land away from farming?

4. Is this market-determined price for land a 'fair' or socially optimal price to charge for agricultural land in view of the support provided for the farming sector?

Chapter 2 deals with the first two of these questions in the context of past changes in agricultural areas. Chapter 3 discusses the state of agricultural policy, especially the CAP, and the implications of the removal of current agricultural support policy, since this is a key determinant of market prices of farm land. Chapter 4 considers the determination of farm land prices and considers the question of the social (as opposed to the private or market) opportunity cost of land for forestry. Chapter 5 presents some preliminary estimates of the areas of land by region in England and Wales which might transfer to forestry or other uses as agricultural returns fall under various policy alternatives. Major conclusions are summarised in the final section.

LAND USE CHANGE IN AGRICULTURE

Figures 1-3 provide an overview of the trends in the major land use patterns in the UK over the recent past. Figure 1 shows that the total land area in agricultural use has been remarkably stable since 1968, a picture which repeats trends since the war. In spite of the 'urban encroachment' on grade 1 agricultural land which causes some excitement from time to time, there is little sign at the aggregate level that the industry is suffering massive erosion of its fundamental resource base. Some overall changes are just discernible from Figure 1: there has been a small increase in the cereal and arable crop acreage, and an associated decline in the area of temporary grass (leys) which are typically included in an arable rotation to both provide a break from continuous cropping and also to provide highly intensive grazing for livestock, especially dairy cattle. At the other end of the intensive/extensive spectrum, there has been some transfer of rough grazings (the hills and uplands) out of agriculture to forestry and to improved grass. However, when seen in the perspective of the total land area, these changes have been marginal, albeit dramatic in some specific locations.

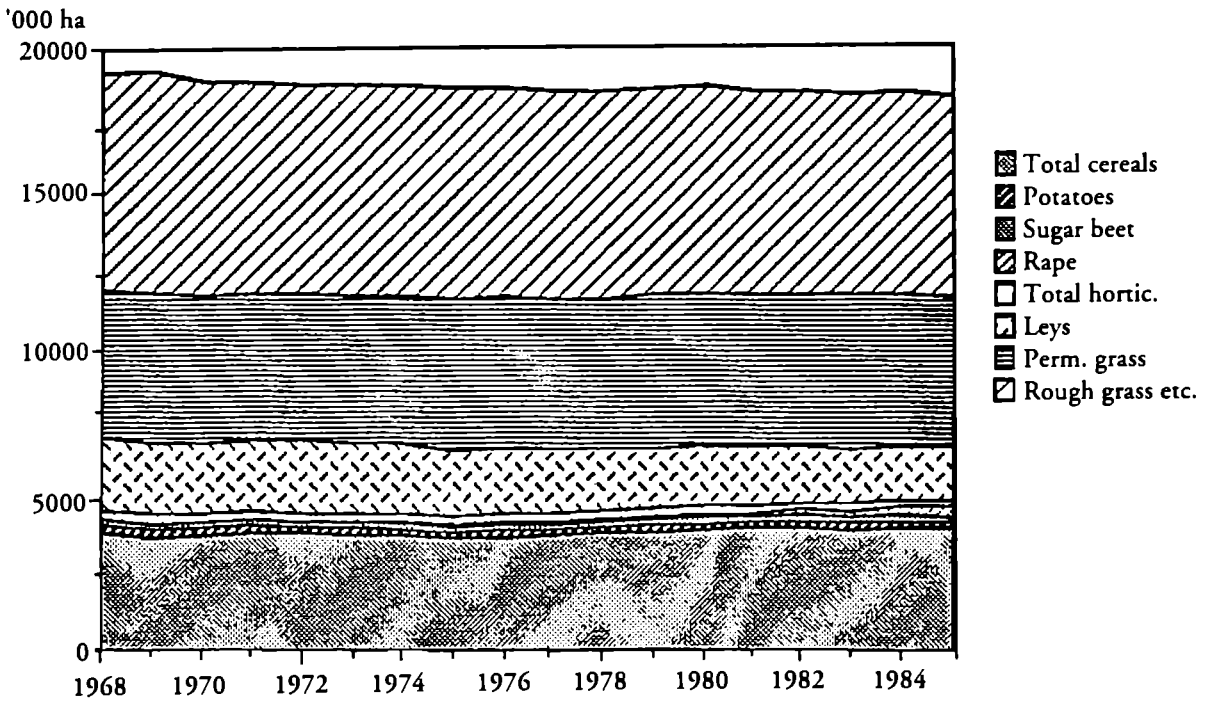

Figure 1 Agricultural land use: 1968-1985, UK

Source: MAFF, June Census results, Agricultural Statistics (as for following figures)

Figure 2 illustrates the major change: the major increase in the area of wheat and rapeseed in the UK. Although there has been some decline in the barley area, there has been an increase in the total cereal area, obviously concentrated but by no means restricted to the traditional cereal growing areas of the Southern and Eastern counties.

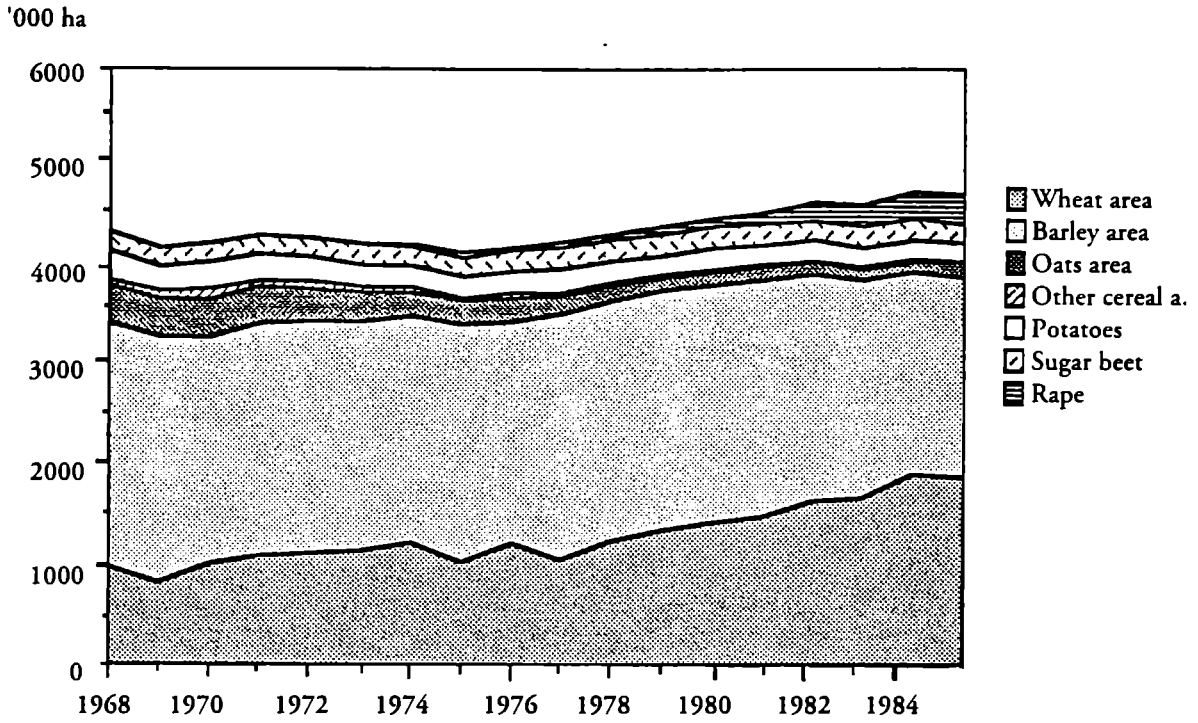

Figure 2 Arable land areas: 1968-1985

Associated with this expansion has been the removal of hedgerows and woodlands, the drainage of wetlands and the ploughing of upland areas, all of which destroy the associated 'traditional' landscape features and habitats. However, in many cases, these features themselves were not natural, they were the result of conscious land use patterns and practices of previous eras and circumstances.

Figure 3 shows the evolution of the grassland area, described as temporary grass (leys), permanent grass, and rough grazings. The decline in the temporary grass area is associated with the increase in the arable area, and the two combined show little change. However, the change is associated with an increase in arable monoculture and the decline of the traditional mixed agricultural landscape.

A recent report describes in some detail the changes in land use and landscape which have occurred since 1978 (ITE, 1986). In summary, this report indicates that 'the area of land under wheat increased by 66% between the survey dates (1978 and 1984). Oilseed rape had increased 10-fold and, like wheat, occupied land that was previously under cereals, other arable crops or short-term grass. The analysis of crop changes, field by field, showed that only about 3% of new cereal land had come from permanent pasture or poorer grazing land'.

The findings for woodlands indicate that the area of new broadleaved woodland planting approximately equalled the area of old broadleaved woodland and scrub removed. 'However, the new plantings differed from the ancient broadleaved woods, and much of the new planting had taken place in the already depleted East Anglia. The removal of

woodland continued in neighbouring areas such as central, south and south-east England. In addition, a relatively large percentage of broadleaved woodland had been underplanted with conifers.' 'There were about 8 times as many hedges removed as had been planted'. 'Overall, the major conclusion from the results .. was that the loss of landscape was slowing down in East Anglia, but was probably increasing elsewhere in southern Britain, in association with the spread of cereals and the intensification of agriculture. Meanwhile the modification of the landscape was being carried out in East Anglia through the planting and encouragement of young trees.'

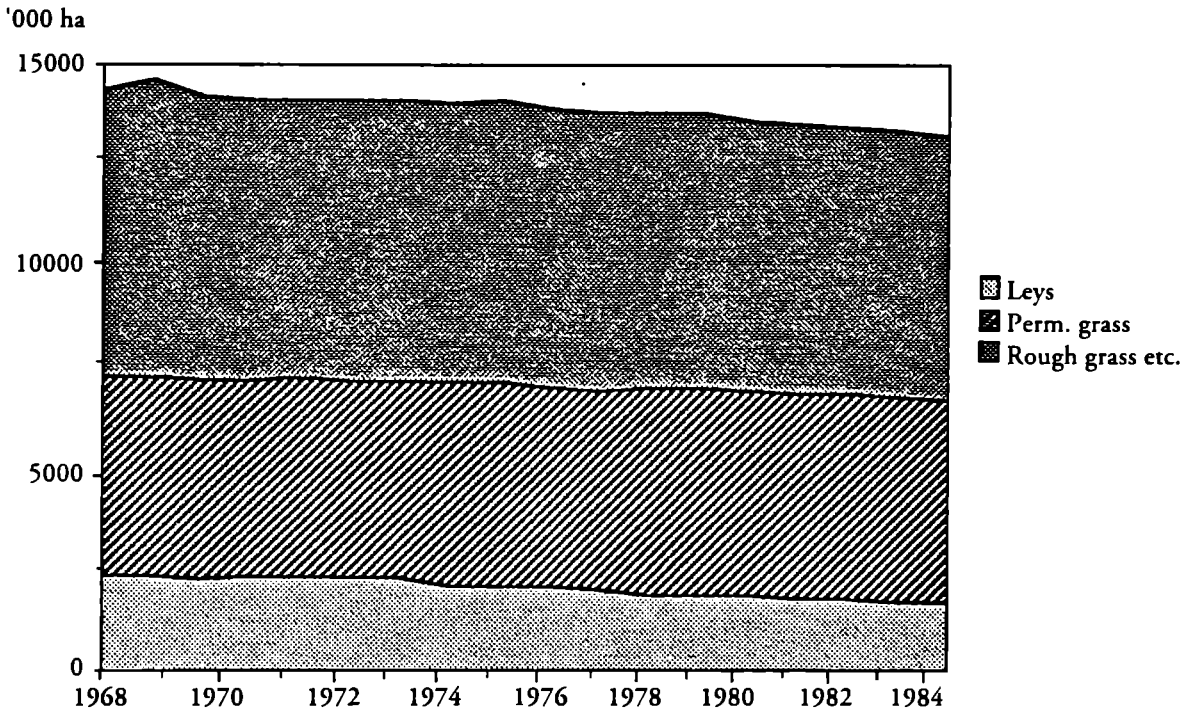

Figure 3 Grassland areas: 1968-1985

Underlying these land use changes are considerable changes in land use practices. Cereal production, in particular, has become increasingly intensive and productive. Higher yields are associated with greater use of chemical fertilisers, herbicides and pesticides, and greater reliance on sophisticated and specialist machinery, as well as with technological improvement in the cereal varieties themselves. The increased reliance on machinery and chemicals has led to the exploitation of economies of size, through the removal of hedgerows and woodlands, and drainage of wet areas. The chemicals themselves have led to increasing concern about their effects on wildlife populations and on the condition of ground and surface water supplies. In turn, the changing structure and increasing specialisation of the cereal enterprise has led to the release of labour from the farm sector, and also the decline in the requirement for local services, both directly and indirectly. The subsequent ramifications on the rural communities have also led to increasing concern.

A similar story applies to the lowland livestock enterprises, especially to the dairy systems. Again, chemical and capital intensive grass and milk production have had major influences. The introduction of milk quotas has emphasised the importance of forage production and use (ICI, 1986 and MMB, 1986). The interaction between the grass-based systems and cereals is emphasised by the fact that the increased production now possible from the grassland has enabled the transfer of land from temporary grazing

to cereals. Improvements in dairy herd management systems, and the introduction of microelectronics (transponders) have revolutionised feeding regimes and increased the productivity of labour employed, allowing the release of labour and the substitution of capital plant and equipment.

Land use changes can best be seen as symptomatic rather than catalytic of the changes in agriculture and farm practices. Furthermore, the land use changes themselves are an imperfect measure of the changes which are occurring. Concentration on land use to the exclusion of the underlying processes of and motives for agricultural change will lead to an unnecessarily narrow and partial analysis. Examples of this approach are particularly prevalent in the discussion of the Common Agricultural Policy (CAP) and the surpluses of agricultural products, especially cereals, milk, and oilseeds. There is a number of studies which have translated the present and projected future surpluses of production, variously defined, into estimates of 'surplus agricultural land'. The arithmetic of such estimates is fairly straightforward. However, the underlying logic is a good deal more questionable.

In its simplest terms, the arithmetic is as follows. The surplus production of each commodity can be defined with reference to current domestic consumption in the EC. Given a measure of surplus production, average yields per hectare can then be used to translate this surplus into area equivalents and the result is then an estimate of the surplus land area. Refinements include projecting future surplus quantities under different EC policy and market conditions, including projections of the disposal or world price levels, and considering different yield levels to take account of future technological change and farmer response to the implied changes in policy or market conditions.

Table 1 summarises some of the estimates which have been made recently. The implication of these estimates is that between 0.7 and 3 million hectares of land will become surplus to farm production requirements over the course of the next 15 years or so. To put these figures in perspective, the 1985 areas and the changes since 1975 are shown in Table 2.

Table 1 Estimates of 'surplus agricultural lands'.

Source	*Area studied*	*Definition*	*Date*	*Range* (million ha)	*Main estimate* (million ha)
Wye College	UK	area available for other uses:	2000	1-6	3-4
Laurence Gould	GB	Surplus needs	1990 2000	0.9-1.25 2.4-2.9	1.1 2.6
Gretton Report	GB		2000		2.6
NFU	GB	area available for other uses:	1990 1995		0.7 1.3
CAS, Reading	E&W	Low gross margin (area equivalent of reduction in production intensity)	5 years forward	0.2-2.21.3	(free trade) 1.9
	(EC quotas)				

Table 2 1985 UK land use, and changes since 1975.

Land use (million ha)	*1975*	*1985*	*million ha change*
Total tillage	4.82	5.265	+ 0.455
+ grass < 5 years	2.138	1.796	- 0.342
= Total arable	6.954	7.061	+ 0.107
+ grass > 5 years	5.074	5.019	- 0.055
= Total crops and grass	12.028	12.08	+ 0.052
+ Rough grazings	6.555	6.088	- 0.467
+ woodland on farms	.225	.312	+ 0.087
+ other land on farms	.171	.223	+ 0.052
= Total farm land	**18.978**	**18.703**	**- 0.275**

Source: Annual Abstract of Statistics, 1987.

It can be seen that total tillage (all land under crops) has only increased by 0.45 million ha, while the area under temporary and permanent grass has declined by almost the same amount between 1975 and 1985. As a result, the total area under crops and grass has increased by a very modest amount (52 000 ha). Nearly 1/2 million ha of rough grazings have been lost, mostly to forestry, while there have been very slight increases in farm woodland and other uses (including such things as camping sites etc.). Changes in land use over the longer term have been equally unremarkable, though generally in the opposite direction. The total arable area, for instance, has declined by only 0.6 million ha in the 40 years since the war. Given the enormous effort to increase domestic production during the war, and the continual erosion of the agricultural land area since then to provide for building, roads etc., this does not represent a particularly large area.

In the context of these historic changes, suggestions of surplus land conjure up a period of remarkable change in the countryside, if they are to be taken as a reliable projection for the future. Can they be regarded as reliable? A recent discussion of future land use changes (Agriculture EDC, 1987) is careful not to present estimates of 'surplus land'. Rather, it takes the view that land will leave cereal production and return to other agricultural uses, especially grass. It suggests that around 720 000 ha could leave cereal production, and concludes that, while significant changes of use are likely, the overall pattern of land use will not be dramatically different in the mid 90s from the mid 80s. Nevertheless, there are likely to be substantial changes on individual farms, since the future pattern will be made up of individual decisions and these will differ according to circumstance.

Similar calculations could equally well be done with the labour force or with the capital investment in agriculture. As an example, suppose that the reductions in output necessary for the sustainability of the CAP or the countryside is of the order of 20% (which is the 'target' reduction in production specified in the European Commission's set-aside regulations, and is approximately equivalent to a 'land surplus' estimate of about 3.7million ha for the UK). For the sake of simplicity, it can be assumed that this reduction could be achieved through the release of either labour or capital from the industry, rather than land. In the context of historical changes in the agricultural industry, changes of 20% in the labour and capital employment in the industry are

commonplace over relatively short time horizons. The full-time hired labour force in the UK has declined by more than 30% in the last 10 years, while the total labour force in agriculture has declined by 18% in the same time (HMSO, 1987). Capital investment in the industry, measured as total assets in agriculture excluding land in real terms, has declined by 18% over the same period, after a significant rise during the last half of the 70s (Johnson, 1986).

In other words, in the context of previous patterns of change in the agricultural industry, the release of labour and capital from the industry seems a much more likely response than the release of land. Such a conclusion is reinforced by the economic logic of an industry competing with other uses for its labour and capital while the competition for land between agriculture and other uses is likely to be much more restricted. As a result, the factor market adjustment for land is likely to occur through changes in its price, as opposed to the quantity adjustment to be expected for labour and capital. Land will only leave agriculture if its returns fall to zero, or if it can earn more in other uses. While there is clearly an increasing demand for rural land for non-agricultural purposes, this demand remains location-specific and relatively small in comparison to the total agricultural area. It follows that attempts to release land from agricultural production are likely to be both more difficult and more expensive than attempts to release more capital and labour. There is no reason to suppose that releasing capital and labour would be any less effective than releasing land as far as curtailing production levels are concerned.

In fact, there is little reason to suppose that there are significant areas of farm land which are likely to become surplus, idle or spare – that is available practically rent-free for alternative uses such as forestry. As immediate evidence for this assertion, consider the present prices commanded by agricultural land, or the levels of payment necessary to persuade farmers to idle even small areas of cereal land under the set-aside scheme. For there to be a large scale release of land from agriculture for any alternative use, the present expectations of returns to be earned in agriculture must be dramatically reduced. The next chapter turns to a consideration of the policy background against which these expectations will be formed.

THE STATE OF THE COMMON AGRICULTURAL POLICY AND IMPLICATIONS OF ITS REMOVAL

The current operation of the CAP has most of its impact on agricultural product markets through the operation of the market support and intervention mechanisms under the Guarantee section of the European budget. This section spent 96.8% of the total agriculture budget in 1985, compared to 3.2% spent on the Guidance section of the budget, which is concerned with 'structural' support directly influencing the resource structure of the agricultural industry. In addition, there are national agricultural and non-agricultural policies which influence agricultural markets (especially potatoes, for example), the production structure of the industry, the resource structure, and also the level and structure of non-agricultural rural activity. At least to some extent, there are trade-offs between the CAP and national policies, so that reductions in the level of one could be off-set by increases in the others. The European Commission, for example, has suggested that price support reductions could be tempered by increases in the structural

support elements of the Common Policy in its recent White Paper: Future of Rural Society (1989). It is also possible that changes in the CAP could trigger changes in national policies, both to off-set unwanted side-effects or to counteract the direction of European policies judged to be against the national interest. The extent of national policies for agriculture should not be underestimated. The UK, for instance, was forecast to spend £2215 million on agriculture in 1985/86, of which only £1308 million or 59% would be covered by receipts from the European agricultural budget – FEOGA – (HMSO, Cmnd 9780, Annual Review of Agriculture white paper, 1986, table 28).

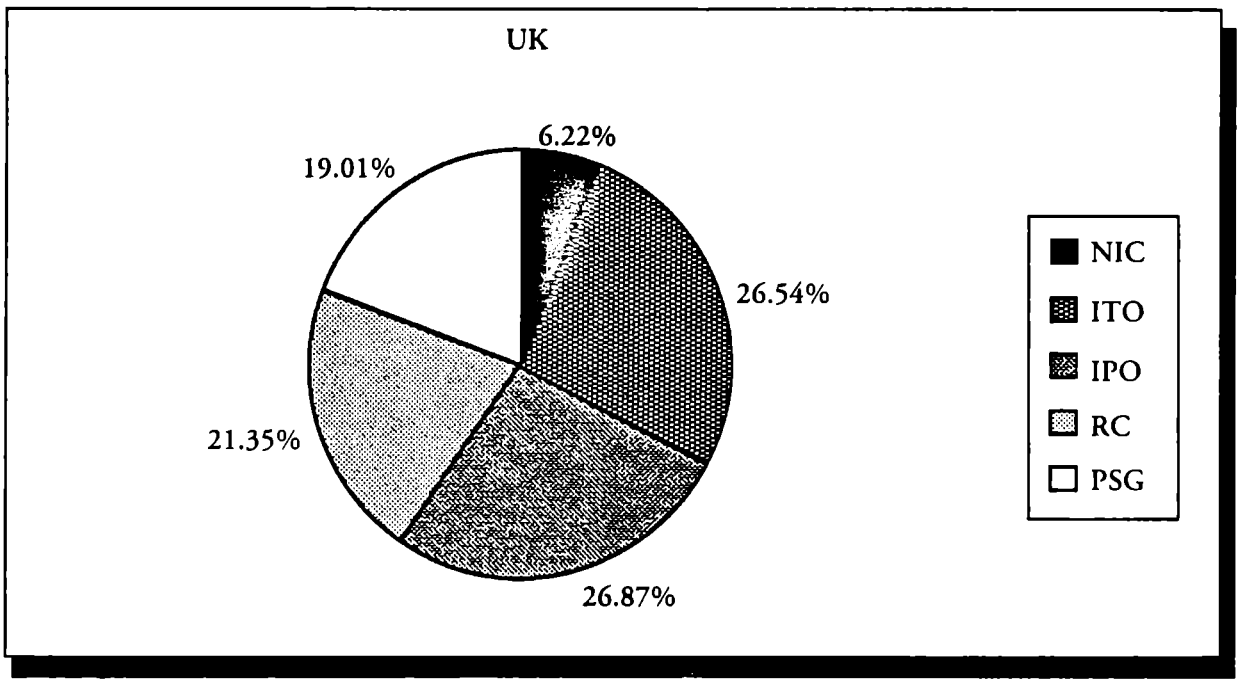

Figure 4 Dispersion of producers' subsidy equivalent of the CAP: UK (1986)

Source: Harvey and Hall (1989) as for Figure 5

A recent overall assessment of the aggregate effects of the CAP market support is illustrated in Figure 4, (Harvey and Hall, 1989). The alternative policy against which the CAP is assessed is the total removal of all common market intervention and support instruments, by both the EC and all other industrial countries. While this prospect may seem remote, it is both the accepted textbook comparitor against which to measure the effects of the policy, and is also the objective of the current round of GATT negotiations on agricultural trade. Under this alternative, the EC moves to free trade with the rest of the world. Domestic market prices would generally fall under this alternative, so other things being equal, output would fall, and consumption in the EC would rise. As a result, the EC would export less to the world market and would import more, and thus one would expect world market prices to rise. The equilibrium world prices under this alternative become the effective market prices in the Community for both producers and consumers, so that the former lose and the latter gain as a result of the policy change.

Because the Community no longer supports market prices, all the Community budget net expenditure on the policy is also saved, to the benefit of the taxpayers. The net cost to society is a measure of the economic cost of the CAP compared to free trade, though

this net cost involves either implicit or explicit compensation to the losers, the producers in this case, if the free trade policy is to be regarded as an improvement in economic welfare terms. Figure 4 shows the component parts of the Producer Subsidy Equivalent (PSE) for UK agriculture, where the PSE is effectively the total taxpayer and consumer burden of farm support through the CAP in the UK.

The component parts are as follows:

1. An instrument cost (NIC) which accounts for the fact that the support instruments require processing and storage of the farm products whose benefits do not directly improve farm returns;

2. An international trade offset (ITO) which reflects the consequence of EC support leading to greater exportable surpluses than would otherwise be the case, thus depressing world market prices and leading to additional expenditure by taxpayers to dispose of the surpluses. These additional expenditures do not improve farm returns from their potential position without the support mechanisms, merely representing a particularly complicated way of shooting oneself in the foot;

3. The international policy offset (IPO) which represents the extent to which current spending on farm support is necessary to offset foreign competitors' support of their own farm sectors, which also depresses world commodity prices as the reference price for UK agriculture;

4. The resource cost of the policy instruments, which accounts for the traditional economic, welfare or deadweight costs associated with interfering in the market mechanism. These arise from the encouragement of domestic production and hence the use of increasingly valuable resources and inputs to agriculture rather than their use elsewhere in the economy, and also the losses to consumers and users of farm products arising from the higher price of food;

5. The producers' surplus gain (PSG) which represents the addition to agricultural gross product (assuming perfectly elastic supplies of inputs to the industry) resulting from the policy.

Of particular note in Figure 4 is the estimate that more than half of the taxpayer and consumer burden of the CAP system of support is 'wasted' in offsetting the effects of both the CAP and competitors' support policies on world markets. It is these effects which give the impetus to the current round of international trade negotiations on agriculture under the GATT, and to which it might be expected that the EC will have to make some positive response. The results of this analysis suggest that the current PSE being paid by consumers and taxpayers throughout the Community amounts to a 17% tax on food, expressing the PSE as a ratio of food expenditure, and provides support to the farming sector, as producers' surplus gain equivalent to 23% of agricultural gross value added (Figure 5).

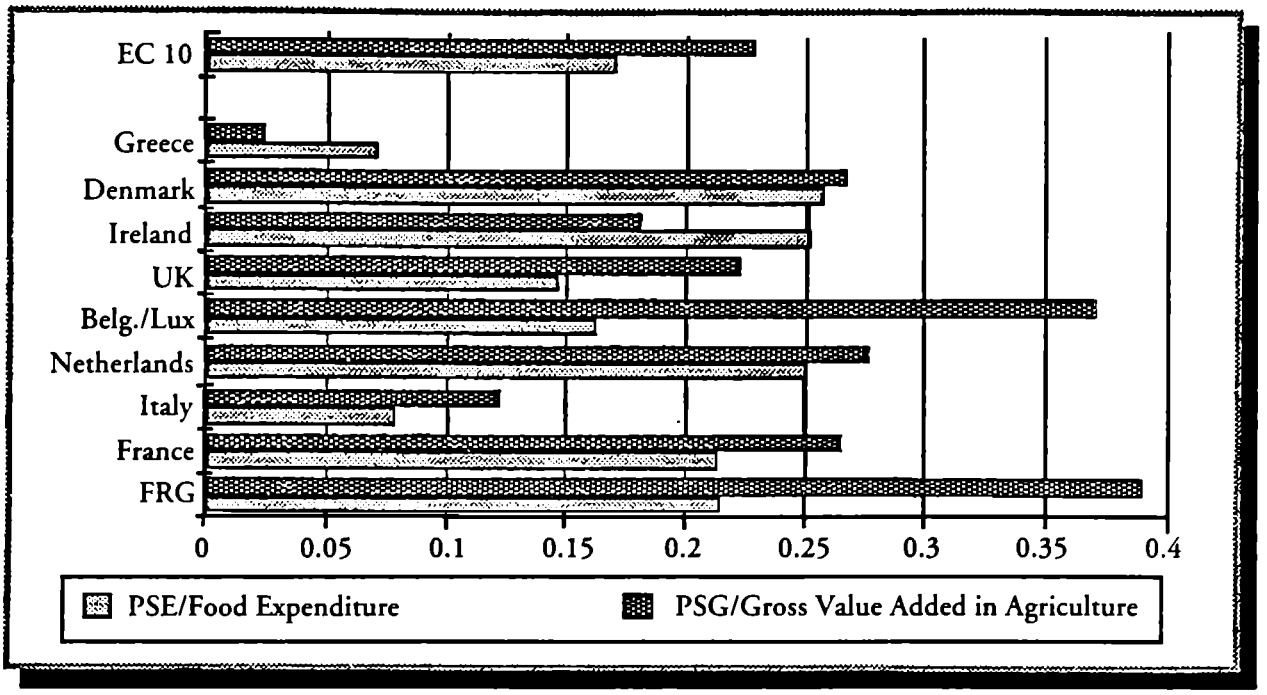

Figure 5 Cost and benefits of the CAP (1986)

The estimates reinforce a familiar observation that the effects of the Common Agricultural Policy are far from common throughout the Community, either between member states or between interested groups of society. Given that these results also demonstrate the other well known feature of the policy – its inefficiency in achieving its major objective of supporting farm gross returns – it is not beyond the realms of possibility that European Community policy makers will reform the policy towards a more liberal market system.

The implications of these estimates for agricultural output in the UK are shown in Figure 6, which provide a more readily understandable picture of the consequences of the removal of market support for the farm sector. These estimates take account of the probable adjustments which would be made by the industry in coping with such a dramatic reduction in the general level of product prices and profitability. Reductions in prices would be followed by reductions in production in most cases, as is shown in the Figure, though output levels are remarkably stable, given the estimates of production response based on previous empirical work included in the Newcastle CAP model (Thomson, 1986).

The logic of these limited changes in output levels is that reductions in product prices lead to reductions in input costs, both through more economical use of these inputs and through reductions in their prices as agricultural demand falls, and through adjustment of capital and other fixed costs, especially through a downward revision in their prices (including land prices). Thus farming incomes may not be radically affected in the longer run, although existing owners of agricultural land and capital will suffer capital losses. What is more important, however, is that these relatively small changes in farm output do not imply substantial reductions in farm areas and land use in agriculture. This is a different story than the one apparently being told by the estimates of surplus land in agriculture, discussed in chapter 2 above. In part, this is due to the more realistic estimate of the extent of surplus production which lies behind these estimates than is implied by current surpluses.

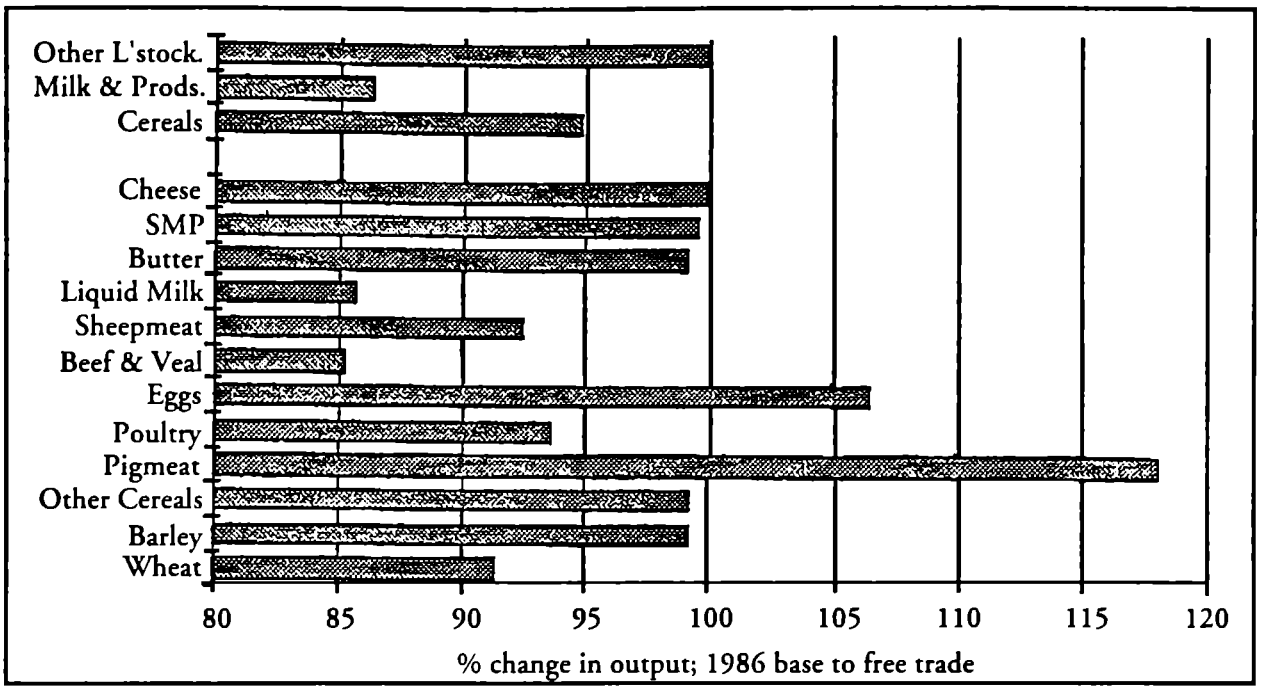

Figure 6 Proportional changes in UK agricultural output: 1986 base to multilateral free-trade

Without some compensation payments, there are clearly very significant implications of this scenario for the economic well-being of the existing farm population. The production responses estimated here assume that the losses suffered by the farm population will be borne by a devaluation of farm assets, especially land, as well as a reduction in the level of intensity. Clearly in making this adjustment, many existing farmers would be bankrupted, but their assets would be taken over, at substantially lower prices, by new farmers and by those large and wealthy enough to survive the financial storm, and land generally would be expected to remain in agriculture, albeit at a somewhat lower level of production than currently. However, some areas with alternative and remunerative uses would probably leave pure agricultural production. The identification of these areas is dealt with below, but they are likely to include field margins, wet patches etc. in areas of good quality land as well as the land in those whole regions more usually identified as 'marginal'.

Since the logic of these estimates appears to contradict common perceptions of the effects of support on agriculture, some further discussion of the mechanisms and implications is warranted. The dynamism of the industry, and the rapid technological and structural change which it produces, practically guarantee that farmers will be able to produce increasing amounts of food and fibre, with increased productivity of all their resources and consequent reductions in cost. In a competitive and unsupported market, this process would result in ever lower prices to farmers and consumers alike. But it would also result in considerable hardship for the more marginal farmer, and for those who, often through no fault of their own, find it difficult to adjust. It would inevitably result in some farms being forced out of business as their more competitive neighbours expand. The consequences, both for the people themselves and for their rural environment, are increasingly regarded as cause for concern.

However, attempts to halt this process by supporting market prices so that the weaker farmer can stay in business are bound to fail. Such policies do not repeal the forces of competition in the industry, they merely push those forces in new directions. Increases in profitability for all farmers will increase the demand for land and fixed plant and equipment and will push their prices up. Prices set by large input supply companies will also tend to increase. The end result is that farm costs increase as output prices are increased. Farm incomes, as the difference between returns and costs, are still under pressure. Figures 7 and 8 tell the story as far as the UK is concerned.

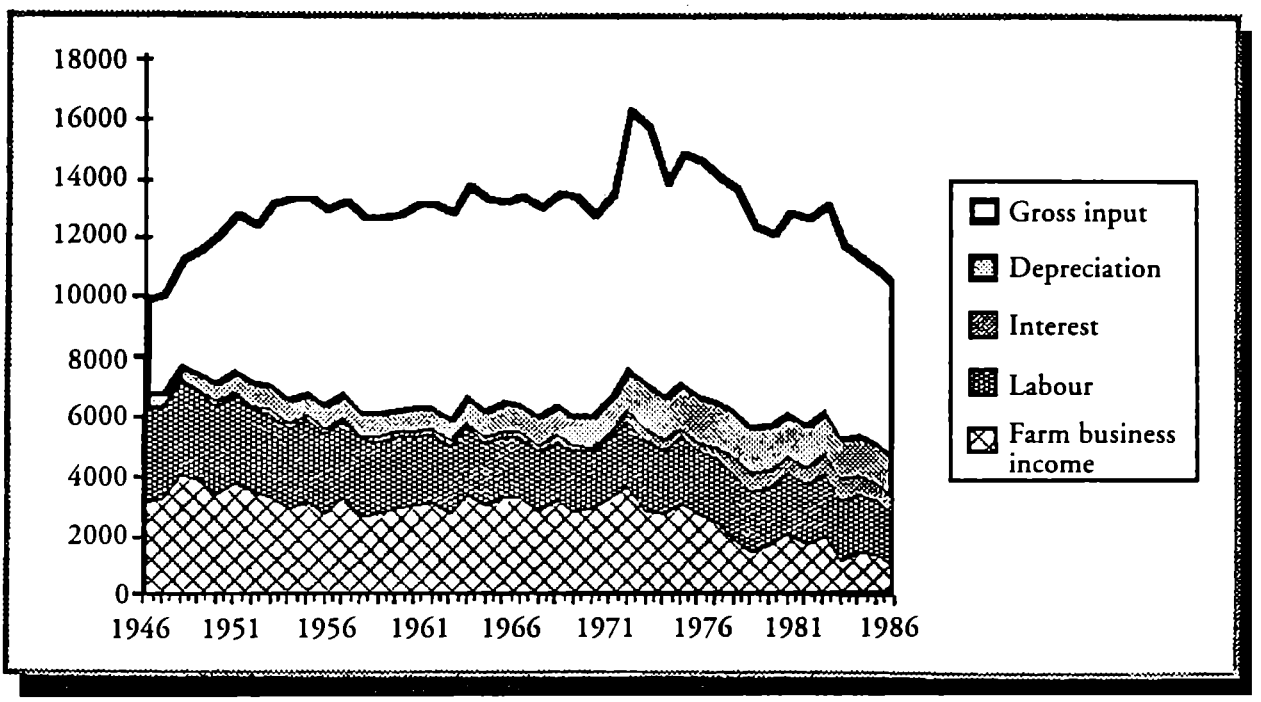

Figure 7 Real value of UK agriculture gross output and component parts, 1946-1987
Source: MAFF, HMSO, Annual Reviews of Agriculture and author's calculations

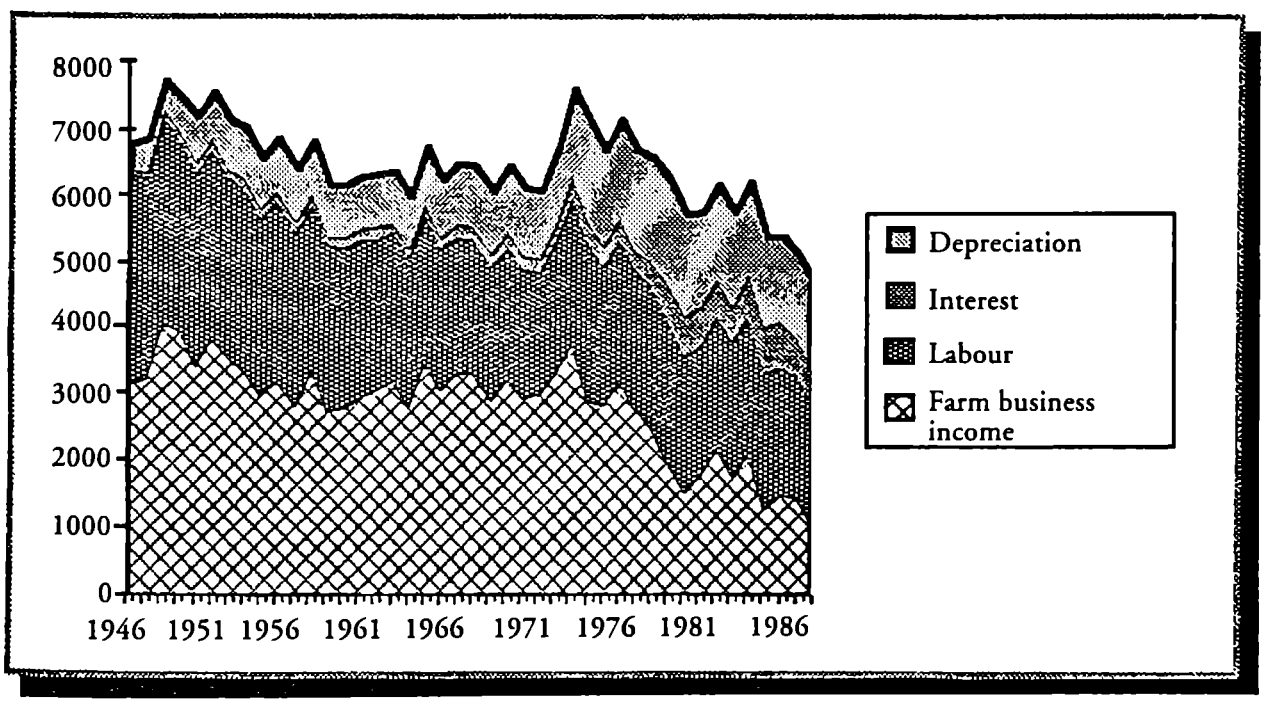

Figure 8 UK agriculture gross product and distribution, 1946-1987
Source: MAFF, HMSO, Annual Reviews of Agriculture and author's calculations

Over the whole post-war period, real gross output and gross input for the industry have shown very weak upward trends while gross product (gross output minus gross input) has shown a stronger downward trend, and that for farm business income (net farm income plus land rents) showing an even stronger downward trend. Over the period 1971-1988, since entry to the European Community and the CAP, all four trends are more strongly downwards, with that for farm business income the strongest trend.

All of this has happened in spite of a general increase in the level of public support to the industry, which almost tripled in real terms between 1972 and 1984 when the additional costs borne by the users and consumers of farm output is taken into account. Furthermore, at the market level, production continues to increase as the industry becomes ever more productive. The increased supply, occurring at increasingly uncompetitive prices, cannot find markets without subsidies and the cost to the public purse grows without limit. Attempts to restrict this expenditure by squeezing prices puts us right back where we started. That, in a nutshell, is the current state of the CAP.

The corollary at the farm level explains many of the current trends in land use and use-practices. As competition for land and other fixed resources in the industry increases, so their prices rise, and the returns which are necessary to justify these higher prices increase. To increase returns, it is necessary to increase the intensity of production, by using more inputs to increase the yields per hectare, for instance. Similarly, hedges, wetlands, and unproductive woodlands become expensive luxuries, since the cost to the individual of converting these areas into productive farm land becomes less than the cost of buying or renting additional land. This arithmetic has been reinforced until recently by government grants for such land improvements.

The prices of farm output have been prevented from falling as much as they otherwise would have done by the CAP support policy, in spite of the fact that they have actually fallen in real terms over the period. As existing farmers have tried to get bigger and potential farmers have tried to enter the industry, so they have bid up the prices and incomes of the resources they need to carry on the business. Those farmers who were fortunate enough to own these resources at the beginning of the period are now richer, but the new entrants have had to rent or buy them at increased prices and are no better off, and in many cases worse off in real terms, than they were before we joined the Common Market.

The opposite side of the same coin is that farming net incomes, or profits, have been squeezed by increasing costs so as to dissuade more people from trying to come into the industry, and to discourage existing farmers from ever more increases in output. It is a hard fact of economic life that if prices are prevented from falling to meet costs in the market place, then costs will increase to meet prices. Otherwise the extra profits would simply attract more and more people into the industry. The problem facing the industry and its policy makers is one of reducing the cost structure of the industry without putting undue pressure on the residual incomes to the people employed directly in the industry.

There are two further implications of this effect. The competition between farmers for profits will tend to favour the larger and already competitive farmer, at the expense of his smaller and more economically vulnerable neighbour, so exacerbating the inequality of income distribution within the farming sector, again amply illustrated by the

development of income distribution patterns within EEC agriculture over the last decade. Furthermore, this factor will result in a greater tendency for the farming industry to be concentrated in fewer and fewer hands and in larger and larger units, as well as encouraging more and more intensive production on the increasingly valuable land base. While the implications of these tendencies for the rural environment are not well understood, there is a strong presumption that they lead to environmentally damaging consequences.

The second implication is that the ancillary industries and the owners of the assets employed in agriculture are the eventual recipients of the support initially intended for the farmers. It is far from clear that these gainers are deserving of this support, but removal can be expected to generate considerable opposition, allied to the farmers themselves who would clearly suffer substantial losses during the adjustment process to the lower price regime. Even in the arid world of economics, the prescription for price moderation towards free-trade is only valid as 'objective and value-free' if the appropriate compensation of the losers, i.e. the farmers, is actually carried out. If it is not, then the existing farm population loses, and it cannot be concluded that everyone is better off. However, as soon as this compensation package is defined, it amounts to a new agricultural policy, and therefore needs to be separately identified and evaluated against the current policy in terms of the gains and losses.

So what would happen if support were removed? Total returns and margins would be reduced. Possibly 25% of existing farmers would be bankrupted. Only those with freehold possession of their land and with low or zero capital liabilities would be able to survive, and then only on lower incomes and margins. The result would be that only the largest farms would be able to provide sufficient income to support the farm family, and then only if hired labour could be released. Many farmers (and their sons and daughters) would be likely to try and leave the industry even if not actually forced out. The result would be a substantial fall in the prices of land and other assets. Input suppliers would find their markets evaporating and the ensuing competition to retain market share would reduce prices and margins of machinery, chemicals, fertilisers and so on. Bankruptcy would spill over into the dealerships and upstream industries. In short, the reduction in income earning potential in the industry would force all those with better alternatives elsewhere, and those without the resources to cope with the fall in returns, to leave the industry. Reduced incomes must be shared by fewer people if incomes per head are to be maintained. The employment results of the CAS analysis (CAS, 1986) suggest that some 20% of the current farm labour force (farmers and farm workers) would be redundant simply on the basis of the lower output of the industry. There could be a further 8% redundancy in the associated upstream and downstream industries.

With dramatically reduced margins in conventional agriculture, there would be some pressure for farm amalgamations and for further exploitation of economies of scale, which would be associated with larger operating field sizes, removal of hedgerows, bigger machinery, and possibly wider use of specific chemicals and improved fertilisers. Such responses would enable farm families to remain fully employed with satisfactory incomes in agriculture. Since land prices would fall, as they are already with the falling returns and increased uncertainty in agriculture, amalgamation would be a viable option in some cases. However, since land would no longer be as valuable, it would no longer make economic sense to farm it as intensively; yields and stocking rates would tend to be lower

than if the support for market prices was retained. Full-time farms would still find substantial advantages from specialisation, and 'prairie' or ranch type agriculture might prove viable under such conditions. However, the economies of specialisation and the associated reliance on purchased inputs (especially fertilisers) might be somewhat reduced under substantially lower output prices. The economies associated with complementarities between grazing livestock and arable production might become more attractive under lower margins, especially in those areas where mixed farming is at an advantage because of soil type and climate. Recycling animal wastes and feeding home-produced grains might be more attractive, especially if technological advance assists with the costs of such practices.

The situation would look rather similar to the thirties as far as agriculture is concerned. Farms would become available at knock-down prices, and some less advantaged areas would tend towards dereliction, reverting to range-lands, sheep-walks and generally extensive farming. While the good farm land would still command a premium over the poorer land, it would not pay to continue with the highly intensive (and expensive) production systems which are typical now. The picture of isolated pockets of highly specialised and intensive operations, on the very best land, with everything else reverting to wilderness is not consistent with the behaviour of an unrestrained market place for land, farm assets and resources, and agricultural products. Under such conditions, it would prove profitable to farm virtually all the available land in some way or other, providing that the capital investment were kept to minimum and the production practices were developed so as to reduce costs and maximise net margins rather than to maximise output. Only in the event that certain land became absolutely worthless in agriculture would land actually revert to wilderness. The prospects for this, even in the 'less favoured areas' are remote.

However, there is a major difference between the current situation, even with no agricultural support, and that of the thirties. The rest of the economy (at least those in work) is relatively rich and prosperous. Non-farmers are keen to live and play in the countryside. The lower are farm prices, the easier it is for non-farmers to buy farm land and equipment. Once purchased, it is likely to be used in some form of agricultural production, albeit at lower levels of intensity and in different ways than at present. Similarly, the existence of a prosperous population outside agriculture, which is keen to take part in and buy rural goods and services, provides opportunities for farm families to diversify their interests and to maintain income by putting their resources (land, labour, management, plant, equipment and buildings) to uses outside conventional agriculture. In addition, changing consumer tastes and preferences, particularly in favour of 'healthy', 'natural' foodstuffs, provides opportunities for farmers to expand their operations downstream towards the final consumer, increasing the 'value-added' to their products and increasing the income earning potential of their activities.

The growing interest in rural landscapes and habitats, expressed in the membership and income of such organisations as the RSPB, also provides an outlet for those who own and operate rural resources. There are a number of potential opportunities for the integration of farming with other activities, especially for new entrants to the industry and for new landowners. Economies of specialisation and of scale may well tend to be less significant than economies of integration and of complementarity. The production practices associated with cereal production on farms which are developing recreation (e.g.

shooting), organic crops for 'natural' home produced flour, or for feeding to home-farm free range chickens or outdoor pig units, are likely to be quite different to those associated with specialist, large scale cereal production, but not necessarily any less economically viable. In addition, the attraction of more trees, especially for amenity, sporting, recreation and landscape purposes, to such a farming sector is likely to be greater than to the currently highly intensive system.

There is no doubt that fewer people would obtain a full time living from conventional agriculture, but that there would be substantial opportunities for part-time income to be earned off-farm. The pressures may not result in whole-time redundancy for farmers and their labour. They could equally well result in more part-time employment, and the substitution of other income sources for the reduction in farm earnings. The structure of the industry would be altered dramatically, with many new entrants with radically different ways of earning their living (as in the thirties), and with the commercial supremacy of the big and intensive farms dramatically reduced compared with the current situation. While the New Zealand experiences (low-cost and extensive production) would be relevant to some farm situations, the density of population and the prosperity of the UK economy would mean a rather different rural and agricultural pattern in the UK. It is tempting to assume that current technologies and production practices are here to stay, and that increased pressure on farm returns will lead to ever greater pressures to increase intensity and land productivity. In some cases at the farm level, such reactions may make commercial sense for a while. However, to argue that this response will dominate the aggregate picture is to argue from the particular to the general and is misleading.

Although there is a strong temptation to look for new crops and products to replace those which are currently in excess supply, and a hope that R&D will provide these saviour or saviours for the farming industry, most informed commentary is of the view that there are no new products on the horizon which will fill this role at anything other than a marginal level (Agriculture EDC, pp 46-60 provides a useful and comprehensive survey, based on previous work). This report concludes that novel products could account for up to 200 000 ha possibly as an addition to, rather than a replacement of, projected tillage areas. There is, in the longer term, a promise (threat?) that the biotechnological revolution will produce modified plants and animals capable of producing feedstocks for a new biochemical industry. This could transform the countryside in a truly science fiction fashion. However, such a revolution would also produce the capability for the production of the same chemicals from yeasts and other microorganisms in a completely controlled-environment industrial system. The competitive position of agricultural versus biochemical plant production of the necessary feedstocks is an open question. There is no natural presumption that the agricultural production systems would necessarily be the less economically efficient.

There is absolutely no doubt that removal of the current market support measures for agriculture would have a severe effect on the existing agricultural industry. There is also little doubt that the existing policy is costing society rather more than it needs to pay, particularly since it is paying for the production of unwanted and unsaleable surpluses and is also associated with environmentally damaging practices and with a distribution of benefits to the larger (and generally wealthy and therefore 'less-deserving') farmer. The cold analytical calculus suggests that society as a whole could be better off without the

support, in the sense that the gainers (the taxpayers and consumers) could afford to compensate the losers (farmers) and yet still be better-off. The problem with this prescription (apart from the credibility of the results) is that is has so far proved impossible to design an acceptable compensation or alternative policy package which will satisfy the major interests involved. It is not yet clear that an 'unsupported' agriculture would necessarily produce a 'better' rural environment. There are some features of an agriculture without government which would appeal to conservationists, particularly lower production intensity and lower land prices allowing easier purchase or renting of land for purely recreational or conservation purposes. On the other hand, there are features which may cause some concern, especially the relative profitability of cereals and some serious problems for lowland livestock operations. Whether or not the possible influx of people who want to live in the countryside and the growth in part-time farming operations would be of environmental benefit is very much a matter of judgement.

However, it is clear that the prospects for the complete elimination of product market support under the CAP are relatively low, though it should not be forgotten that this is precisely the objective of the current round of GATT negotiations on agriculture. The scenario painted in the preceding paragraphs serves to identify the most extreme pressure on the existing land utilisation pattern, not to form a prediction. Continued price pressure is inevitable, and may even be increased for some commodities. This pressure may either result from reductions in support prices directly, or through co-responsibility levies and tighter intervention conditions. In either case, the tendencies outlined here will be important, though not in such extreme form as would be the case in the event of complete removal of price support. More likely development of the policies involve the introduction of quotas and limits on the right to support. So long as these are freely tradeable, and are not tied to land, then their effects on land use-practices is likely to be similar to that outlined for the support elimination. This is because the quotas would achieve a value equal to the value of the support they confer, and other assets, including land required for farm production would lose value as they would under the equivalent price reduction, with the same results for land utilisation. The major difference between quotas and price reductions is that consumers and users would not benefit from quotas, and by the same token, the loses to farmers can be restricted to the over-quota production rather than being suffered on the whole of production. As a result, the pressures from quotas will be weaker than the equivalent price reduction and the consequences less dramatic. At the margin, however, the effects would be broadly similar.

The same is not true of quotas that are tied to land. In this case, those areas of land with quota would be farmed at current levels of intensity, and with similar practices, while those areas without quota would tend to be farmed less intensively or to move out of conventional farm production. If the intention is to create a 'split' landscape, with some areas of intensive 'commercial' agriculture, and other specific areas where environmental objectives are met, then the land-tied quota, in some form or other, is the way to achieve this. If there is a desire to 'plan' the countryside, then again the land-tied quota is an appropriate instrument. Otherwise, there is every reason for farmers, environmentalists and others concerned with the appearance and development of the countryside to resist this instrument, except in very special circumstances such as Sites of Special Scientific Interest (SSIs).

THE PRICE OF FARM LAND AND ITS SOCIAL OPPORTUNITY COST*

Land use decisions at the farm level

The farming sector is a large collection of individual farm operators (upwards of 120 000 depending on definitions of farmers) with the exception of a few conglomerates and limited company operations. Any theory which seeks to explain the actions of this heterogeneous collection of individuals, many of whom farm partly as a way of life, is bound to be a gross simplification. However, farms are like any other business in the sense that outgoings cannot exceed income indefinitely. Thus, in this treatment, farmers will be considered as profit maximisers.†

According to this theory, land will be allocated to each crop and product so that the marginal return generated in each use is the same. Those farmers able to generate greater returns from land than their neighbours will tend to expand at their neighbours' expense. Ability to generate relatively high returns depends on a number of different factors such as better management skills, greater efficiency through more appropriate levels and mixes of inputs and other resources, possibilities of exploiting economies of size and scale (by spreading existing capital plant and equipment over larger areas and more output) and so on. The opportunity cost of farmer's capital resources also plays a part in land purchase decisions. Individual differences arise because of tax considerations, requirements for capital gains versus income and attitudes to risk. In addition, family considerations and the preferences of individuals for particular occupations (like farming) colour the individual valuations of various forms of capital return, so that some people are willing to place a considerable non-monetary value on remaining (or becoming) farmers, which translates to higher valuations on the land necessary to remain in or join the business.

Demand for farm land at the industry level

At the industry level, the implication of the economic theory is that land will remain devoted to agricultural activities unless the returns to be earned from alternative uses exceed those to be made in agriculture (by those who can earn the highest returns, including non-monetary returns in agriculture). Changes in the use of land are conditioned by the returns which it can earn in different occupations, and the land market can be expected to produce a price for land which reflects its earning ability in the best possible use, as constrained by planning and policy decisions as well as by the characteristics of the land itself. Since land is heterogeneous 'market price' will reflect the mixture of different qualities which are actually traded in period, and the average price is an imperfect representation of the constellation of price individual and specific parcels of land. However, it is common, in the absence of detailed information on each and every transaction, to concentrate on the possible factors and weights in the determination of the average price of land, in effect assuming that distributions of different qualities and of different motives for the purchase and sale of land do not change over time.

*This section draws heavily on Harvey, 1989b

†Following e.g. Cowling, Metcalf and Rayner (1970) p9-11.

Land prices and the farm land market

Land is a stock as opposed to a flow. Neoclassical representations of stock markets on the concept of 'Reservation' Demand*, that is: the demand for a stock is exhibited by continued ownership of the stock as well as through actual purchases over a period of time.

Consider such a stock, available in strictly limited quantity (Qf), all of which is currently owned by someone, Figure 9. The representation of the market for this stock in dimensional terms implies that land is measured in homogeneous units, somehow accounting for quality differences in the underlying and indestructible properties of the soil. Current owners will be prepared to sell their holdings, or part of them, depending on the price. The 'offer curve' represents this response, more being offered for sale by current owners as price of the stock is increased. By implication, any stock which is not offered for sale at each price is retained by the existing owners, and is in that sense 'demanded' (or 'reserved') that price. Thus the reservation demand curve (RD) is the mirror image of the offer curve. Non-owners are willing to buy some of the stock, while existing owners are willing to add to their holdings, depending, *inter alia,* on the price of the stock. This demand for additional 'excess' stock (over and above current holdings) is represented as XD, normally sloped with respect to price.

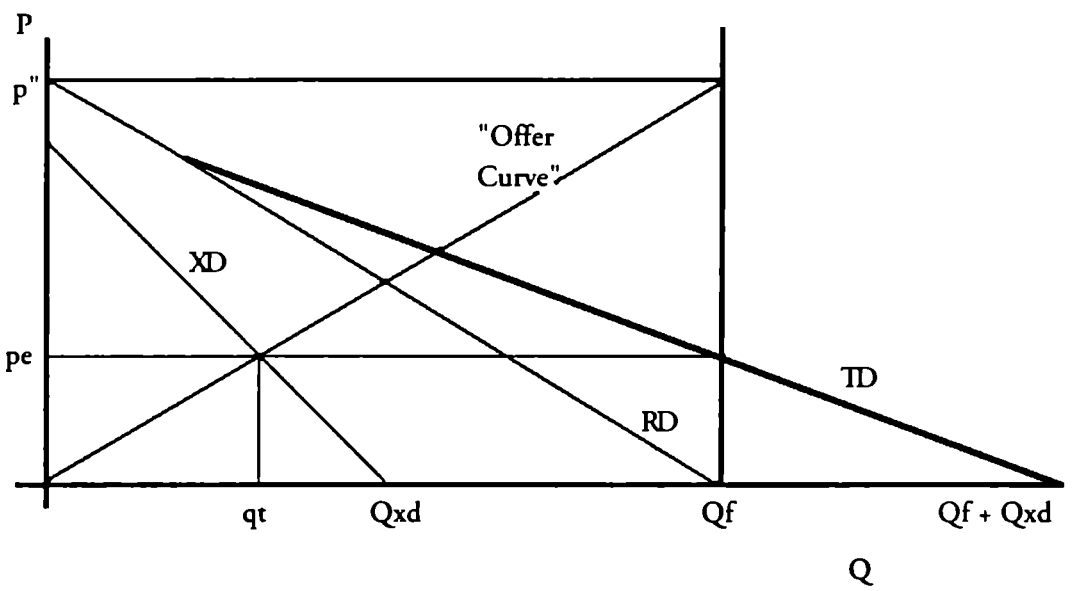

Figure 9 The theory of the land market

Total demand (TD) is the horizontal sum of the excess demand (XD) and the reservation demand (RD) at each and every price, and the intersection of the TD curve with the fixed supply determines the equilibrium price of the stock, at **pe**. By definition, at this price XD is equal to the quantity of the stock offered for sale by the current owners. Hence **qt** will be traded between the buyers and the sellers.

Once all transactions have taken place, owners of the stock will be content to remain the owners at the equilibrium price, *ceteris paribus,* and this condition defines the equilibrium for the stock market. No current owner will be prepared to sell unless the

*Stigler (1952) p152f.

offer price is above pe, while bids for extra stock will only be made at prices less than pe. Hence the XD and offer curves shift as transactions occur so as to intersect at the vertical axis at equilibrium, at which point no further trade will occur. In other words, the maximum bid price exhibited by anyone (owner or non-owner) for additional units of the stock (given by XD) is below the minimum selling, offer or acceptance price exhibited by current owners of the stock (given by the 'offer curve').

This analysis can be conducted in terms of the stock itself, or in terms of the flow of services from that stock, with the price in this case being the 'rent'. The rent is expected to be related to the stock price through the discounted present value of the perpetual rental stream, although this relationship might be complicated since it involves expectations about future rental streams and also about future opportunity costs of capital, as affected by taxation considerations.

The effects of agricultural markets and support policy on land prices

The theoretical derivation of land price determination provided above does not identify the precise effects to be expected of changes in farm product or input markets, other than to identify the importance of rents to be earned in agriculture. Neoclassical production theory leads us to expect increases in product prices, reductions in input prices, and reductions in opportunity costs of capital, labour and management to increase the marginal value product (and hence rent) of land, and thus to increase land prices. The analytical derivation of the precise relationships between these variables is dependent on the form of production or cost function employed and its characteristics, especially the substitution possibilities between products, inputs and resources. In addition, the demands for land, capital, labour and management, as well as those for inputs, will be jointly determined with the supplies of farm products, which suggests that a rigorous specification would involve the estimation of a simultaneous, non-linear and highly constrained system.

However, the literature has not yet identified this system. Given that land prices are dependent on farming returns, and given that these returns depend on the support provided to the agricultural sector through the Common Agricultural Policy, it is clear that land is likely to be 'over valued' in agriculture compared with its value under free market conditions. Farm policies are under review within the current round of GATT negotiations and that the European Community's CAP is constantly under pressure for reform. The social opportunity cost of land in agriculture is the price of land which would obtain under freely competitive agricultural markets, assuming that present farm policy is not intended to increase the value of farm land. Both for projection/prediction purposes and for social cost/benefit analysis of rural land use change, a model of land prices which reflects these factors is required.

Harvey (1989) shows the development of the following model of price determination for England and Wales vacant possession farmland over the period 1947 to 1987:

$$P_t = \underset{(4\text{-}90)}{0.54\ GP} + \underset{(3.49)}{139.1\ INF} + \underset{(5.35)}{201.1\ INT} - \underset{(4.81)}{380.6\ CGA} + \underset{(4.56)}{0.57\ P_{t-1}}$$

Corrected R^2 = 0.93
DW = 2.11
F ratio=101.43

where: t statistics are shown in parentheses;
P is the current land price in real terms;
GP is Agricultural Gross Product in real terms (£m);
INF is the inflation rate (derived from the GDP deflator);
INT is the real interest rate;
CGA is the crops and grass area (England and Wales) – the supply of land;
P_{t-1} is the lagged endogenous variable, reflecting an adaptive expectations specification of the explanatory variables.

The estimated land prices from a similar equation estimated over the period 1947-1981, using actual values for the explanatory variables in the post-estimation period, compared with actual land prices are shown in Figure 10.

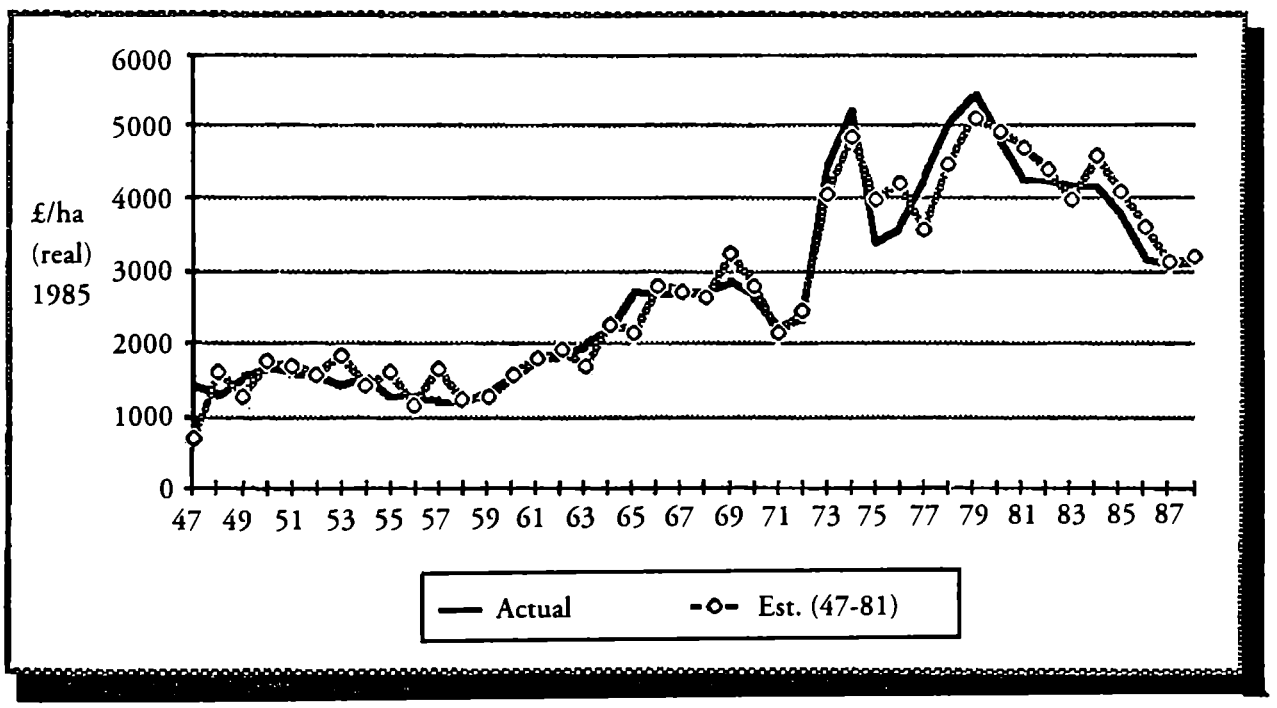

Figure 10 Actual and estimated land prices (England and Wales): 1947-1987

The model performs reliably, especially outside the estimation period. The parameters of particular interest here (on gross product, supply and the lagged endogenous variables) are robust under a substantial change in the estimation period and are thus reliable, though the parameter on real interest rates is both counter-intuitive and counter-theoretical and needs more research into the dynamics of the market. The land price elasticities, evaluated at 1986 values of the variables, with respect to real Gross Product are 0.90 in the short run and 2.10 in the long run, while the implied elasticities of land demand, derived through the crops and grass parameter, are -0.84 in the short run and -0.36 in the long run. The differences between the short and long run are provided through the parameter on lagged price. These elasticities are the inverse of the

elasticities of land price with respect to changes in supply: -1.18 in the short run and -2.73 in the long run, since supply is considered as perfectly inelastic with respect to price in this model. The root mean square errors for this model are 13.5% within the estimation period and 8.04% over the prediction period (1982 -1987). The latter rises to 12.9% when predicted rather than actual lagged prices are used.

An exactly similar equation applied to Scottish land prices yields the following results:

$$P = \underset{(2.88)}{0.29\,GP} + \underset{(6.06)}{155.6\,INF} + \underset{(6.06)}{155.6\,INT} - \underset{(3.28)}{1305.9\,CGA} + \underset{(2.77)}{0.30\,P_{t-1}}$$

Corrected R^2: 0.87; DW: 2.4; F ratio: 50.5

Although the model does not perform quite as well with the Scottish data as for England and Wales, it is still reasonably respectable. Clearly more work needs to be done on the analysis of land prices, especially at the regional level. In particular, the definition of agricultural gross product should properly be defined consistently with the region being considered, which has not been done here owing to lack of time and resources. However, the implications of the Scottish model as it stands are that the elasticities of land prices, evaluate at 1987 values of the relevant variables, are 1.67 with respect to gross product and 2.53 wit respect to land supply in the long run, where the long run in the Scottish case is rather longer than for England and Wales (more than 3 years compared with less than 2). The general performance of the Scottish model is illustrated in Figure 11.

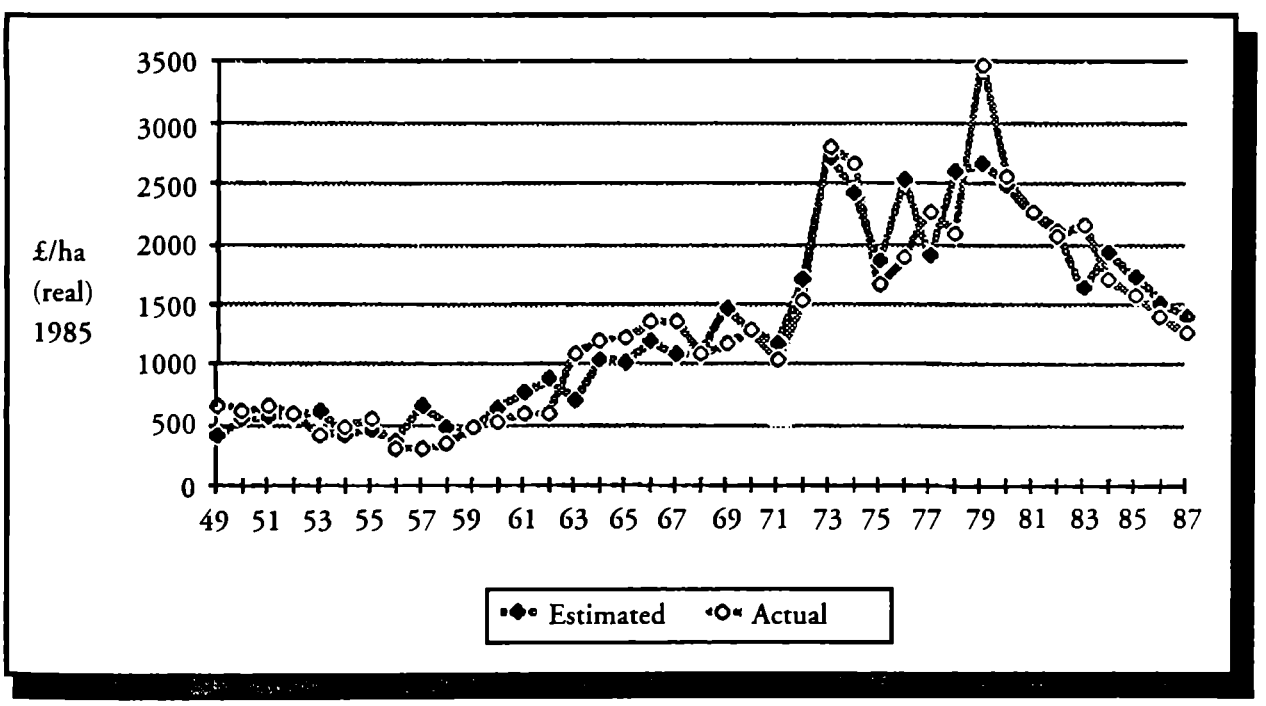

Figure 11 Actual and estimated Scottish land prices: 1949-1987

However, much of the interest in forestry has applied to the hill and upland areas rather than to the lowland areas. The same land price model applied to Scottish land prices for the hill and upland land results in the following estimates:

$$P = 0.124\ GP_t + 98.65\ INF + 110.8\ INT - 363.6\ CGA - 134.2\ RGA + 0.23\ P_{t-1}$$
$$(2.26) \quad (6.78) \quad (6.48) \quad (1.1) \quad (1.4) \quad (2.04)$$

Corrected R^2: 0.90; DW: 2.33; F ratio: 59.04;
where RGA is rough grazing area in million ha.

Inclusion of both crops and grass area and rough grazing area in the equation reduces the significance of both variables, but does not alter the remaining parameters or the performance of the model overall. Neither of the area variables is significant and the significance of the parameter is improved substantially with the removal of one or other area variable from the equation. However, the consequence of so doing is to assume that all the supply effects are captured by the single definition of land supply rather than the combination of rough grazing and crops and grass areas. The implied elasticities, evaluated at 1987 values of the variables, are 0.98 with respect to gross product and -1.80 with respect to total land area (-0.96 for crops and grass and -0.84 for rough grazing) in the long run, which in this case is about 4.5 years, implying slower adjustment of hill land prices than for lowland prices. Changes in gross product for the UK have less impact on hill land prices in Scotland than for land in England and Wales or for lowland areas in Scotland, as would be expected.

Two implications of these results are worthy of particular note. First, the removal of land from agriculture, for whatever purpose, will increase the value of the remaining land. Suggestions that up to 1 million hectares of land is currently surplus to agricultural requirements do not accord with this model of the farmland market. Removal of 100 000 hectares of crops and grass in England and Wales would raise land prices in real terms by 2.7%, and by 15% in Scotland, reflecting the relative scarcity of such land in Scotland. According to these estimates, removal of 100 000 ha of hill land in Scotland would increase the price of the remaining stock by 3%. It can be inferred from the two Scottish equations that removal of crops and grass land for other purposes (including forestry) is likely to have much greater effects on the price of the remaining agricultural land stock than is the removal of rough grazing, again as would be expected. Thus, increasing incentives will be necessary to persuade the industry to release more land. In addition, removal of land for development purposes will increase the value of the remaining stock quite apart from the effects of 'rolling over' capital gains from development into the land market, reflecting lower opportunity costs of this capital compared with new investment in the market because of tax provisions.

The second implication concerns the effects of support policy on land prices. Harvey and Hall (1989) provide an estimates of the extent to which agricultural gross product in the UK is greater than it would be under conditions of multilateral free trade: 22%*. This

*The estimates are based on the hypothetical situation in which the EC and all other industrialised countries eliminate all policies which distort domestic production and consumption levels, and thus distort trade flows and world prices. This situation is the objective of the current round of GATT negotiations (the Uruguay round) on agriculture, so is not a completely academic scenario. Nevertheless, most commentators agree that it is rather unlikely that such a situation will apply to UK agriculture in the near future.

estimate provides a basis in principle for establishing the extent to which UK land prices are higher than they otherwise would be because of the CAP and other countries support policies. This is the textbook comparitor against which the effects of the current policy can be measured. On the basis of the England and Wales model, land prices are inflated by 46% because of support policy, on average. On the basis of the Scottish results, Scottish land prices are overvalued by 36% as a consequence of the present CAP, while hill land in Scotland is overvalued by just over 20%.

At 1986 land prices, this increase amounts to £655 ha^{-1} in England and Wales According to a rent equation estimated by Lloyd, this inflation in land prices is associated with a policy induced rent increase of £34 ha^{-1} on average. Applied to the UK agricultural land area, this amounts to £631million which in turn is 55% of the estimated producers' surplus gain. Thus the implication is that just over half the support provided to the agricultural sector through existing price support policies is capitalised in land values and rents. The remaining 45% is therefore distributed through the factor and input markets to other resources used directly or indirectly by the industry.

However, before reaching this conclusion two major questions must be considered. First, would the demand for rural land for other uses prevent farmland prices falling to the full extent indicated here in the event of elimination of farm product support? If so, then the free-market price of land is higher than this estimate suggests. Second, the reasons for agricultural policy and the support provided to the farming sector might be associated, albeit imperfectly, with a social valuation of the agricultural activity as a use for land, in which case the 'free-market' price of land would again be higher than indicated here, and in the limit would be approximated by current market values of land (in the case where all support is interpreted as an expression of the social requirement for rural land to be used for agriculture).

Although it was suggested in Chapter 2 that non-agricultural demands for land were unlikely to result in large areas of farm land changing use, this is not quite the same thing as arguing that non-agricultural demand for land is insignificant in determining farmland prices. The demand for land as 'living space', often associated with desirable properties and views, is not incompatible with continued use of the land for farm purposes. Even within agriculture, there is likely to be consumption element to land purchase and ownership, in which the value of the land is independent of its potential future earning capacity. As the market price of farm land falls in real terms (under conditions in which policy support is progressively removed, for instance), so this consumption element will become more important as a determinant of the total value of land. So too is it more likely that new entrants to the land market will purchase land for its consumption and living characteristics rather than its earning capacity. In the limit, it is this valuation which will put a floor in the farm land market. In addition, economic and income growth in the rest of the economy mean that this element is likely to increase in importance, which will tend to raise the floor price through time. To some extent, the desire to own land for its own sake is completely independent of the use to which it is put, thus affecting forestry land identically with agricultural land. But it is also possible that living space and ownership values depend on the physical appearance of the land and that traditional agricultural landscapes, with hedgerows and copses etc. are more highly valued than either ranks of Sitka spruce or acres of intensive cereals. However, there are no estimates available at present to substantiate these hypotheses.

To the extent that agricultural policy has an objective of retaining rural landscapes in their agricultural format, current support for farming will raise farmland prices above their free-market levels. Given the acceptance of the political process as the appropriate mechanism for the defining social benefits and costs, this 'inflated' value would represent the social opportunity cost of using farmland for other purposes. Neither the objectives set out in the 1947 Agriculture Act for the UK nor the objectives of the EC Treaty of Rome for the Common Agricultural Policy specify directly the occupancy and use of rural land for agricultural purposes as an objective, which might be sufficient evidence to conclude that such an objective does not exist for either the UK or for the EC. However, the Treaty of Rome objectives do make reference to maintaining the agricultural population, which implies continued use of rural land for agricultural purposes while a similar interpretation of UK objectives is also possible. Nevertheless, it is possible to design support instruments which would achieve the objective of maintaining the agricultural population without distorting the land market, through direct income support of farmers rather than through product price support. In this case, estimates of farmland prices in the absence of product price support could then be used as indicators of the social opportunity cost of land.

However, the history of product price support has led to the capitalisation of support measures into the price of farmland, and as a consequence, landlords are reluctant to agree to the removal of such support, at least without appropriate compensation. To the extent that the political process grants these interests power in public decision making, and to the extent that this process is granted the status of defining social objectives and hence social opportunity costs, then free-trade estimates of farmland prices underestimate the social opportunity cost of farmland, notwithstanding that current market prices overestimate this cost.

It could be argued that release of small areas of land from agriculture in the present policy climate raises a rather different question, namely, what is the social value of the loss of a small area of farmland. The logic of the theory provided above applies at the farm level, since land prices are determined at the margin, and (given regional and quality differences around the average price of farm land) the market price applies to each and every parcel of land, just as the price of shares applies to each and every share. The observation that if every acre of land were to come on the market at the same time, then the price would be very much lower than the observed market price is not relevant. For all land to be put up for sale, the factors determining demand for land would have to fall dramatically, thus altering the present market conditions and thus the social valuation of land.

If we wish to account for the effects of agricultural policies on farmland values, then it is necessary to define the conditions which would exist without these policies. Given that existing policies are an accident, not a genuine reflection of society's view of the worth of agricultural production, then removal of all the effects of all policies should produce the social value of farm land. It could be objected that the use of multilateral free trade as the appropriate 'no-policy' situation is both unrealistic and unnecessary. If only a small parcel of land is removed from agricultural use, then world prices would not change and no policy change would be necessary. What, then is the appropriate value of this land? Surely it would reduce the surplus production from agriculture and would therefore be a social benefit to remove it rather than a cost?

There are several steps involved in the analysis of this situation. First, surplus production in the EC or the UK is not valueless. It is worth the current world market price, aside from any additional social valuation which might be put on domestic production rather than foreign supplies, for either self-sufficiency or security grounds. Second, there is the question of the appropriate world market price to choose, since world prices are highly variable as are international exchange rates which have to be used to convert world prices to domestic currency. The question is one of the long term value of foregone production (conversion to trees typically means foregoing the land's use for anything up to 60 years). What is the long term projection for world agricultural prices? This is a difficult question. However the answer is unlikely to be today's price except by accident. Perhaps an average of the last 3 years' prices would suffice, though this implicitly assumes that the world market conditions which gave rise to this price are sustainable in the long term. However, present conditions in agricultural world markets are not sustainable. In any event, current world prices are not an accurate reflection of the prices which would rule if the policy were eliminated (which is the implication of choosing world prices to value the output rather than current domestic prices).

Could it not be argued that removal of a small quantity of land and its associated production (i.e. a marginal change) will not affect current world prices at all, and that therefore the elimination of policy is not relevant? If this argument is adopted, then the question changes from the social opportunity cost of land to one of the 'second best' solution to an already distorted market, which will be returned to below.

Third, other inputs and factors of production are used to produce this agricultural output, so the world market value is not all ascribable to the land on which it is grown. From society's point of view, the opportunity cost of these other inputs and factors is defined as the most they could earn (or produce) elsewhere in the economy, including elsewhere in agriculture. Given that these earnings (as with the earnings of the land) are currently influenced by agricultural policies, the current values of these inputs and factors are not the appropriate measure of the opportunity cost of these resources from society's point of view. In the absence of farm policies, where would these resources go and what would they earn? Again, this is not an easy question to answer without very extensive analysis. However, if it is inappropriate to take current domestic values of the products as the correct measure of the social value of these products because of farm support policies, it is also inappropriate to take current market values of the inputs and resources as measures of social value of the released resources. These resources earn additional 'rent' because of the support policies, in exactly the same way that land does. The loss of this rent would not be a gain to society, so cannot be deducted from the no-policy value of the product to arrive at the residual social earnings of the agricultural land.

In fact, the purpose of the exercise is to determine the present value of future rent stream which the particular parcel of land would be expected to earn in agriculture in the absence of farm support policies. This precisely the same thing, in theory, as determining the price of farmland in the absence of policy, which was the purpose of the analysis earlier in this section. Given a reasonably competitive agricultural industry, costs of production, including rents and owners' labour, capital and management returns, exactly exhaust total revenues. This is so because competition between farmers for the inputs and resources they require for production will drive prices of these inputs and factors up so as to eliminate all profits over and above those necessary to keep them employed in the

industry rather than move to another occupation or use. In many cases, the present gap between EC domestic prices and current world prices, at current policy supported yield levels, is greater than the annual rent for land, so that deduction of all costs (other than land) from returns valued at world prices would indicate a negative return to land. But, why is the return to land treated as the residual in this calculation? Why not treat the return to owner's capital, management and labour as the residual and value land at its current market rent? In fact, the social values of all factors and inputs, including land, are lower than indicated by their current market valuations because of the farm policy. The question is by how much? There is no justification for assuming that land is the sole residual value and that the social opportunity costs (social values) of all other factors and inputs are correctly measured by their current market valuations. Whitby, Willis and Whitby provide examples of the methodology suitable for micro-level applications of these principles. However, there is great difficulty in establishing the appropriate discount for inputs and factors of production other than land at this level of analysis, as is pointed out in these papers. It is likely that a regional or land-type analysis of farmland values along the lines indicated in this section would prove more tractable than extensions of the micro-level analysis.

However, if the argument is one of determining the 'second best' solution to an existing problem of policy-created surplus production in agriculture, then a different set of considerations apply. Under these circumstances, it is necessary to treat existing agricultural policy as inviolate other than non-price means (including land transfer) of restricting output to domestic consumption requirements. The question is then one of identifying those areas of land which are least efficient (highest cost) as far as agricultural production is concerned and encouraging their transfer from agriculture to some other use. The world price of output is not relevant to this question. The answer depends solely on the variation in domestic costs of production. In economic terms, the question becomes one of identifying the location of production at the top (right hand end) of the supply curve, and then designing policies to eliminate this high cost production.

Neoclassical production theory suggests that this production will have the highest marginal cost and should be eliminated first. Unfortunately, it is very unlikely that this high cost production will all take place in one location. Marginal costs are expected to increase as the intensity of production increases, while every farm is pictured as trying to maximise profits, and therefore producing up to the point at which marginal Cost is equal to marginal revenue (or domestic support price in this case). This suggests that each and every farm will be producing some high cost output. Thus the most efficient reduction in output will involve each producer being encouraged to cut back, as is done through a quota mechanism. In so doing, marginal areas in each farm may become available for alternative uses and some farms may become unviable as single businesses. If so, then either they will go out of business and their land be amalgamated with an adjoining unit, or alternative income sources will be added to the farm business through diversification to ensure the survival of the business. However, the next section attempts to identify those areas of the country most likely to release land from agriculture under a range of future policy conditions.

If quotas on production of some form are adopted as the second best solution to a presently distorting policy, then it is possible to implement these quotas as rights to produce at the supported price, so that they are freely tradable and not tied to land. In

this case one would expect the value of the quota to capture all the benefits of agricultural support, with the prices and values of all other factors and inputs falling to reflect the underlying market conditions. Thus land prices would fall, as would earnings on farm labour and capital as well as prices of those inputs in less than perfectly elastic supply to the industry (machinery, fertilisers, chemicals). In this case, estimates of the resulting price of farmland could be made by following the same procedures as identified above.

LAND USE, AND ITS DETERMINATION

This section turns to some preliminary estimates of areas of land which could be declared redundant by agriculture under certain policy conditions in the future, and to the identification of the sorts of land which might be made available for other uses. It draws heavily on a CAS study (Harvey *et al.*, 1986).

A basis for the analysis of possible future changes is as follows:

1. to identify the policy options available to the European policy makers, and thus to identify specific 'policy scenarios' from this continuum of options to illustrate the policy possibilities;

2. to estimate the agricultural production consequences of these options;

3. to examine the likely impacts of these consequences on land use and the rural environment. Inevitably this analysis involves somewhat arbitrary and artificial categorisations and classifications of the likely consequences, particularly at the rural environment end. However, the analytical framework developed here does allow for the extension and modification of these classifications to meet different needs. The reliance of the analysis on European policy changes assumes that the UK will remain within Europe and that the European Policy will continue to be the major determinant of the economic circumstances surrounding agriculture into the foreseeable future.

The policy scenarios

For the purposes of this analysis a set of four major policy scenarios were defined as follows:

1. The 'Fundamentalist' scenario is defined as a trend projection of the previous history of the policy and of the other developments in the farm sector, without any introduction of further quantitative limits, on the implicit assumption that the inevitable budgetary pressures which such a policy would generate would be solved through the expansion of the budget. It is at least arguable that the last increase in the European budget (or 'own resources' in Eurojargon for the EC's budgetary funds) could only have been agreed by the member states in association with the immediate and drastic action to curtail CAP expenditure by the introduction of milk quotas. Some similar action, on cereals and probably beef, is likely to be necessary before any further increase in 'own resources' can be contemplated. It may even be that a more fundamental shift in the policy will be required the next

time round. However, the Fundamentalist scenario as described for this study does represent one of the extremes of the spectrum of possible policy scenarios. It may also represent the common public perception of the future of the CAP, encapsulating the hopes and fears associated with a continuation of 'present trends'.

2. The 'New Libertarian' scenario is defined as the elimination of all European price support programmes (the European free trade option) including, for example, the hill livestock allowances currently paid for herds and flocks in the 'Less Favoured Areas', with the presumption that the future development of the industry (its structure, production practices and levels) would be left entirely to market forces. The New Libertarian scenario is, therefore, the other extreme of the possible policy spectrum. The analysis of the 'naked' market forces scenario can be justified on the grounds that: a) at least some of the criticism of current agricultural practices from an environmental perspective blames the CAP for the 'desecration' of the countryside; and b) a 'redirection' of support from pure farm production of conventional products towards environmental 'goods' and practices within an overall budget constraint implies a reduction (in the limit, an elimination) of the current market support system. The implications of both these arguments can be conveniently examined with the aid of the New Libertarian scenario. While in practice, such a policy would almost certainly be associated with some form of compensation or adjustment payments, the scenario examined here does not include any such payments. Rather, the results of examining the New Libertarian scenario allows the effects of the elimination of the support system to be described, and thus provides some evidence for the sorts and levels of adjustment and compensation programmes which would be necessary.

3. The 'Pragmatic' scenario is defined as additional co-responsibility levies (i.e. producer taxes on production) on those products in surplus, but otherwise no change in current policies. This is analytically indistinct from price reductions on the production side except that the smallest farms could be expected to be exempted from the levies and retain their current prices, while the budgetary pressure is eased at least until the political acceptability of levies prevents further increases in the rates of levy.

4. The 'Crisis' scenario is defined as quantitative restrictions on the level of supported output of, particularly, cereals and beef as the products in most serious 'structural imbalance'. The initial distribution of the quantitative restriction between countries and eventually between farms is of crucial importance in the specification of this scenario. In the event that the restriction simply applies at the national level, then analytically the option could collapse to the co-responsibility levy. If reflected back to the farm level then the ease with which farm quotas can be transferred between farms will have considerable implications for the land use and environmental consequences of the option. In this study, the quotas are assumed to apply at the farm level, and it is also assumed that the limits are freely transferable between farms, i.e. that the quotas can be bought and sold.

While this set of possible scenarios is highly restricted, it does represent both the extreme possibilities, the Fundamentalist and the New Libertarian, and the most likely future

course for the policy, as a combination of the Pragmatic 'deteriorating' to the Crisis (which could be identified as the Main Case). The reasoning behind this specification is detailed in the CAS report *(op. cit)* and also in Harvey, 1989c, which also includes a schematic representation of the subjective probabilities associated with the policy options. The specification of the policy scenarios, and their impacts at the aggregate level on farm prices, are summarised in Table 4.

Table 4 Summary of policy scenarios.

Policy scenario	*Price changes (to the farmer)*	*Quota limits*	*Other changes*
Fundamentalist:	None, other than trend changes	Milk only, as '85	None
New Libertarian:	European Free Trade e.g. cereals - 22% L'stock products - 40% Milk - 32%	None	None
Pragmatic (Co-responsibility levies)	Beef -5%	Milk only, as '85 Cereals - 15%	None
Crisis:	None @ EC Consumption levels (+ Milk)	Cereals and Beef	None

The impacts of the scenarios on land use

The effects of these policy scenarios on land use decisions and farm production activities, as well as on employment within and related to the agricultural industry form the major part of this study. The identification of the likely production responses within the farm sector, and the relationships between production decisions and the associated land-use and employment outcomes are pivotal to the rest of the analysis. It has to be said the 'state of the art' in this area is not very firmly established. There is room for considerable debate about the likely farm production responses to changes in policy settings, and also about the implications of these responses for land use and employment.

1. Aggregate Farm production response to policy changes specified under the four scenarios is estimated in this study at the aggregate, national level by using an existing model of the CAP (Thomson, 1987). This model makes use of previous research on commodity production response at the aggregate level, and provides estimates of production and consumption changes (*inter alia*) resulting from policy and price changes.

2. Implied Land Use changes These national estimates do not include the underlying changes in land use (and hence the regional distribution of production changes) and production intensity which would be associated with aggregate output changes. In

order to estimate these, a land allocation model has been developed specifically for this project (the 'Reading' model). This analysis relates the aggregate production levels to the underlying land base, specified as the amounts of land of particular production characteristics and possibilities available in England and Wales. The model 'allocates' the production levels specified at the aggregate level to the various land classes (and thus to regions etc.) on the basis of maximising the 'gross margins' (as total returns less variable costs of production, eg fertilisers and chemicals, fuel and repairs). In addition, the Reading model is used to verify and calibrate the land classification system and the associated land uses (cereal production, livestock numbers etc.) to the aggregate production and financial statistics provided by the MAFF (e.g. in the Annual Review White Papers under the 'Departmental Net Income Calculation').

3. The Classification System. The description of the land base used in this study is provided by the Land Classification system developed by the Institute of Terrestrial Ecology (ITE). This classification system has the advantage of being explicitly related to the landscape, wildlife and natural resource characteristics of the countryside, detailed on the basis of intensive surveys of a statistical sample of the total land area, so that at least in principle changes in land use associated with changes in agricultural policies can be traced through explicitly to changes in the countryside down to the field level. It has the additional advantage of being based on the (kilometre) grid square of the whole country, so that the results can be aggregated or disaggregated to any level, though the statisdcal reliability of the results for the smaller areas (a single National Park for instance) would not, at present, be sufficient to be useful. For the purposes of this study, however, it does allow for the presentation of the results at the regional level.

The production characteristics and financial consequences of agricultural land use are already identified with the physical and ecological data on the land classes in the ITE system. In principle, it should be possible to use this information to analyse the consequences of changing product prices etc. on land use. To do this, some rules or relationships determining how land use would change in response to changes in policy and product prices are needed. The Reading land allocation model provides such a set of rules or criteria which determine the re-allocation of land between enterprises in response to changes in gross margins (i.e. the difference between the total receipts from farm production and the variable costs (fertilisers, chemicals, etc.) of that production).

Figure 12 shows the actual 1984 situation in terms of the distribution of land uses by DoE standard regions in comparison with the distribution which the 'Reading' model suggests would maximise the total gross margins earned by these farming activities (the 'optimum'). The actual 1984 situation is shown as the central overlaid narrow columns in each case, while the 'optimum' allocation (shown as the wide, background columns in each case) is determined assuming no change in prices, costs or aggregate production levels, but merely through the reallocation of land types among the competing enterprises. It will be seen that the model suggests that there is already some scope for the release of agricultural land (identified in the graph as 'LGM', or 'low gross margin' land and amounting to some 1 million hectares in total, 9.5% of the current agricultural land area).

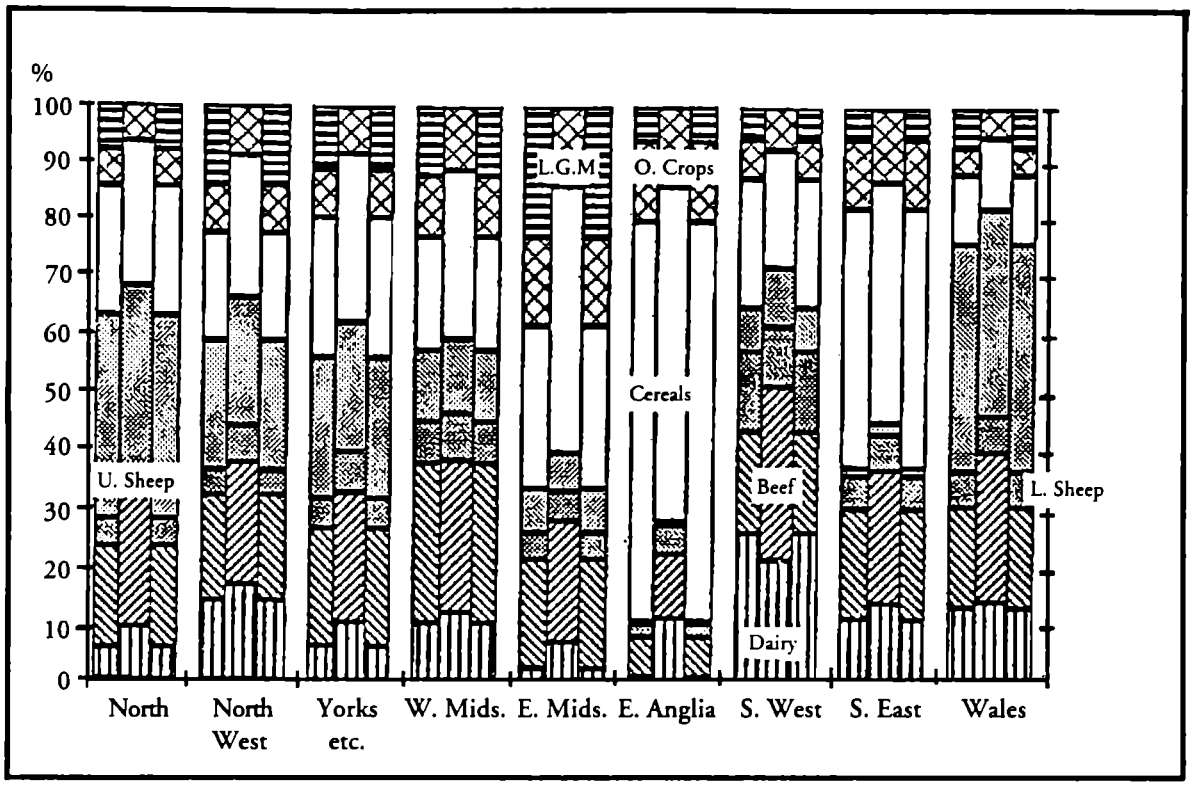

Figure 12 'Optimum' land use distribution (wide) versus 1984 land use (narrow columns)

Source: Harvey *et al.*, (1986)

The proper interpretation of this result is that it is an indication of the inaccuracy and simplicity of the current model. There is little sign that anything like this amount of land is currently 'looking' for alternative uses. It is true that there are some areas of land in all regions which are being turned over to alternative uses such as leisure, housing, recreation, environmental 'reserves' under management agreements, forestry and woodlands and so on, but not on this scale. As an indication of the meaning of the release of land suggested by the model, the total gross margin for England and Wales as a whole is only improved by 1.7% as a result of the reallocation and release of land under the 'optimum' result. This minimal improvement is not likely to provide a sufficient return to warrant the adjustment and capital investment costs associated with the re-allocation and the implied additional intensification of the remaining land area.

However, the relative tendencies may be valid and the results may be taken as providing an initial indication of the sorts of land use which are 'under threat', in the sense that these areas could be among the most likely to be transferred to alternative uses, since they have the lowest value in agriculture. It appears that the East Midlands region as a whole is the region most likely to see some significant transfer of land under the 'status quo' option, with lowland livestock and cereal areas being reduced in favour of some other use. Following this region, the North West, Yorkshire and South Humberside, and the West Midlands regions also show signs of some release of farm land, concentrated in the lowland livestock farms and in the cereals area. Lowland livestock use is also under some threat in the Northern region, while the non-dairy lowland livestock uses are the 'marginal' activities in the South West and Wales.

There are clearly many more factors which determine land use than the few very simple factors included in this prototype model, and it is not possible in this study to decide how important these omitted factors might be. There are two major omissions: the model does not include the fixed costs associated with livestock, plant, machinery and equipment or buildings; no non-agricultural land uses (e.g. woodlands, tourism and leisure uses, building and living-space land uses) are included in the model. As a consequence, all of these results must be taken as preliminary, tentative indications rather than hard and fast projections. In view of the fact that the model does show some substantial land use changes even before the policy scenario changes are introduced, the 'policy run' results are shown in comparison with the 'optimum' land uses rather than the actual '84 distribution. This allows the separate effects of the policy changes themselves to be isolated from the internal behaviour of the model.

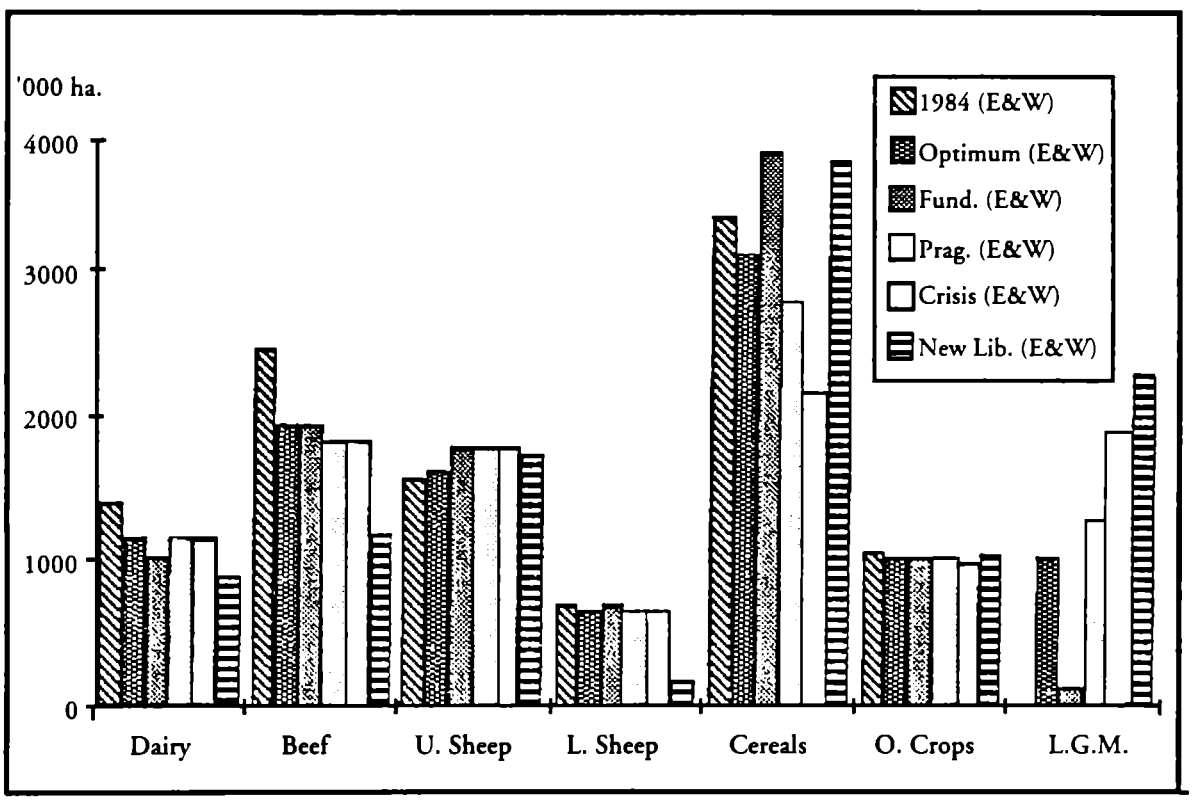

Figure 13 Land use in England and Wales under various policy scenarios

Figure 13 shows the aggregate results of the model for the principal land using agricultural activities dealt with in the modelling exercise for each of the scenarios identified in this study, including the 'optimum' identified above. The most obvious and important feature of these results is that the lowland livestock activities, especially beef and dairy, but also lowland sheep in the New Libertarian case, suffer the major reductions, while the upland sheep activities (perhaps often associated with the 'marginal' land in the public mind) remain remarkably stable regardless of the policy scenario considered, even in the case of the New Libertarian scenario which is the one case in which all Less Favoured Area (LFA) payments are assumed to be removed. The total gross margins earned on upland sheep would clearly suffer considerably, but the model shows that there is some economic advantage to be gained by continuing to use this 'marginal' land even in the 'worst' agricultural scenario imaginable. It is to be expected

that the market place would reflect this economic advantage in time, though the ability of existing farmers to survive the economic storm would depend on their current asset and wealth situation, as well as their ability to draw on non-agricultural earnings. In many cases the survival of the upland sheep activity would depend on new farmers taking over from the existing shepherds and their families.

The second implication to be drawn from Figure 13 is that the cereals area (perhaps identified by many as the major culprit in the apparent deterioration of the rural environment in recent years) would tend to increase under both the Fundamentalist and the New Libertarian scenarios. The latter result is largely a consequence of the improved prices and margins to be earned on cereals relative to livestock in this scenario, in spite of the general reduction in all margins and prices. This relative change may be exaggerated in this case because of the particular prices used to define the New Libertarian scenario. Nevertheless, the economic logic of the New Libertarian scenario does suggest that this change in relative prices would be maintained, if to a smaller extent, under different world market conditions. In this sense, then, it may well be inappropriate to blame the existence of the CAP for the increase in the cereal area, since the removal of the CAP could well increase, rather than reduce, the cereals area (although perhaps at generally lower levels of intensity and thus cost, to be consistent with the lower prices for cereals).

The third implication of the aggregate results is that under all but the Fundamentalist scenario there is an increase in the area of land which can be described as 'gross marginal', that is the 'low gross margin' land. The model identifies this land as 'surplus' in the sense that using it, given existing technologies as reflected in the definition of the production activities through yields, stocking rates etc., detracts from rather than adding to the total gross margin to be earned from the land. However, it is not gross margins which provide incomes and savings (to be invested in land purchase for instance), but net margins, i.e. net of fixed costs. As the industry adjusts to a situation of reduced gross margins, so one would expect that these fixed costs would also be reduced as investment is reduced and labour is released. Time and resources did not permit the extension of the model (which would have been considerable) to include the fixed costs to provide the net margin configuration. The level of intensity would also be expected to fall in these circumstances, and while some land might be released to alternative uses (not included in this preliminary analysis), this LGM land might be better thought of as the 'hectare equivalent of the potential reduction in intensity which could occur over the whole land base'. The consequences of this potential reduction in intensity are obviously likely to be significant for the environment and wildlife, but this aspect of possible changes in land use has not been properly explored in this preliminary study.

An indication of the scope for intensification and extensification is provided by the gross margins computed by the model. The results show that the total gross margin for England and Wales changes by the following proportions compared with the 1984 situation: Fundamentalist +9.9%; Pragmatic -10.8%; Crisis -10.0%; New Libertarian -40.9%; New Libertarian (with the added restraint that all the land should be used and none released) -43.6%. It is clear that an improvement of less than 3% in total gross margin associated with 'allowing' the model to release land in the New Libertarian scenario is unlikely to provide an adequate return on the additional capital and fixed costs associated with the implied more intensive use of the land. In other words, the result provided by the model for the release of land is likely to be a consequence of the

simplified model structure rather than a reliable indication of the probable consequences of the scenario itself, though the result can be taken as an indication of the potential for more extensive systems to be employed, as already noted.

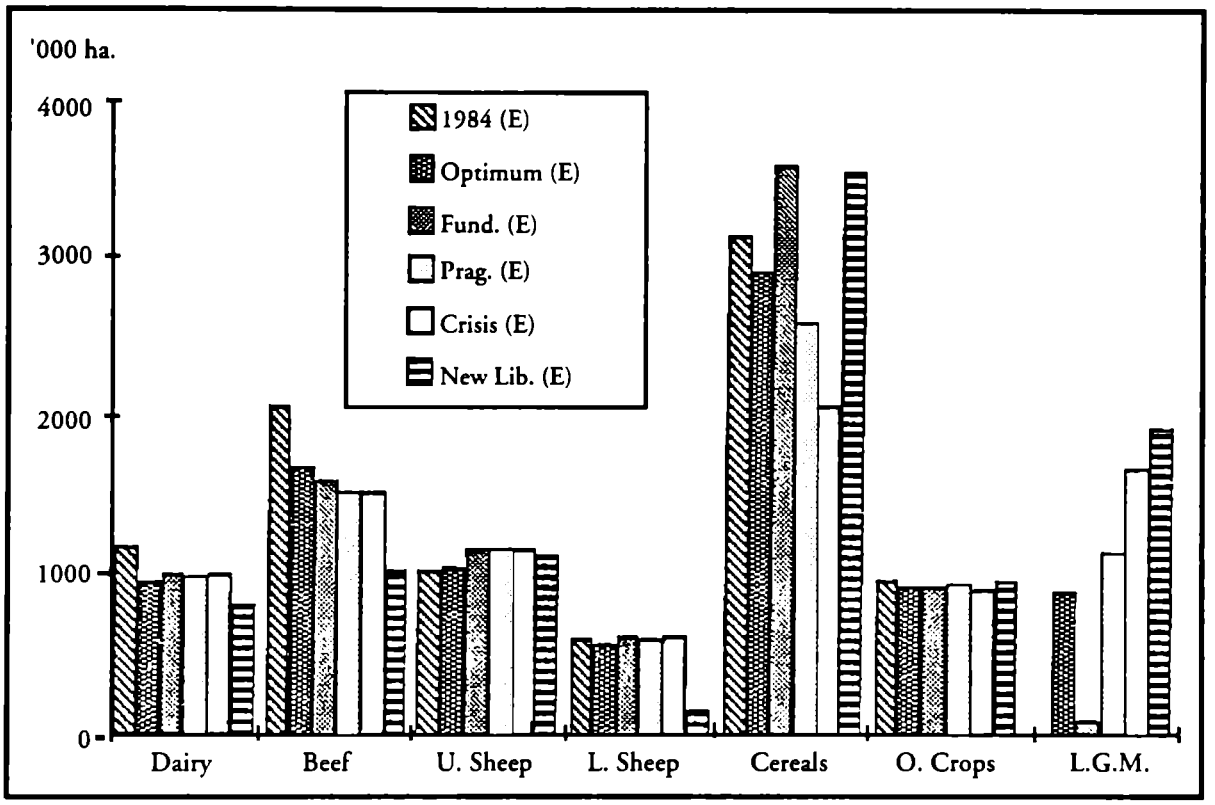

Figure 14 Land use in England under various policy scenarios

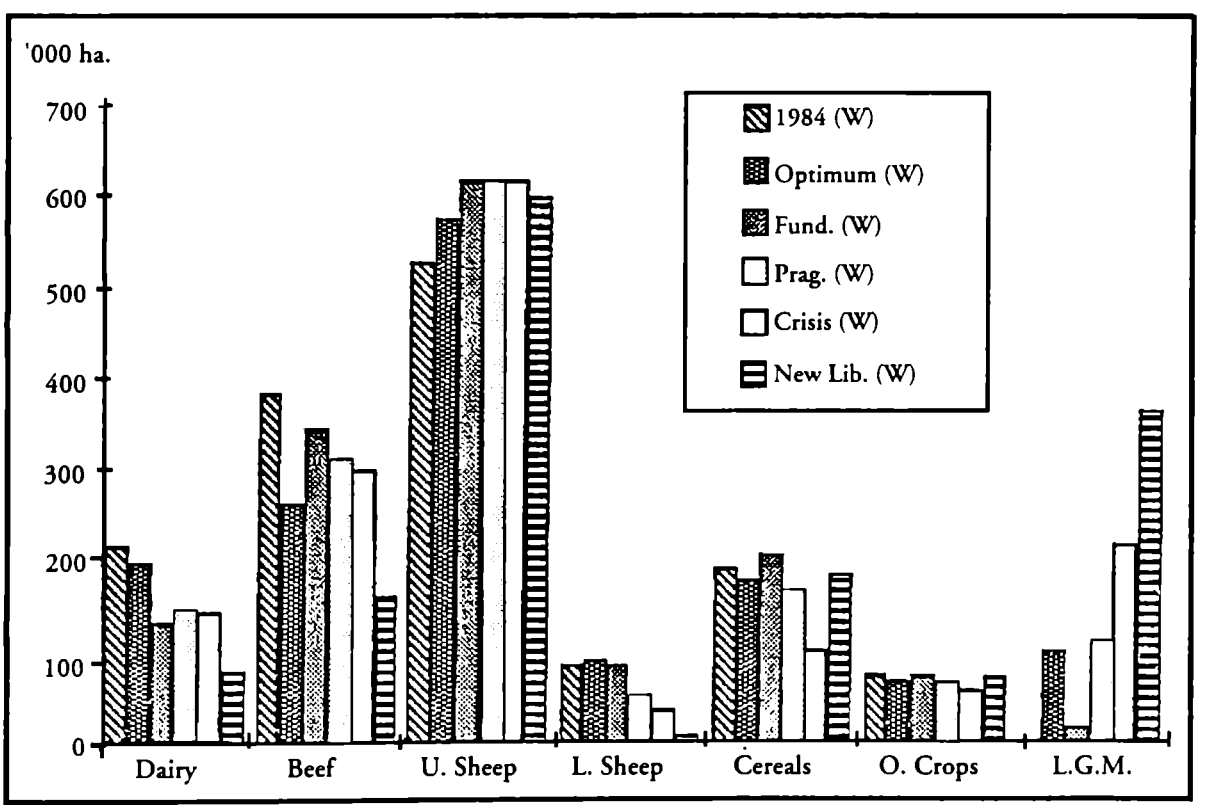

Figure 15 Land use in Wales under various policy scenarios

Figures 14 and 15 show these results broken down for England and for Wales separately. The above results are largely repeated in England, as might be expected given the dominance of England in the total area. However the results for Wales do show some differences. The pressure on the lowland livestock activities is more pronounced and there is no offsetting 'strength' in the cereals sector in Wales. The implication is that all of the scenarios would result in significant areas of lowland in Wales 'looking' for alternative uses, or (more likely) all lowland being farmed more extensively. Upland sheep, on the other hand, are shown to be remarkably robust, though as mentioned earlier, this may not apply to their shepherds.

The fact that the Welsh results differ markedly from those for England and Wales as a whole indicates that there are likely to be substantial regional differences in the possible effects of the various policy scenarios, particularly in the balance of dairy and beef enterprises. This would be expected given the sensitivity of these activities to small changes in gross margins and given the overall quota restriction on milk output in all but the New Libertarian scenario. There are obviously many other factors which will 'buffer' the agricultural system in favour of the status quo, as reflected particularly in the Agriculture EDC study (1987). Therefore, these results should be taken as a preliminary indication of the trends which the policy scenarios might encourage, rather than as precise projections.

Confirmation of these general results is provided by Crabtree and Macmillan (1989) and Crabtree *et al.*, (1989) who have examined forestry investment potential in Scotland, especially in the light of changes in tax benefits to private investors introduced in the 1988 Budget. The general conclusions of this work suggest that new plantings will tend to shift away from the poorer land of the north and west towards higher quality hill land as well as lowland of limited agricultural potential. However, in these cases, the extent of new plantings will be heavily dependent on farmland prices. 'To maintain the rate of planting observed in recent years will require not only a substantial fall in land prices, which implies reductions in the degree of agricultural support, but also a greater flexibility in the release of agricultural land for planting.... It appears that a major shift of new planting in Scotland will occur away from poor land in the north and west towards better sheep grazing and improved farmland'. (Crabtree and Macmillan, 1989, p. 321). No direct estimate is provided in these publications as to the extent of the farmland price reduction necessary to encourage new plantings at levels consistent with present planting targets.

However, Crabtree *et al.*, (1989) do point out that doubling the 'better land supplement' from £200 to £400 ha^{-1} 'produced only a small increase in the area with forestry potential' for land of MLURI class 3.2 (moderate range of crops). On a present land price of £1950 ha^{-1}, such a supplement represents a 20% discount. Most potential is seen for land of class 4 and 5 (improved grassland and rough grazings), while land of better quality (arable and crop land) does not appear to offer sufficient yield improvement in forest terms to offset the substantially higher agricultural value of the better land, especially if broadleaved trees are required in the rotation for conservation or amenity purposes. However, these calculations only account for the commercial value of the forestry enterprise and do not include the possibly substantial nonmarket and recreation elements which go to make up the economic value (Benson and Willis, 1991; Pearce, 1991).

CONCLUSIONS

The major conclusions of this paper are briefly stated.

First, there is little reason to suppose that agricultural returns will keep pace with general rates of inflation in the medium term, largely because of the necessity to limit the levels of agricultural support.

Second, it follows that the demand and therefore the value of farmland for agricultural purposes will fall. Estimates presented here suggest that the fall would be about 45% in real terms in England and Wales, rather less in Scotland, in the event that product market support is completely removed. Under certain circumstances, such a discounted farmland price could be regarded as an appropriate 'social opportunity cost' of farmland. However, this assumption requires that no part of existing farm support is regarded as socially desirable to maintain rural areas in agricultural use and also requires that other demands for farmland associated with demands for living-space, landscape, amenity and recreation directly associated with agricultural use of land do not yield higher values for farmland than its value as an agricultural productive factor.

Third, this reduction in demand and land price is not equivalent to an equivalent release of farmland for other purposes. In the limit, if 30% of crops and grassland is transferred to other uses then farmland prices would not be expected to fall at all. It is estimated here that each 100 000 ha of crops and grassland removed from agriculture in England and Wales would raise the price of the remainder by about 2.5%, or by 15% in Scotland In other words, removal of farmland from agriculture will temper the extent to which farmland values fall. Plausible and theoretically consistent analysis of the possible consequences of reduction or elimination of farm support strongly suggests that large areas of land will not leave agriculture unless the earning potential of land in other uses increases markedly. Rather the industry will adjust to lower returns through lower costs and the adoption of less intensive production practices, and through a revaluation of agricultural assets (including land). People and capital is more likely to leave the sector as returns fall than is the land base.

Fourth, if it is assumed that the present methods of support, including the CAP, are inviolate, then the question becomes: which land is least productive in agriculture and so should be released for other purposes, such as forestry? In effect, the question is one of identifying marginal (highest cost) production and encouraging its elimination. The social opportunity cost arguments then relate solely to domestic costs of production. Economic theory suggests that every farm will produce some marginal or high cost units of output, so elimination of this costly production should occur everywhere. However, some areas of the country are likely to be less competitive than others and indications are given in Chapter 5 of where these areas are likely to be. Land that is released from agriculture is not likely to be solely (or perhaps even largely) in the 'marginal' areas. Lowland grassland in the Midlands and North appears to be especially likely to be attracted out of the sector. Further, this land is unlikely to become available for forestry in large scale commercial tracts. Rather it is likely to be released in small parcels with amenity, recreation and wildlife characteristics as important as the productive value of the land.

REFERENCES

AGRICULTURE EDC (1987). *Directions for Change: Land Use in the 1990s*, and associated papers to TVS/EDC conference, Southampton, June.

BENSON, J. and WILLIS, K. (1991). *The demand for forests for recreation.* Forestry Commission Occasional Paper 39. Forestry Commission, Edinburgh.

BUCKWELL, A.E., HARVEY, D.R., THOMSON, K.J. and PARTON, K. (1982). *The costs of the Common Agricultural Policy.* Croom Helm, London.

COUNTRYSIDE COMMISSION (1987). *New opportunities for the Countryside.* Report of the Countryside Review Panel.

COWLING, K., METCALF, D. and RAYNER, A.J., (1970). *Resource structure of agriculture: an economic analysis.* Pergammon, Oxford.

CRABTREE, J.R. and MACMILLAN, D.C. (1989). UK fiscal changes and forestry planting. *Journal of Agricultural Economics* 40 (3), 314-322.

CRABTREE, J.R., MACMILLAN, D.C. and STEVENSON, E.G. (1989). Modelling Forestry Investment Potential. Paper to *European Association of Agricultural Economists Conference*, Newcastle, June (forthcoming).

ESRC (1987a). *Newsletter 59*, Environmental Issues, February.

ESRC (1987b). *Final Report*, ESRC Rural Land Use Working Group, J.K. Bowers, Feb.

EUROPEAN COMMISSION (1985). Perspectives on the Common Agricultural Policy. European Commission, Brussels.

HARVEY, D.R. (1970). The price of farm land: a theoretical and empirical analysis, unpublished *MA Dissertation*, Manchester University.

HARVEY, D.R. (1974). A theoretical and empirical analysis of agricultural land values in England and Wales, 1948-1970. *PhD Thesis*, Manchester University.

HARVEY, D.R and THOMSON, K.J. (1985). Cost, Benefits and the future of the Common Agricultural Policy. *Journal of Common Market Studies* 24 (1), 1-20.

HARVEY, D.R. (1985). *Milk quotas: freedom or serfdom?* CAS Study No. 1, Centre for Agricultural Strategy, and Knight Frank and Rutley, Reading, July.

HARVEY, D.R. *et al.*, (1986). *Countryside implications of possible changes in the CAP.* Report to the Department of the Environment and the Development Commission, Centre for Agricultural Strategy, University of Reading.

HARVEY, D.R. (1989a). The GATT and agriculture: the production entitlement guarantee (PEG) option, DP 1/89, *Department of Agricultural Economics and Food Marketing Discussion Paper*, Newcastle upon Tyne.

HARVEY, D.R. (1989b). The Economics of the Farmland Market. Paper to *Agricultural Economics Society* one day conference on the Farmland Market, December.

HARVEY, D.R. (1989c). Alternatives to present price policies for the CAP. *European Journal of Agricultural Economics* **16**, 83-111.

HARVEY, D.R. and HALL, J. (1989). PSEs, Producer Benefits and Transfer Efficiency of the CAP and Alternatives, DP 3/89, *Department of Agricultural Economics and Food Marketing Discussion Paper*, Newcastle upon Tyne.

HERDT, R.W. and COCHRANE, W.W. (1966). Farm land values and technological advance. *Journal of Farm Economics* **48**, 243-263.

HODGE, I. (1985). *Countryside Change, a Review of Research*, Report to the ESRC Environment and Planning Committee, Department of Land Economy, Cambridge.

ICI (1986). *Profit from Quota*, Dairymaid report for the quota year 1985/86, ICI, Grassland Unit, Farm Advisory Service, Agricultural Division.

IEEP/CPRE (1987). *Removing land from agriculture – The implications for farming and the environment*, Seminar papers, Institute for European Environmental Policy and Council for the Protection of Rural England

ITE (1986). *Landscape changes in Britain*, Colin Barr, Chris Benfield, Bob Bunce, Heather Ridsdale, Margaret Whittaker.

JUST, R.E (1988). *The role of monetary, fiscal and agricultural policies in farmland prices.* Working Paper, University of Maryland.

JUST, R.E. and MIRANOWSKI, J.A. (1988). US Land Prices: Trends and Determinants. Paper to Plenary session VII (Land markets, Agricultural Development and Agricultural Adjustment), *XX International Conference of Agricultural Economists*, Buenos Aires, August.

LLOYD, T.A. (1989). A reconsideration of an agricultural land price model for the UK. *Discussion Paper No. 69*, Department of Economics, University of Nottingham.

LLOYD, T.A., RAYNER, A.J. and ORME, C.D. (1989). *On modelling agricultural land prices in England and Wales.* Mimeo, Department of Economics, University of Nottingham.

MAFF (1985). *Woodlands as a farm crop.* HMSO, London.

MAFF (1987). *Farming and rural enterprise.* Package of Government publications on agriculture and rural development. HMSO, London.

MAFF (various). *Departmental net income calculation.* HMSO, London.

MERLEWOOD RESEARCH STATION (1981). Land classes in Great Britain: preliminary descriptions for users of the Merlewood method of land classification. *Merlewood Research and Development Paper* No. 86.

MERLEWOOD RESEARCH STATION (1982). A preliminary visual presentation of land classes in Britain. *Merlewood Research and Development Paper* No. 91.

MMB (1986). An analysis of farm management services costed dairy farms, 1985/86; *MMB Farm Management Services Information Report* No. 50, A.H. Poole, J.A. Craven, S.J. Mabey, August.

STIGLER, G.J. (1952). The theory of price. Macmillan, New York.

PEARCE, D. (1991). *Assessing the returns to the economy and to society from investments in forestry.* Forestry Commission Occasional Paper 47. Forestry Commission, Edinburgh.

THOMSON, K.J. (1987). A multi-market model of the Common Agricultural Policy. *Journal of Agricultural Economics* **38**,193-210.

TRAILL, W.B. (1979). An empirical model of the UK land market and the impact of price policy on land values and rents. *European Review of Agricultural Economics* **6**, 209-232.

TRAILL, W.B. (1980). Land values and rents: the gains and losses from price support programmes. *Department of Agricultural Economics, Bulletin 175*, University of Manchester.

TWEETEN, L.G. and NELSON, R.R. (1966). A methodology for predicting United States farm real estate price variation. *Journal of Farm Economics* **48**.

WHITBY, M.C. (1985). Opportunity costs of land conversion in the less favoured areas of Britain: some indicative estimates. In *Agriculture and Management of Natural Resources*, ed. Lechi, Vauk, pp. 59-68.

WILLIS, K.G. and WHITBY, M.C. (1985). The value of green belt land. *Journal of Rural Studies* **1**, (2), 147-162.

WOLLMER, F.J., (1989). Theoretical Considerations in Modelling Agricultural Land Prices: a Discussion. Paper to *Agricultural Economics Society Conference*, Aberystwyth, April.

'FORESTRY EXPANSION: A STUDY OF TECHNICAL, ECONOMIC AND ECOLOGICAL FACTORS'

This is one of a series of papers which form part of a study to consider the scale, location and nature of forestry expansion in Britain.

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The full list of papers is as follows:

Occasional Paper No	Title	Author
33	Introduction	Professor Ian Cunningham, Macaulay Land Use Research Institute
34	British Forestry in 1990	Hugh Miller, University of Aberdeen
35	International Environmental Impacts: Acid Rain and the Greenhouse Effect	Melvyn Cannell and John Cape, Institute of Terrestrial Ecology
36	The Long Term Global Demand for and Supply of Wood	Mike Arnold, Oxford Forestry Institute
37	UK Demand for and Supply of Wood and Wood Products	Adrian Whiteman, Forestry Commission
38	Development of the British Wood Processing Industries	Iain McNicoll and Peter McGregor, University of Strathclyde and Bill Mutch, Consultant
39	The Demand for Forests for Recreation	John Benson and Ken Willis, University of Newcastle
40	Forests as Wildlife Habitat	John Good, Ian Newton, John Miles, Rob Marrs and John Nicholas Greatorex-Davies, Institute of Terrestrial Ecology
41	Forestry and the Conservation and Enhancement of Landscape	Duncan Campbell and Roddie Fairley, Countryside Commission for Scotland
42	The Impacts on Water Quality and Quantity	Mike Hornung and John Adamson, Institute of Terrestrial Ecology
43	Sporting Recreational Use of Land	James McGilvray and Roger Perman, University of Strathclyde
44	The Agricultural Demand for Land: Its Availability and Cost for Forestry	David Harvey, University of Newcastle
45	Forestry in the Rural Economy	John Strak and Chris Mackel, Consultants
46	New Planting Methods, Costs and Returns	Jim Dewar, Forestry Commission
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