

The background features a complex geometric pattern of triangles in various shades of beige and light orange. The triangles are arranged in a way that creates a sense of depth and movement, with some pointing upwards and others downwards. A solid orange triangle is visible on the right side of the page.

Farming and Food's Contribution to
Sustainable Development:
The Current Situation and Future Prospects

Introduction and summary

1. Over the last 50 years a wide range of underlying economic and social trends have profoundly shifted the contribution which food and farming makes to the three pillars of sustainable development – economic, environmental and social. These shifts in contribution have in turn shifted the nature and focus of the public policy concerns which arise in these sectors.
2. In relation to economic sustainability, 50 years ago these issues were shaped by:
 - the importance of food in households' budgets in a potentially unstable political framework for international trade;
 - the importance of agriculture as a sector of the economy, particularly in depressed rural areas; and
 - by agriculture's contribution to a trade balance constrained by fixed exchange rates.
3. The underlying economic and social changes of the last fifty years have reduced the role of agriculture in the economy and diminished the significance of these issues. Today, the key issues of economic sustainability relate to:
 - concerns with competitiveness and farm incomes;
 - concerns relating to the significant costs which present policies – particularly the CAP – impose on the rest of the economy; and
 - concerns with the costs which animal diseases impose on the economy.
4. At the same time that long term social and economic trends have shifted food and farming's contribution to economic sustainability, so there has also been a similar shift in its environmental contribution. Rising incomes, with collateral shifts in tastes and preferences, mean that the countryside environment – and countryside leisure activities – have become significantly more important to consumers. At the same time, developments in production methods, reinforced in some cases by policy incentives, mean that farming has been less likely to sustain the features of the countryside which are valued. And, similarly, it has also been more likely to cause damage to the countryside environment through pollution or over-use of natural resources.
5. Issues of environmental sustainability also concern the food chain beyond agriculture, through processing to retailing and food service. Underlying economic trends have shifted consumption patterns toward foodstuffs which require more processing and packaging whilst supply structures have become more geographically dispersed. At the same time there are rising concerns about the packaging and waste and the use of natural resources which have all been increased by these underlying changes in economic organisation.
6. Historically, the main contribution which food and farming made to social sustainability was through its central contribution to rural economies, at a time when many of these

were depressed by the long term decline in agriculture and other traditional industries. Today, this direct contribution to rural economies is less important than food and farming's indirect contribution, through sustaining the countryside environment upon which the growing countryside leisure sector, and rural businesses more generally, depend. At the same time as agriculture's role in the rural economy has declined, a combination of underlying economic and social trends has resulted in different sources of economic growth in many rural areas. The result has been sustained growth in population and employment in most of rural England over the last several decades, underpinned by the distinctive advantages of the countryside. As a consequence, most rural economies have been able to adapt reasonably successfully to the long term decline in agriculture; but not all rural areas have shared in this growth, and even in otherwise prosperous rural areas there are pockets of deprivation which remain.

7. Food and farming also makes a broader social contribution in relation to public health, in particular through people's diet and through workplace safety, and in relation to animal welfare.
8. One common theme underlying this analysis is the importance of competitiveness – particularly in farming – not just as a key to economic sustainability but also as an essential foundation for the environmental and social contributions which food and farming make. In agriculture, the UK's productivity has fallen back from a position where it was above the EU average thirty years ago, but where it lags behind the high growth EU countries today. The UK's slow productivity growth reflects slower re-structuring in UK agriculture, as compared with most other EU countries, and it is associated with lower levels of skills, slower innovation and transfer of new technologies and weaknesses in business structures and organisation. Nevertheless, there is a lot of variability in the productivity performance of UK farming. And the many first rate businesses which exist show what might be achieved across the sector as a whole.
9. In the food and drink sector, the UK's productivity similarly lags behind many of our competitors, reflecting low investment, lower levels of skills, and weaknesses in innovation and technology transfer.
10. Improved competitiveness in agriculture is important to increasing the present low level of farm incomes in the UK, which have been depressed by the decline in the value of the euro against the pound, weak world commodity markets and animal disease outbreaks. Most current forecasts of the underlying macroeconomic drivers of farming profitability – in particular, developments in commodity markets and exchange rates – suggest that only a modest recovery is likely from the present low levels of farm incomes unless it is possible to improve competitiveness.
11. The structure of the paper is as follows. The next three sections look in turn at each of the three pillars of sustainable development and draw upon economic and statistical evidence to track the key changes in farming and food's contribution – including evidence upon a broad range of costs and benefits which result from current policies and practices. Of course, there is a significant interdependence between economic, environmental and social aspects. The final two sections of the paper look at competitiveness and the implications for farming's business prospects.

12. This section looks in turn at

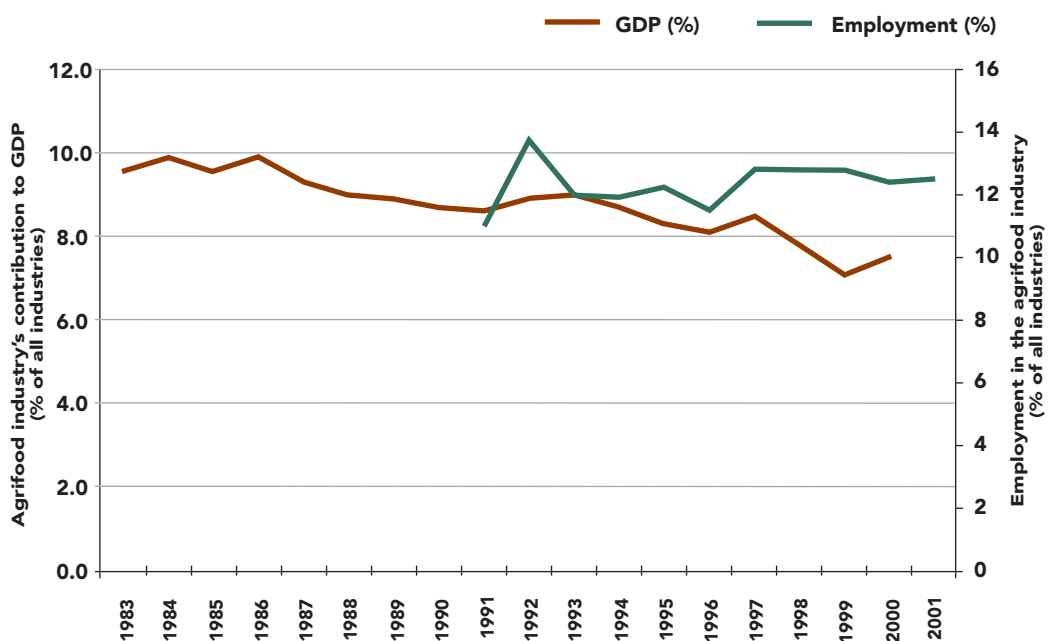
- farming and food in the economy
- shares of value along the food chain
- trade flows
- the economic costs of the CAP
- the economic costs of animal diseases.

Farming and food in the economy

13. The agri-food sector – comprising the agriculture, fisheries, food and drink, and catering industries – accounts for broadly 8% of Gross Domestic Product (GDP) in the UK and 12.5% of total employment (see Chart 1). The share of GDP and employment has declined slightly over the last 20 years (see Chart 2) principally because agriculture has declined in significance.

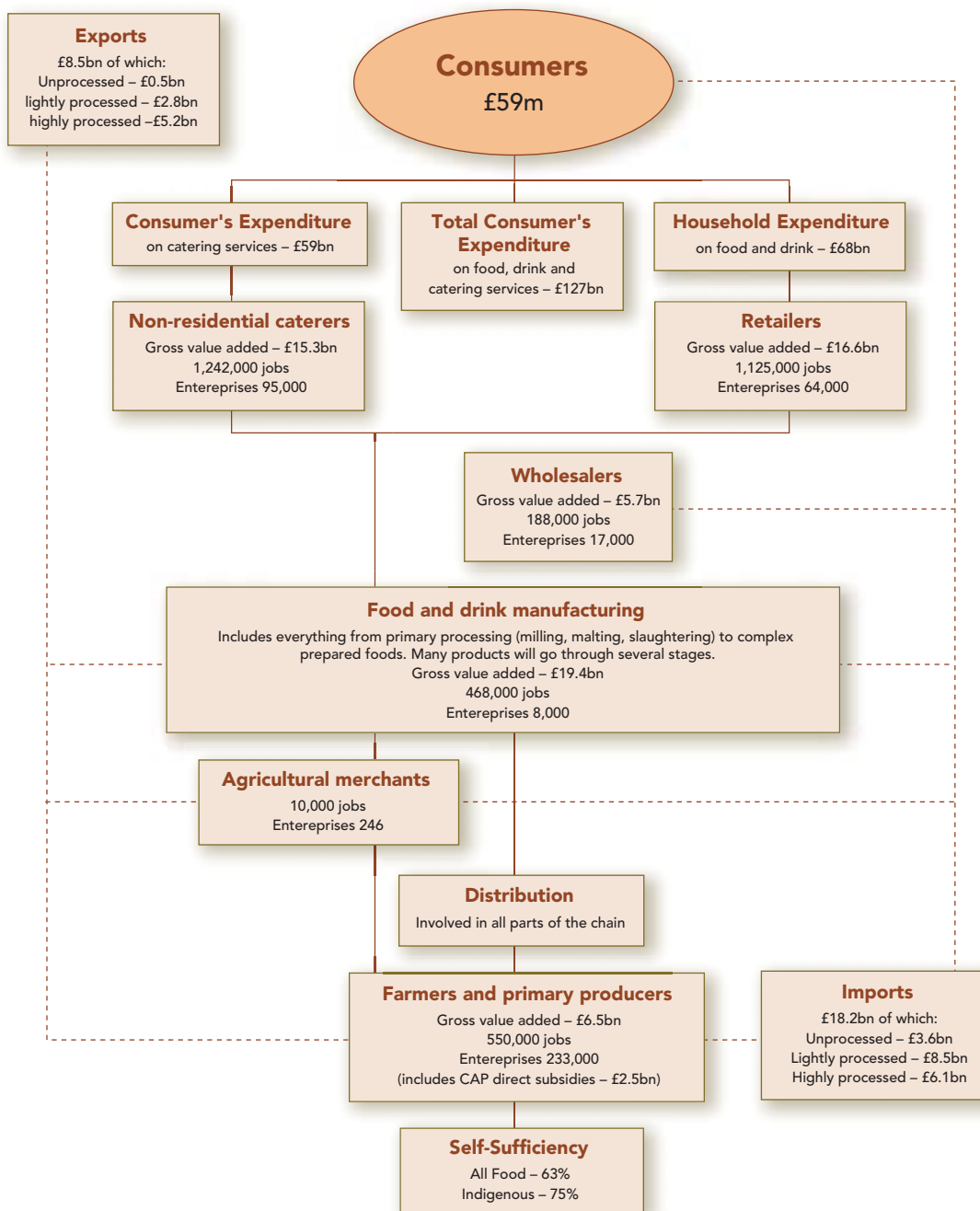
Chart 2

Employment and contribution to gross domestic product in the agrifood industry (% of all industries)



Source: Annual Business Inquiry, ONS; Annual Census of Production, ONS; UK National Accounts Blue Book, ONS; UK Sea Fisheries Statistics, Defra; Agriculture in the United Kingdom, Defra

Chart 1
The UK food chain

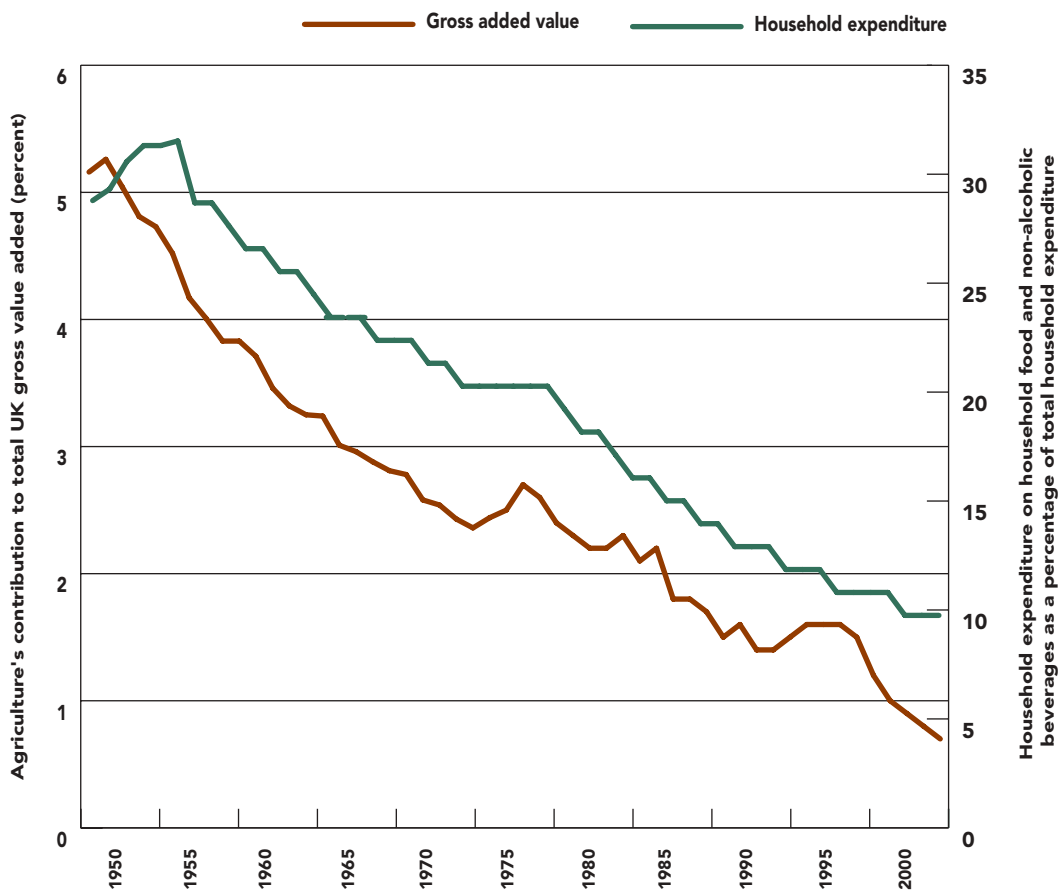


Sources: Economics and Statistics Directorate, Defra

14. The last 50 years have seen a significant reduction in agriculture's share of the UK economy (see Charts 3 and 4). At the beginning of the 1950s agriculture accounted for 5% of GDP and broadly 6% of employment: today the figures stand at broadly 0.7% and 2%, although the share of employment is clearly higher in rural areas, at 4% for England. These trends are common to most developed economies and are indeed more pronounced in most other EU countries.

Chart 3

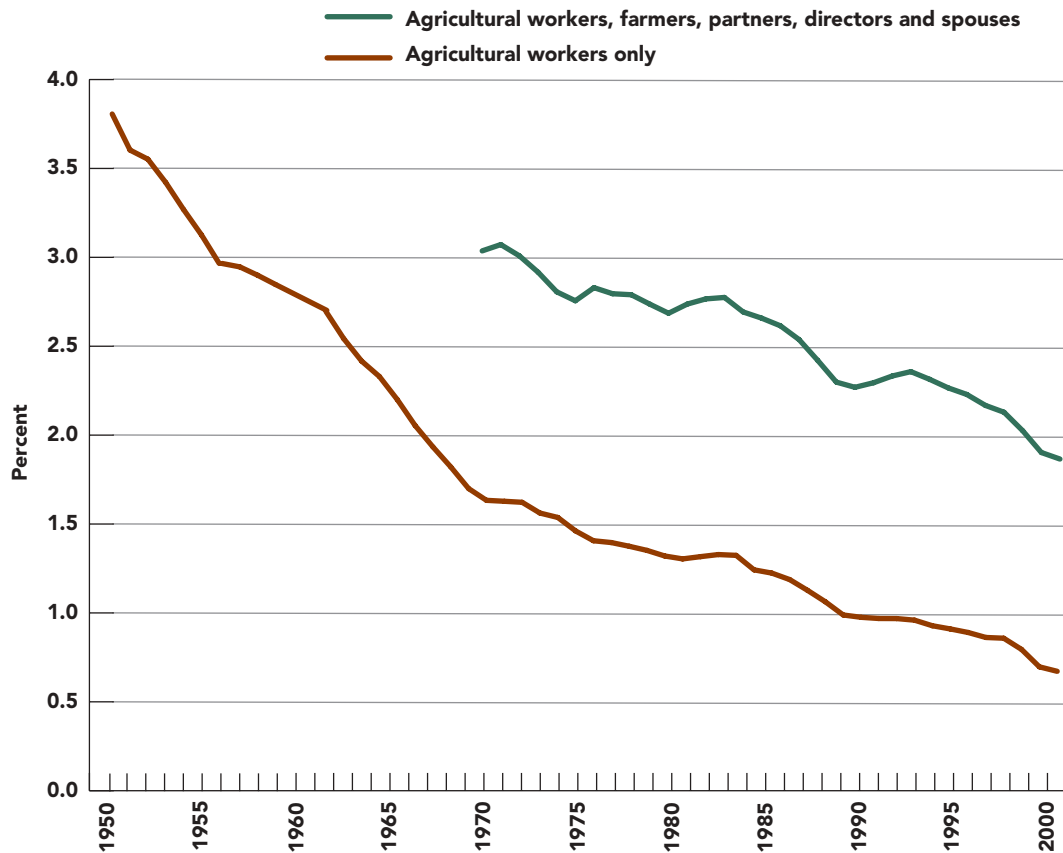
Agriculture's contribution to gross value added, and household expenditure on food and non-alcoholic beverages



Source: Office for National Statistics; A Hundred Years of British Food and Farming (a statistical survey); Agriculture in the United Kingdom 2001, Defra

Chart 4

Agricultural workforce as a percentage of the UK total workforce

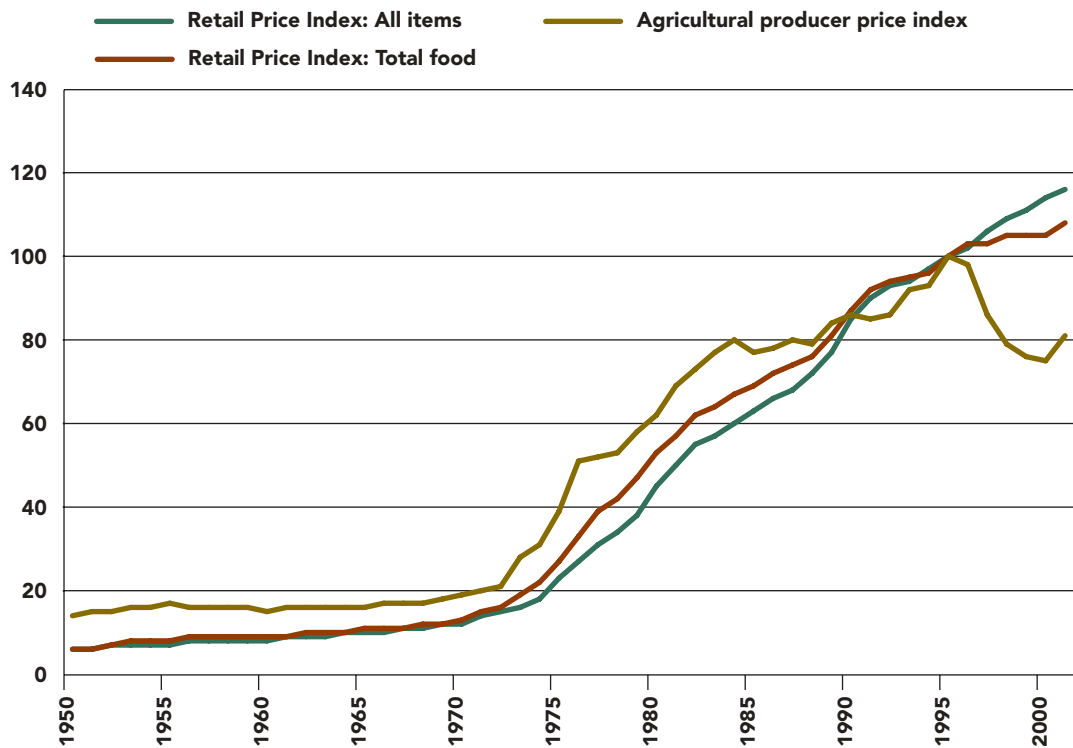


Sources: Office for National Statistics; A Hundred Years of British Food and Farming (a statistical survey); Agriculture in the United Kingdom 2001, Defra

15. These trends are driven by underlying changes in consumption patterns and in technology. As consumers' incomes rise they tend to spend a smaller proportion of their family budget on food and drink (down from 30% to 10% over the last 50 years) whilst expenditure is more focussed on products where value has been added in processing and packaging. At the same time technological developments (in both the farming and transport) have reduced the prices of agricultural commodities relative to the prices for other goods and services (by around a third over the last 30 years – see Chart 5) and this means that retail food prices have also risen less quickly than the general price level (although clearly to a lesser degree, because of the range of input costs other than agricultural commodities). Trends in the prices of agricultural commodities are also shaped by policy developments; in particular, joining the Common Agricultural Policy (CAP) and subsequent reforms.

Chart 5

Prices indices (1995=100)



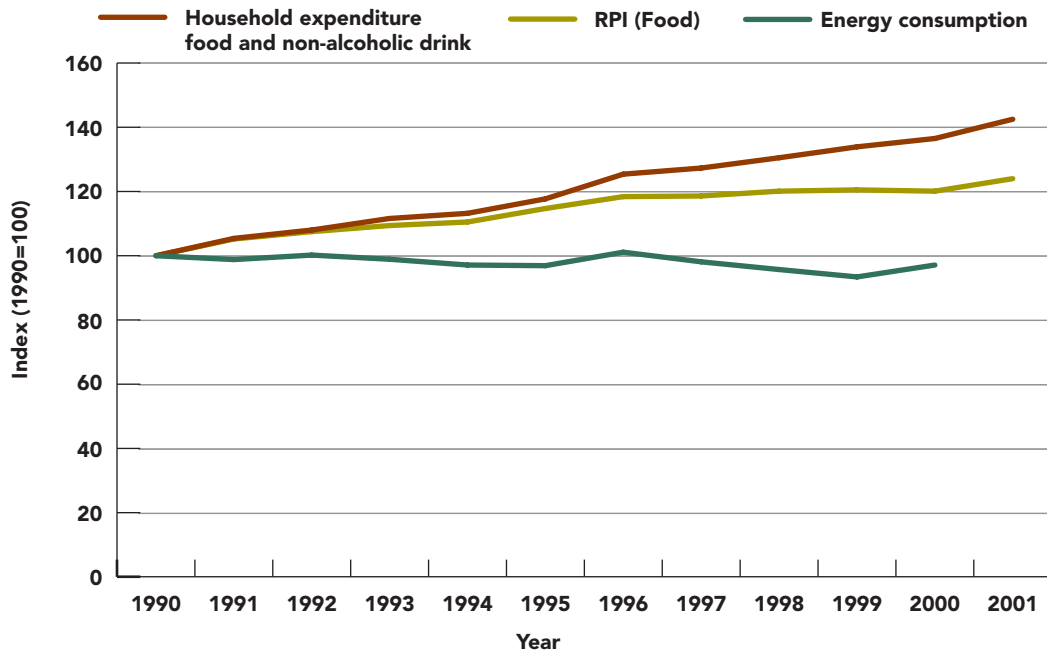
Sources: Eurostat
Statistics (C&S), Defra

Shares of value along the chain

16. These long term trends have had the effect of reducing over time the share that farmers receive of total retail spending on food. In particular, there has generally been increasing consumption of processed foods, and consequently an increase in value added beyond the farm gate. These trends are illustrated in Chart 6 which shows that consumers' expenditure on food has been rising faster than either retail food prices or physical consumption, indicating a switch toward higher value products. The implications of these trends for the farmers' share of retail spending is illustrated in Chart 7.

Chart 6

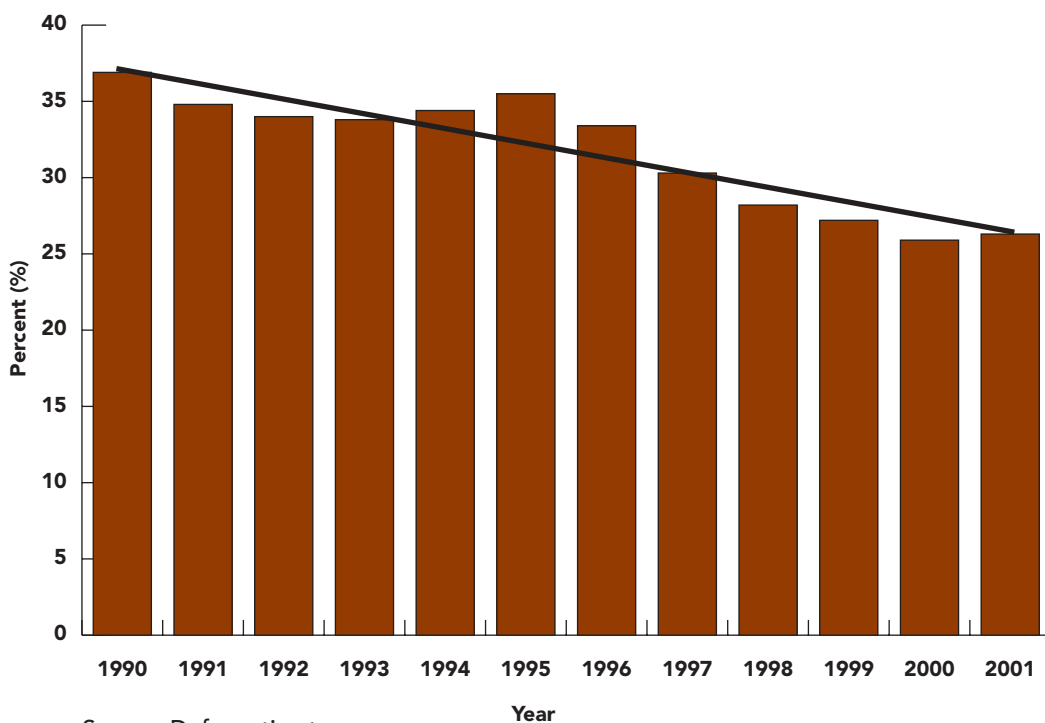
Growth in consumption and household expenditure on food and non-alcoholic drinks (1990–2001)



Source: National Food Survey (2000), Defra; Consumer Trends, ONS

Chart 7

Consumption of agricultural raw materials as a percentage of UK retail food and non-alcoholic drinks expenditure (1990-2001)



Source: Defra estimates.

Note: Black line denotes the trend line.

17. Factors that should be considered in assessing the trends in chart 7 include:

Relative price flexibility in the food chain: changes in farm-gate prices are unlikely to produce an equal change in retail food prices because retail prices are dominated by other factor input costs.

The exchange rate: the ups and downs of sterling during the 1990s have had a disproportionately important impact on farm-gate prices compared with the effect on other factor input prices; this means that farmers' share of retail spending has declined less rapidly than trend in the first half of the 1990s and more rapidly than trend thereafter.

Downstream buying power: the supermarkets in particular continued to increase their share of the retail groceries market over the 1990s. A Competition Commission investigation of the supermarkets concluded that they were satisfied that the industry was broadly competitive and that, overall, excessive prices were not being charged nor excessive profits earned. Following the investigation, the Office of Fair Trading drew up a Code of Practice in order to achieve a fair and balanced trading relationship between the largest supermarkets and their suppliers.

Imperfect transmission of changes in farm-gate prices: market imperfections may prevent changes in raw material prices entirely feeding through into retail prices but analysis of price transmission down the supply chain in UK red meat markets suggests that during the 1990s the greater part of farm-gate price changes for beef, pork and lamb (70% to 90%) were eventually passed through to retail prices (see Lloyd, T., McCorriston, S., Morgan, W, and Rayner, A (2002)). However the process was not instantaneous, averaging about four months before farm-gate price changes were fully reflected in retail prices. For the 1990s as a whole; retailers were found to be slower to cut retail prices in response to a fall in farm-gate prices than to put up prices when commodities became more expensive. However, from 1998 onwards retail prices became more responsive to changes in farm-gate prices.

Tighter regulatory standards may impose additional costs within the food supply chain. For example, more stringent hygiene standards that abattoirs are obliged to meet are likely to have led to transportation of livestock over greater distances.

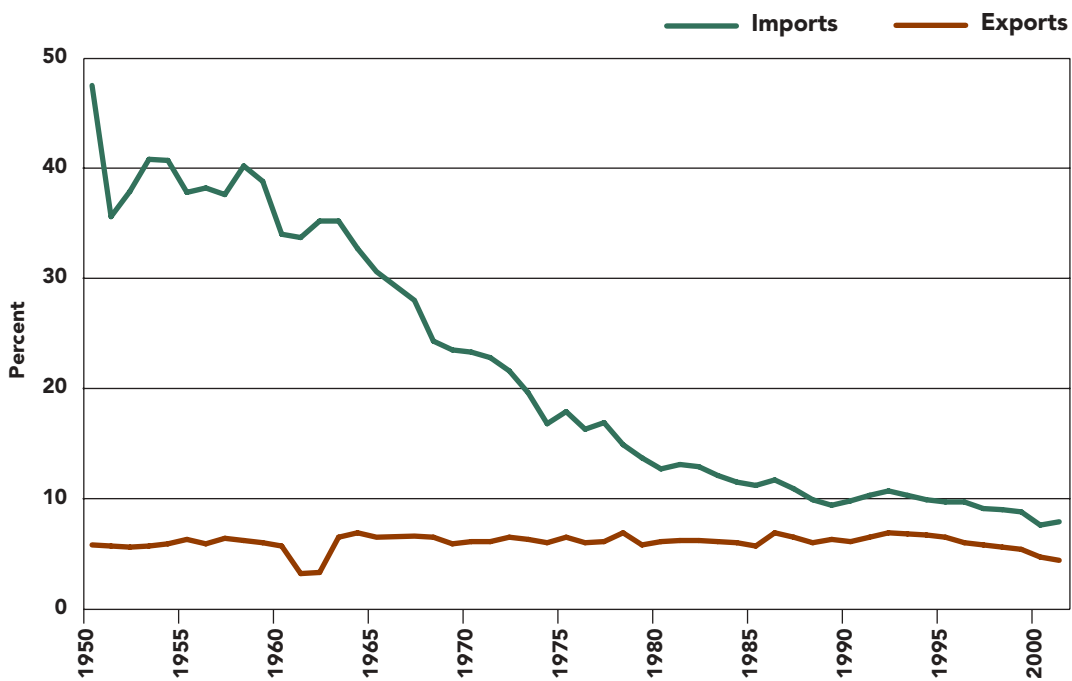
18. The evidence suggests that the key determinants of the declining share of returns to farmers in retail spending are the long term developments in the food supply chain, notably the switch of consumers to more sophisticated patterns of consumption. However underlying trends in the food supply chain over decades can be temporarily disguised or exacerbated by movements in the commodity price cycle, and the effects upon this of exchange rate movements. It seems likely though that farmers will need to move toward greater involvement in downstream value adding activities if a permanent reversal of these powerful underlying trends is to be achieved.

Trade flows

19. The reduced importance of agriculture in the economy and in household's consumption has also been reflected in trade flows: at the beginning of the 1950s food and drink still accounted for 40% of the UK's imports (see Chart 8). Today this figure has fallen below 10%, although the overall value of food and drink imports has fallen only slightly in real terms whilst imports of other goods and services have increased. Imports of a few items of food and drink, such as wine and fish, have increased (see Chart 9). In contrast, the value of food and drink exports has increased very significantly (see Chart 10). There have been increases in the exports of most commodities, reflecting both agricultural commodities and value added activities further along the chain.

Chart 8

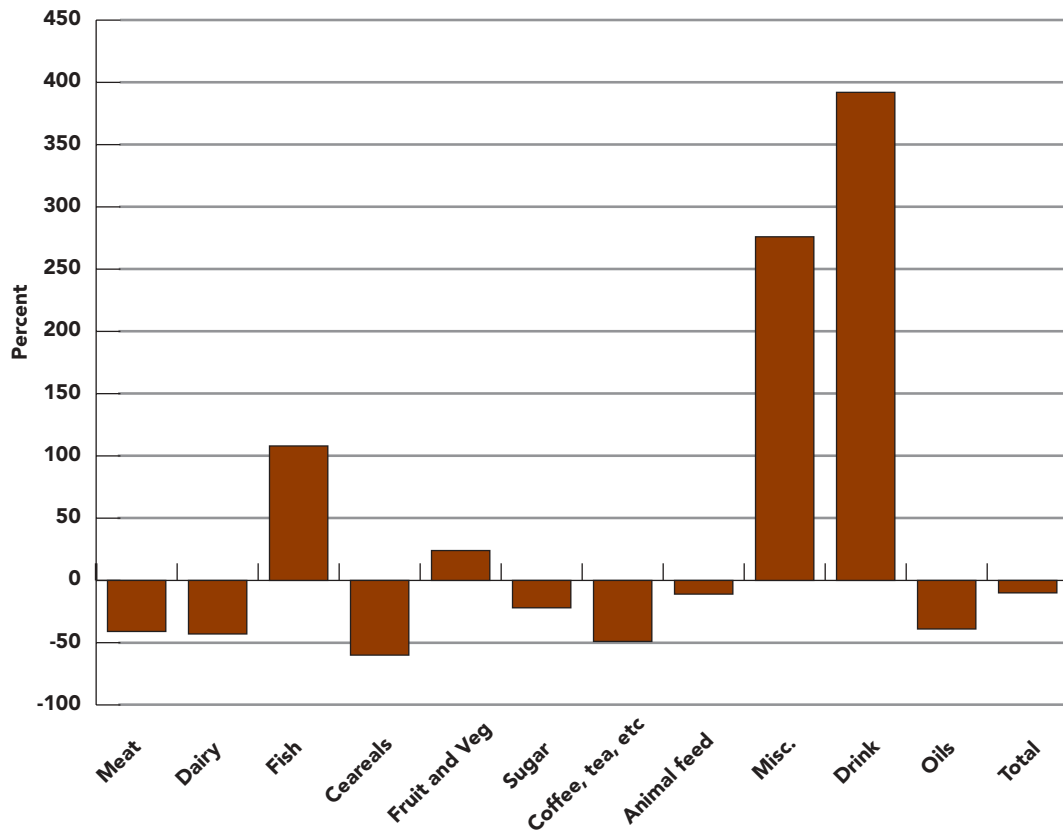
Value of trade in food, feed and drink as a proportion of total UK trade



Sources: HM Customs and Excise
Data prepared by Statistics (Commodities & Food) Accounts and Trade, ESD, Defra

Chart 9

Percentage change in imports 1960–63 to 1999–2001: real terms



Source: H M Customs and Excise

Data prepared by Statistics (Commodities & Food) Accounts and Trade, ESD, Defra

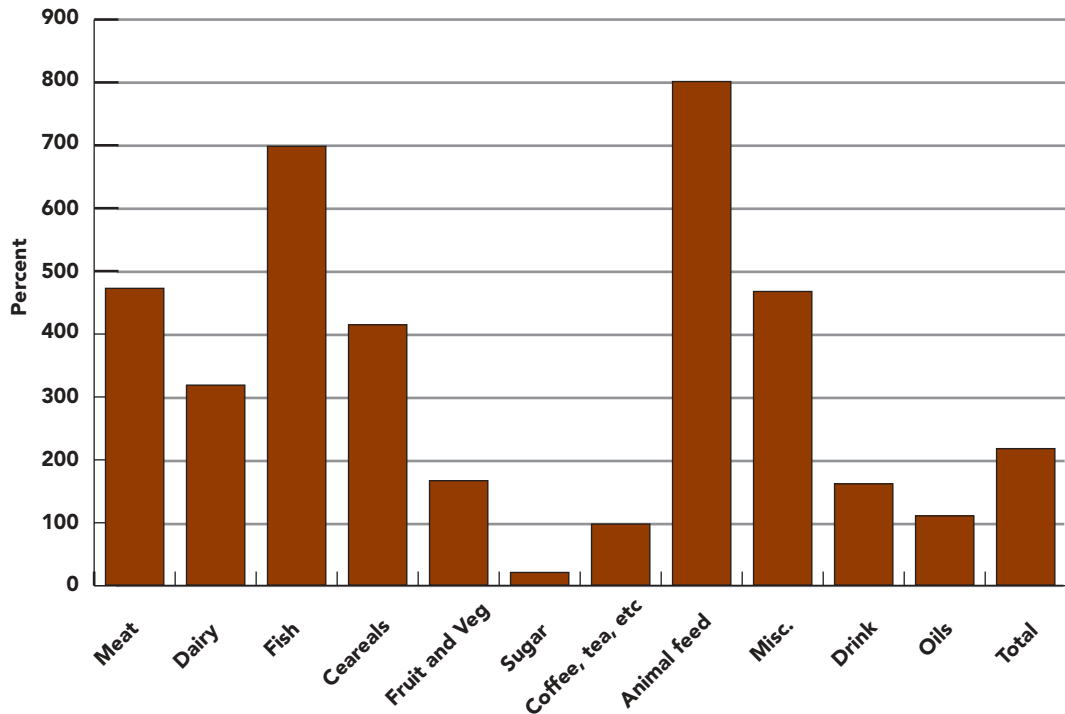
20. This strong growth in exports, coupled with a small decline in imports, means that the UK's self-sufficiency in food is considerably higher than in the 1950s (see Chart 11). In recent years, however, there has been a decline in self-sufficiency shaped by the high level of the pound/euro exchange rate and the impact of foot and mouth disease.

Economic costs of the Common Agricultural Policy

21. The CAP imposes significant costs on the European economy through the support which it provides to agricultural production. Consumers are worse off because prices are regulated above world market levels, and also because this support may weaken incentives to differentiate quality produce. And tax-payers need to finance the expenditures which are required to sustain these high prices (through buying up surplus produce or subsidising exports) as well as financing the direct subsidies which are provided to agricultural production. Taken together these costs are worth nearly €90bn a year at present across the EU 15 as a whole; the corresponding figure for the UK is broadly €10bn. Reforms of the CAP, together with developments on world markets, have resulted in a significant reduction in the real value of these costs over the last ten years (see Chart 12) and a further reduction can be expected as the Agenda 2000 CAP reforms are fully implemented.

Chart 10

Percentage change in exports 1960–63 to 1999–2001: real terms

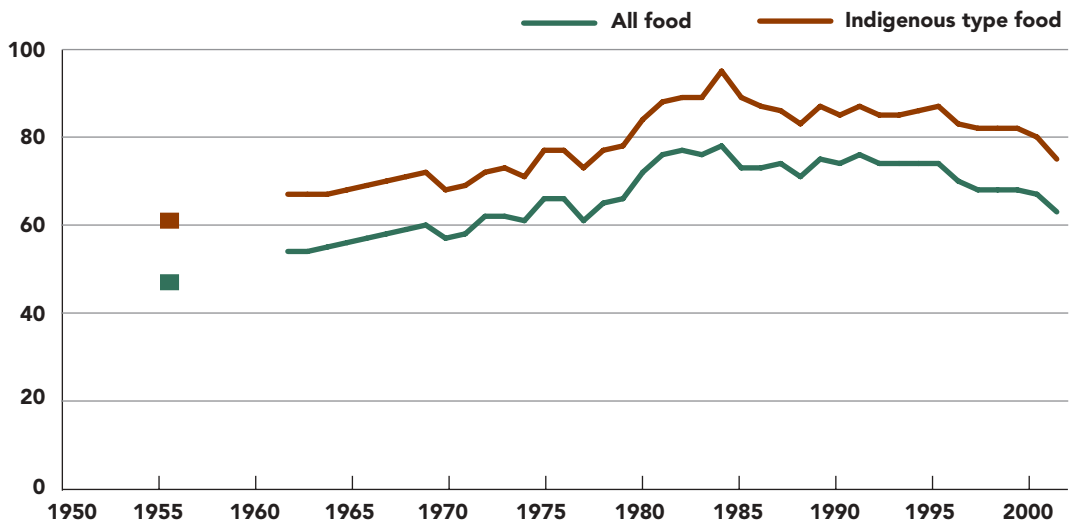


Source: H M Customs and Excise

Data prepared by Statistics (Commodities & Food) Accounts and Trade, ESD, Defra

Chart 11

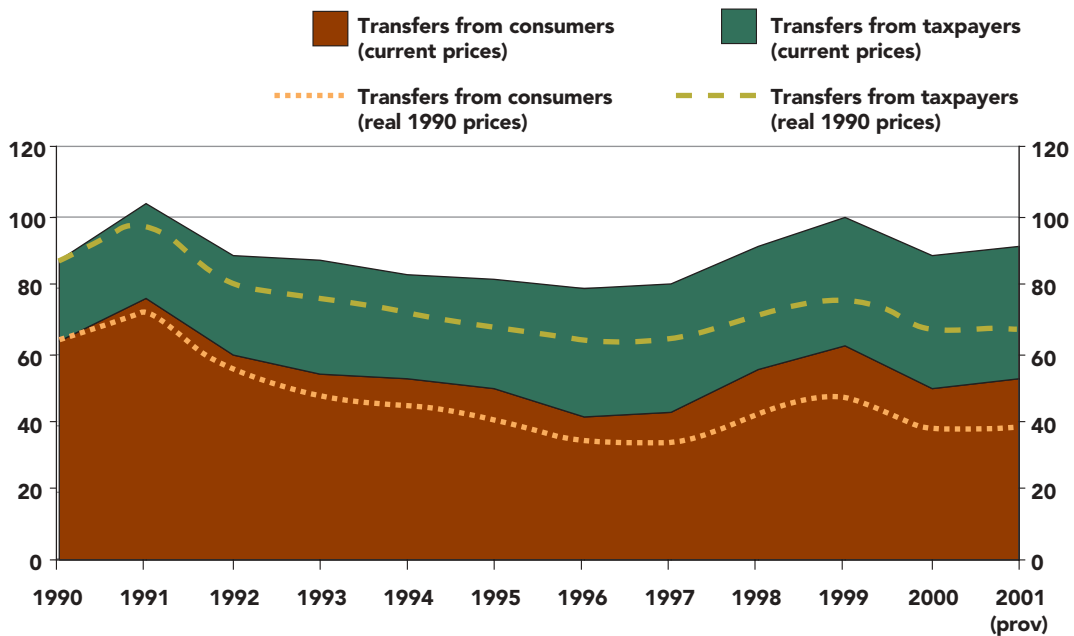
UK self-sufficiency in food as a percentage of all food and indigenous type food



Sources: Statistics (Commodities & Food) Accounts and Trade, ESD, Defra

Chart 12

Total transfers from EU consumer and taxpayers under the CAP (billion Euro)

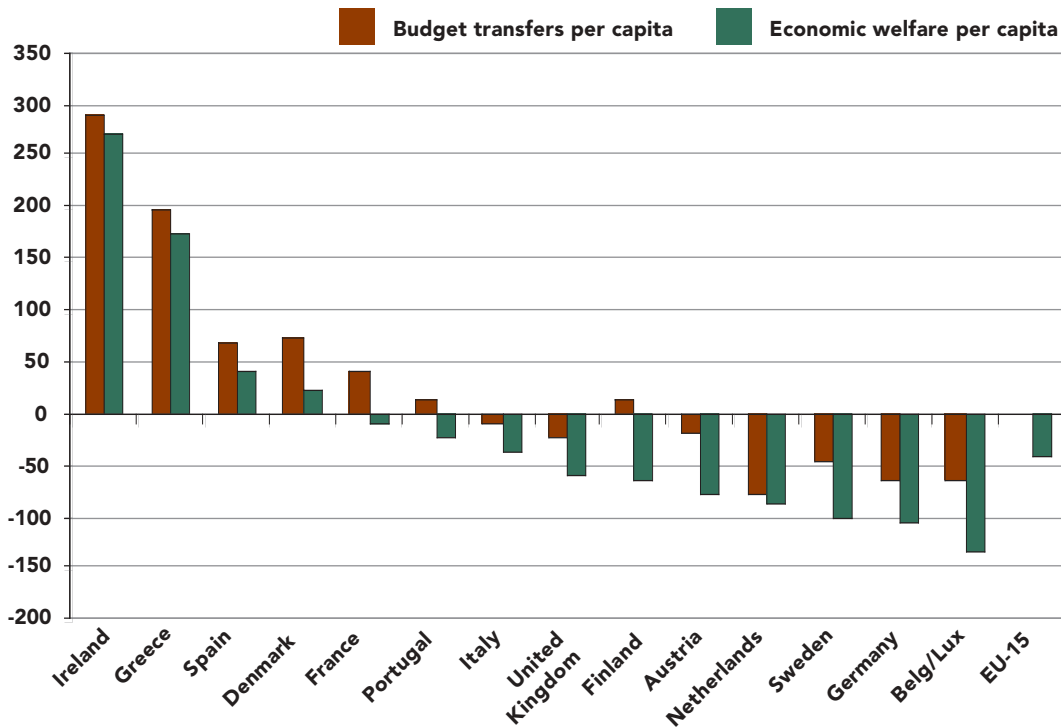


Source: Court of Auditors Report; OECD Monitoring and Evaluation Report

22. Much of these costs to taxpayers and consumers also represent additional income to farmers. However, even when this is allowed for there still remains a substantial cost to the European economy as a whole, as is illustrated in Chart 13. These costs result from holding intervention stocks, from administration costs and from substituting high cost European production in place of produce supplied from competitive world markets. In addition, there are a broader range of economic costs, which it is not possible to quantify in the chart, and which arise because the CAP has slowed productivity growth in farming, blunted market development and squeezed the market share of European food processors in world markets for value-added products. There are also costs to the environment which result from a bias towards intensive methods of production (and which are discussed further in section C).
23. The present CAP also imposes economic costs beyond Europe by distorting the commodity markets which face farmers in developing countries. For example, the Tinbergen Report (see Francois, J. (2000)) suggested that the benefits of a new World Trade Organisation (WTO) trade round in all products (that is, not just agriculture) would be worth three times as much to developing countries as what they currently receive in development aid.

Chart 13

FEOGA budget transfer and net overall economic welfare by member state 1998 (Euro per head)



Source: Defra

24. Whilst the CAP imposes economic costs through the support of agricultural production, research studies also show that the CAP's "second pillar" support of more environmentally friendly farming – through agri-environment schemes – generally provides worthwhile value for money. The studies suggest that the public typically value the landscapes which are sustained by these schemes sufficiently highly to make the expenditure worthwhile (see Maff (2000) for a discussion of this evidence).

Economic costs of animal diseases

25. The potential costs to the economy of animal diseases are illustrated by last year's FMD outbreak. The overall costs of FMD to the food and farming sectors in the UK is estimated at broadly £3bn, with much of this cost borne by taxpayers, although there have also been losses to farmers and to other businesses along the food chain. There have also been very significant costs (of a broadly similar order of magnitude) to a range of other rural businesses as a consequence of fewer people visiting the countryside. However, much (but not all) of these latter costs have been offset by gains in other sectors of the economy as consumer spending was displaced. Nevertheless, the impact has varied widely between different parts of the country and different businesses, and consumers have been disadvantaged because they have been forced away from preferred leisure activities (for more details see Thompson et al (2002)).

26. This section looks in turn at:

- farming's environmental performance;
- costs and benefits of farming's environmental impact; and
- environmental impacts of the broader food chain.

Farming's environmental performance

27. At the same time that long term social and economic trends have shifted farming and food's contribution to economic sustainability, so there has also been a similar shift in farming and food's environmental contribution. Rising incomes, with collateral shifts in tastes and preferences, mean that the countryside environment – and countryside leisure activities – have become significantly more important to consumers. At the same time, developments in farming technology and business practices, reinforced by incentives from the CAP and other policies, mean that farming has been less likely to sustain the features of the countryside which are valued. And it has also been more likely to cause damage to the countryside environment through pollution or over-use of natural resources.
28. Perhaps the most straightforward measure of the increasing value which consumers place on the countryside is provided by the number of visits which people make. In 2000 the number of tourist visits by UK residents was over 30m (with over a billion day visits) providing the underpinning for leisure and tourist businesses in rural areas. In a similar way, membership of organisations associated with countryside conservation provides another indicator of the significance of the countryside to the wider population.
29. The increasing importance of countryside leisure activities parallels awareness and concern about the environment and pollution as Chart 14 illustrates. Issues to do with farming and wildlife are a material part of this concern.

Chart 14

Important issues the government should be dealing with: 1986, 1989, 1993, 1996/7 and 2001

England ¹	Percentages				
<i>What do you think are the most important issues the government should be dealing with?</i>					
	1986	1989	1993	1996	2001
Health/ Social Services	22	32	29	42	58
Education	14	13	17	39	43
Crime	17	17	21	19	30
Environment/ Pollution	8	30	22	15	25
Unemployment	75	26	46	28	17

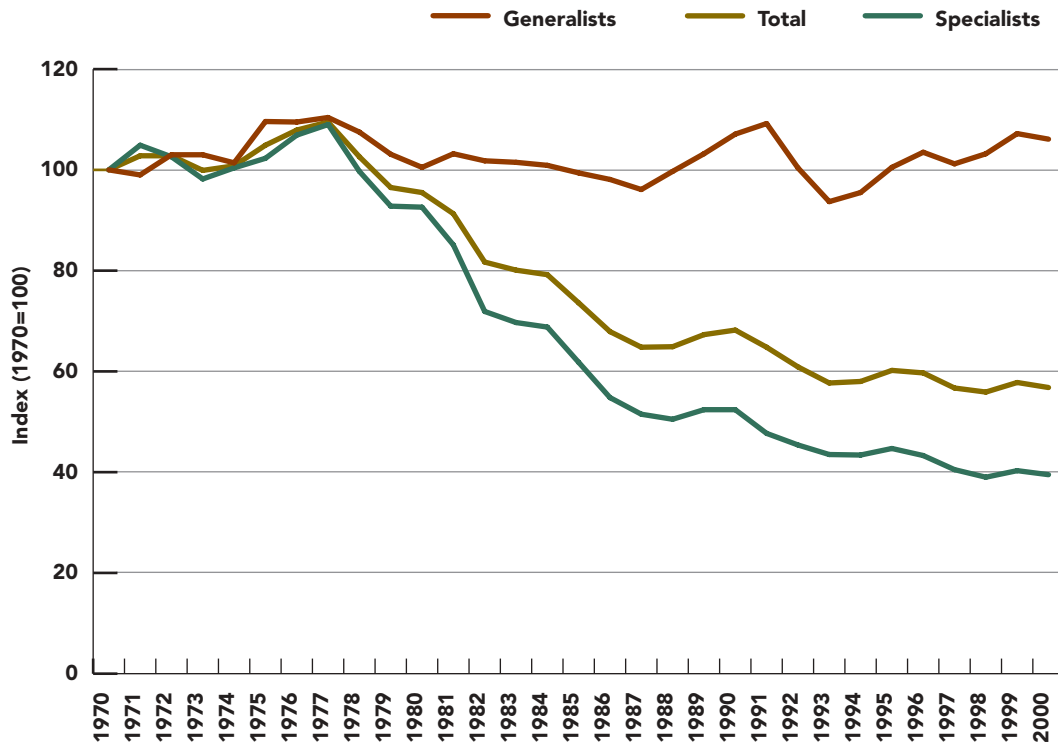
Source: Department for Environment, Food and Rural Affairs

¹ England and Wales for 1986, 1989, 1993 and 1996/7

30. Whilst the public's interest and concern with the countryside environment has been increasing, technical developments in farming – reinforced by commercial incentives embedded in the Common Agricultural Policy – have tended to result in adverse trends in the state of the countryside environment.
31. A good illustration is provided by the trends in the population of farmland birds (see Chart 15): this can be regarded as a good overarching indicator of the broad state of wildlife and the countryside. The combined populations of the 20 species included in the farmland bird index have declined by nearly a half between 1977 and 1993, though they have been relatively stable since then. A number of factors have contributed to the decline, including a loss of habitat diversity and quality caused by increased specialisation in farming, the change from spring to autumn sowing for cereals (with fewer stubble fields in winter), the loss of hedgerows and other uncropped habitats, and the use of pesticides.

Chart 15

UK Index of populations of farmland birds

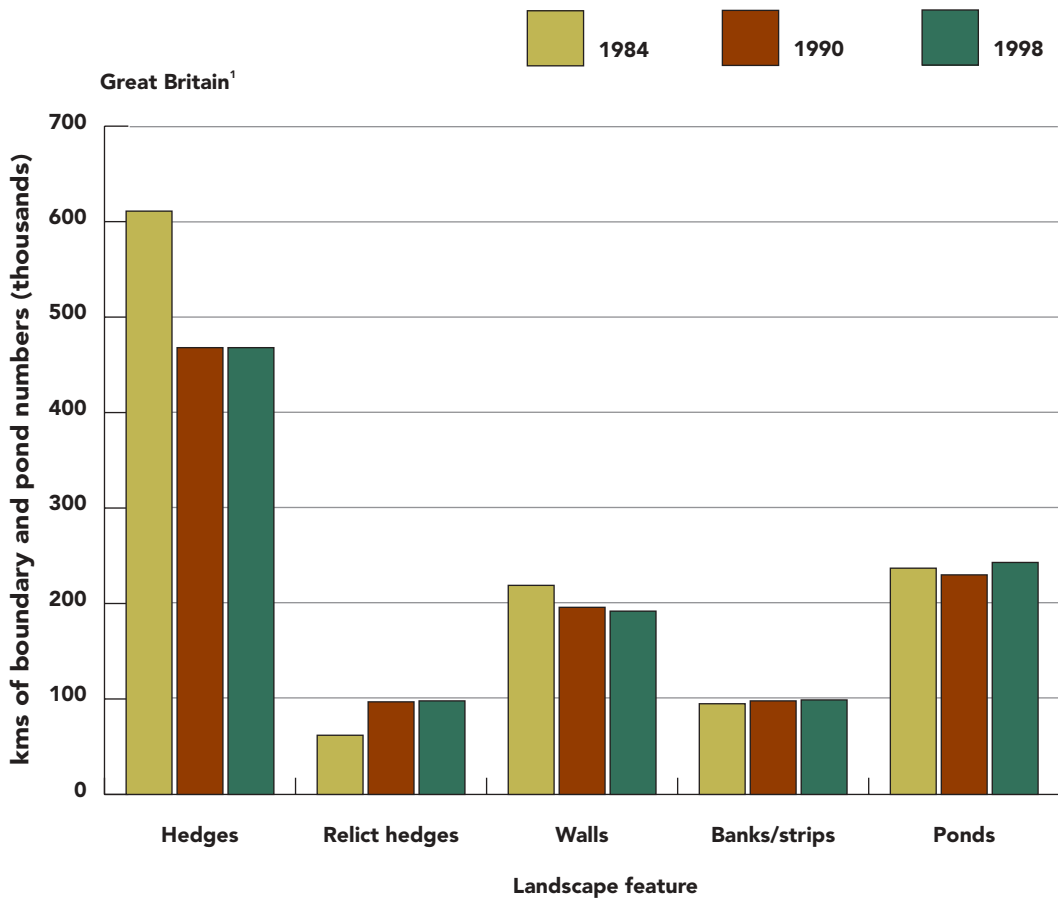


Source: Defra, BTO and RSPB

32. Countryside features – such as hedges, walls and ponds – are a valued part of the landscape, as well as providing valuable habitats. These landscape features have been on a downward trend because of their reduced cost-effectiveness in modern agriculture. Over the last ten years, however, this decline has been halted (see Chart 16). Nevertheless, the Countryside Survey 2000 showed that the condition of habitats in the wider countryside continues to decline.

Chart 16

Changes in characteristic countryside features: 1984-1998



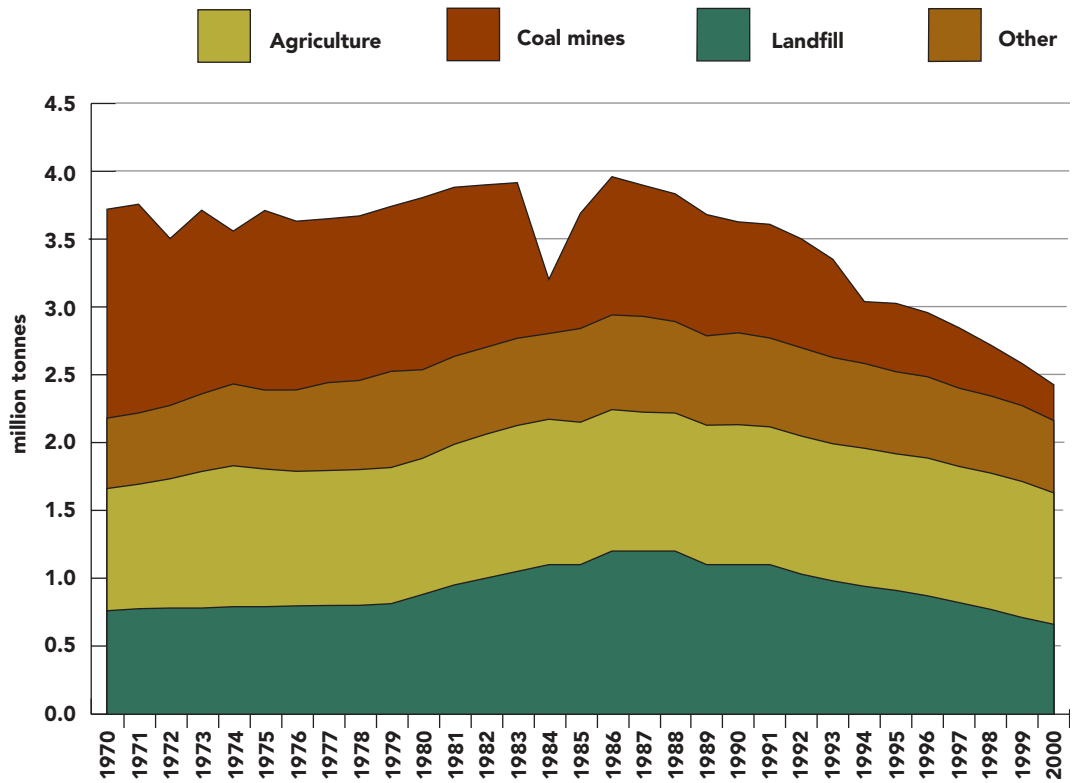
¹except hedges, which is England and Wales

Source Defra, lowland pond survey (1996), Countryside Survey (1990), Hedgerow survey (1993), Countryside Survey (2000)

33. Agriculture is a major source of methane emissions; chart 17 shows that it contributes 40% of the total. And it also contributes 83% of the UK's ammonia emissions. Agriculture is also a material source of water pollution. Phosphate from manure and fertiliser leaks into rivers and lakes and this, together with phosphate in sediment from soil erosion, causes excessive algal growth in up to 200 freshwaters each year. Phosphate concentrations in rivers have been improving over the last ten years but nitrate concentrations (where agriculture is a major contributory source) have remained more stable (see Charts 18 and 19). In 2001, agriculture accounted for 18% of the most serious (category 1 and 2) of water pollution incidents.

Chart 17

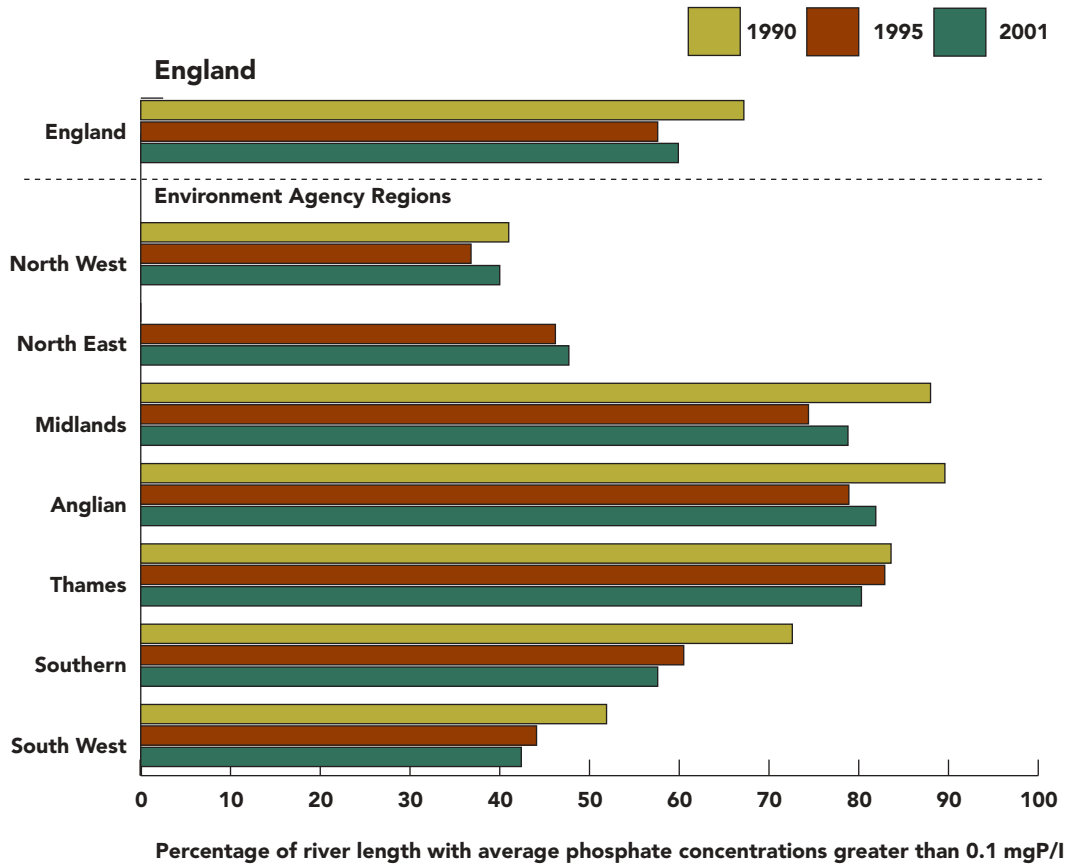
Methane emissions by source: 1970-2000 – United Kingdom



Source: Digest of Environmental Statistics, EPSIM, Defra

Chart 18

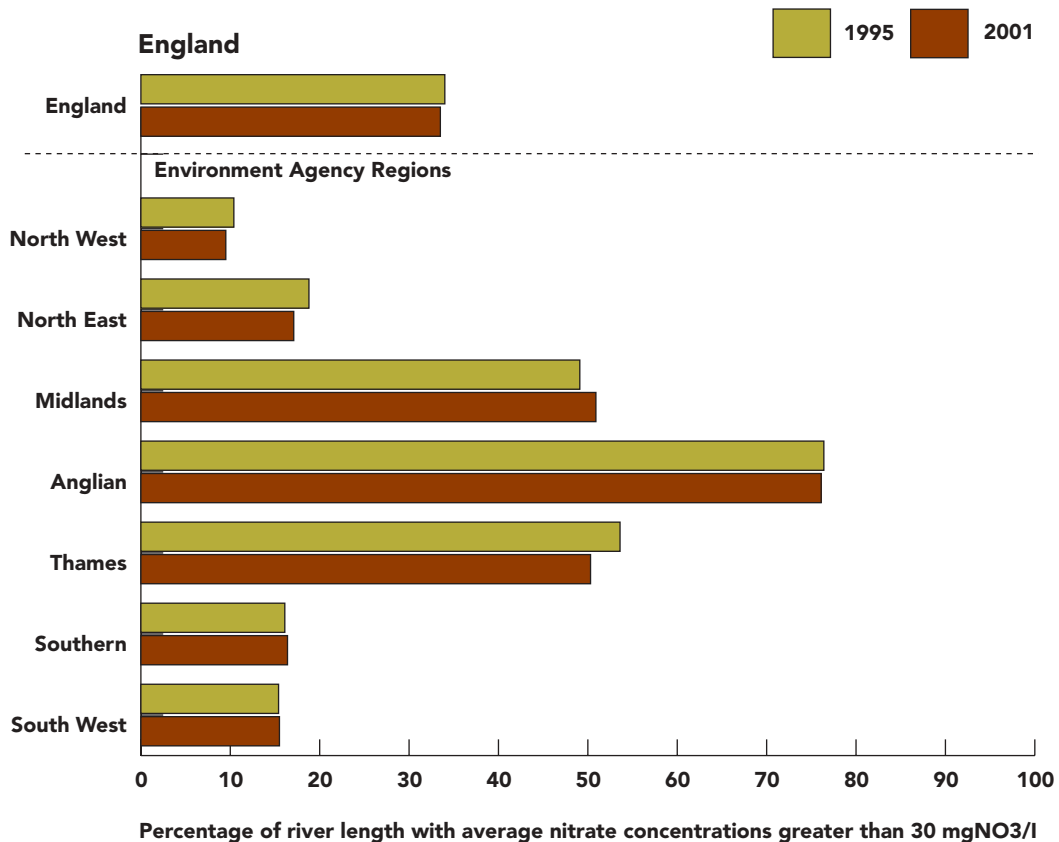
Phosphate concentrations in rivers: 1990–2001



Source: Environment Agency

Chart 19

Nitrate concentrations in rivers: 1995–2001



Source: Environment Agency

Costs and benefits of farming's environmental impact

34. Putting a value on the various contributions of agriculture to environmental sustainability – in the same way that the previous section looked at contributions to economic sustainability – is more difficult, because the impacts are not directly valued in the market place. This means that estimates of costs and benefits have very broad margins of uncertainty.
35. Even with this caveat, it is clear from the research evidence that both the costs and the benefits are substantial. Chart 20 draws together results from three studies which have estimated the costs of agriculture's negative impacts upon the environment through pollution or the over-use of natural resources. The studies show estimated costs in the range £1bn–£1.5bn (although other types of land use will also generate environmental impacts, both positive and negative). To put this in context, the value of the gross output of UK agriculture was £15.1bn in 2001 and its contribution to GDP was £4.4bn.

Chart 20

External environmental costs of UK agriculture

Cost Category	Hartridge and Pearce (£ Million)	Pretty et al (£ Million)	Environment Agency (£million)
• Damage to Natural Capital: Water	430	230	203
• Damage to Natural Capital: Air	585	1115	760
• Damage to Natural Capital: Soil	20	95	264
• Damage to Natural Capital: Biodiversity and Landscape	40	125	NA
Total	£1075	£1566	1266

Source: Hartridge and Pearce (2001)

Pretty et al (2000)

Environment Agency (2002)

36. The positive environmental benefits provided by agriculture – as a bi-product of food production – include the range of environmental and cultural goods which make up the countryside landscape, the habitats embedded in the farmed countryside and carbon dioxide sinks. In relation to these environmental benefits, valuation studies which have been carried out of agri-environment schemes show that the public place a considerable value on countryside features – hedgerows, traditional field patterns and farm buildings, ponds, tracks and bridleways (see Maff (2000) for a discussion of this evidence). Chart 21 shows the results of a study which estimated the overall value of the environmental services provided by agriculture in the UK at £600m a year. A study by the Environment Agency estimated the value of the positive carbon sinks provided by agriculture at £300m a year (although these latter benefits are not included in Chart 21 because they have been netted off from the environmental costs estimated by Hartridge and Pearce).

Chart 21

Estimated external benefits of agriculture

Environmental Services	Value (£m)
• Total	595
• Agricultural Landscape	140
• Forest and Woodland	84
• Environmentally Sensitive Areas	190
• Sites of Special Scientific Interest	180

Source: Hartridge and Pearce (2001)

37. In summary, although there are considerable technical challenges – and correspondingly broad margins of uncertainty – on these findings, nevertheless the research studies provide convincing evidence that agriculture imposes significant environmental costs but also provides significant environmental benefits. The evidence shows that the balance of these positive and negative impacts has been materially worsening over the last several decades – as a result of changes in farming technology – at the same time as the public’s interest and concern with the countryside environment has been steadily increasing. However, many of these adverse trends have been slowed or reversed in recent years.

Environmental impacts of the broader food chain

38. Issues of environmental sustainability concern the whole of the supply chain beyond agriculture through processing to retailing and food service. Along the whole chain each step involves the use of resources and the generation of waste and emissions (see Roberts, S. (2002) for a more detailed discussion).
39. The environmental awareness of companies operating within the food supply chain appears to be high. In October 2002 Defra surveyed the web-sites of 30 food and drink companies, 29 of which were in the FTSE 350 plus one large private company. This exercise revealed that 23 had an environmental policy or strategy, 16 published environmental reports (either separately or as part of their main annual report) and 12 monitored environmental performance. These results corroborate an Environment Survey by the Food & Drink Federation (FDF) which found that 31% of its responding members produced an environmental report.

40. *Waste:* The processing of food products can lead to high levels of loss. One estimate states that it takes ten tonnes of raw materials to deliver one tonne of product to the consumer; the remaining 90 per cent being discarded as waste (BRC Retail Link 2000). Since food waste is organic this has traditionally been seen as benign. However, if not managed carefully this can still lead to significant economic and environmental impacts. The FDF's recent report, World Summit on Sustainable Development 2002, highlighted, amongst other things, that its Environmental Survey had found that its members were taking a number of actions aimed at waste reduction, reuse, recovery and recycling. Such action is also highlighted in the British Retail Consortium's Sustainability Strategy, "Towards Retail Sustainability", which was launched last year.
41. *Packaging:* Packaging is essential for processed food and drink as it preserves and protects it during handling and helps prevent spoilage and contamination during production, distribution and sales. It is also a communication tool displaying information on ingredients, nutrition and serving and storage instructions.
42. An estimated 3.2 million tonnes of household packaging waste are generated each year (see: SUSTAIN). This can be illustrated by the 12 billion plastic carrier bags and 29 billion food and drinks cans disposed of each year. The UK's current target is to recover 50 per cent of all packaging waste. The main burden lies with the retailers, including food retailers; any company with a turnover of more than £2 million is obliged to recover 48 out of this 50 per cent. In order to achieve this, a trading system has been introduced to allow obligated companies to do the job. Reprocessing companies issue special vouchers, packaging recycling notes (PRNs), to represent the amount of waste that has been recycled. Many food retailers also provide recycling bins in their car parks to encourage consumers to contribute to recycling effort.
43. *Water:* Water is required for most food and drink manufacturing processes. Both the FDF and the CIAA (Confederation of Food & Drink Industries of the EU) note that the food and drink industry has taken a number of proactive measures to reduce, reuse and recycle water resources.
44. *Global Warming:* The cause of global warming is identified as emissions of greenhouse gases (GHGs). Energy use and the resulting carbon dioxide (a GHG) emissions are the key factors in tackling climate change in the food chain. Energy is used at all stages in the downstream agri-food sectors: in processing and packaging food products, in retailing the food products, by consumers in cooling and freezing food as well as cooking it, and throughout the chain for transport. From the perspective of greenhouse gas emissions the mix of fuels (natural gas, coal, oil, renewable energy sources etc) needs to be considered in addition to the overall quantity of energy consumed. Comprehensive measurement of energy use at all

stages in the food supply chain has proved difficult but partial data provides insights into its relative significance. An important source of carbon emissions is road transport; agricultural commodities, livestock and food products account for almost 30% of total UK HGV tonne miles and increased by 3% per year over the last decade (see Department of the Environment, Transport and the Regions (2000)).

45. The FDF and many supermarkets have entered into climate change agreements with the Government whereby participants receive an 80% discount from the climate change levy in return for meeting challenging energy reduction targets as a contribution to the reduction of greenhouse gas emissions. In addition to contributing to global warming, energy use in the downstream food industries will have implications for a wide range of environmental impacts, notably air quality.
46. *Key Performance Indicators*: The FDF has developed for its member companies a series of quantitative Key Performance Indicators (KPIs) for sustainable development that are relevant for the manufacture of food and drink. Two types of indicators can be distinguished: **core** indicators which all companies should aim to implement and **additional** indicators which companies can choose to adopt if they are relevant to their business. A summary of the proposed core indicators relating to the environment is in Chart 22.

Chart 22

Food and Drink Federation: Key performance indicators for sustainable food and drink manufacturing

Effective protection of the environment

- Volume and Composition of trade effluent (annual mass/permitted maxima under consents) discharged per tonne of product per year (kg)
- Total CO₂ equivalent emissions (kg) per tonne of product per year from i) manufacturing and ii) distribution to direct customers from sources owned or controlled by the company including own and contract transport (kg)
- Total waste ex factory (tonnes) per tonne of product per year including packaging waste arisings on the premises (kg)
- Percentage total waste ex factory recovered per year including packaging waste arisings on the premises (%)

Prudent use of natural resources

- Total raw materials in (tonnes) per tonne of product per year (all raw materials including packaging but excluding fuel and water unless water¹ is also a main ingredient/raw material). (tonnes)
- Total water consumption (m³) per tonne of product per year (except cooling water extracted and returned to source) (m³)
- Total packaging placed on the market per tonne of product per year (kg)
- Total energy use (KWh) in manufacturing per tonne of product per year (KWh)

Source: Food and Drink Federation (2002)



D

Social sustainability

47. This section looks in turn at:

- Agriculture in the rural economy;
- Public health – nutrition and work place safety; and
- Animal Welfare

Agriculture in the rural economy

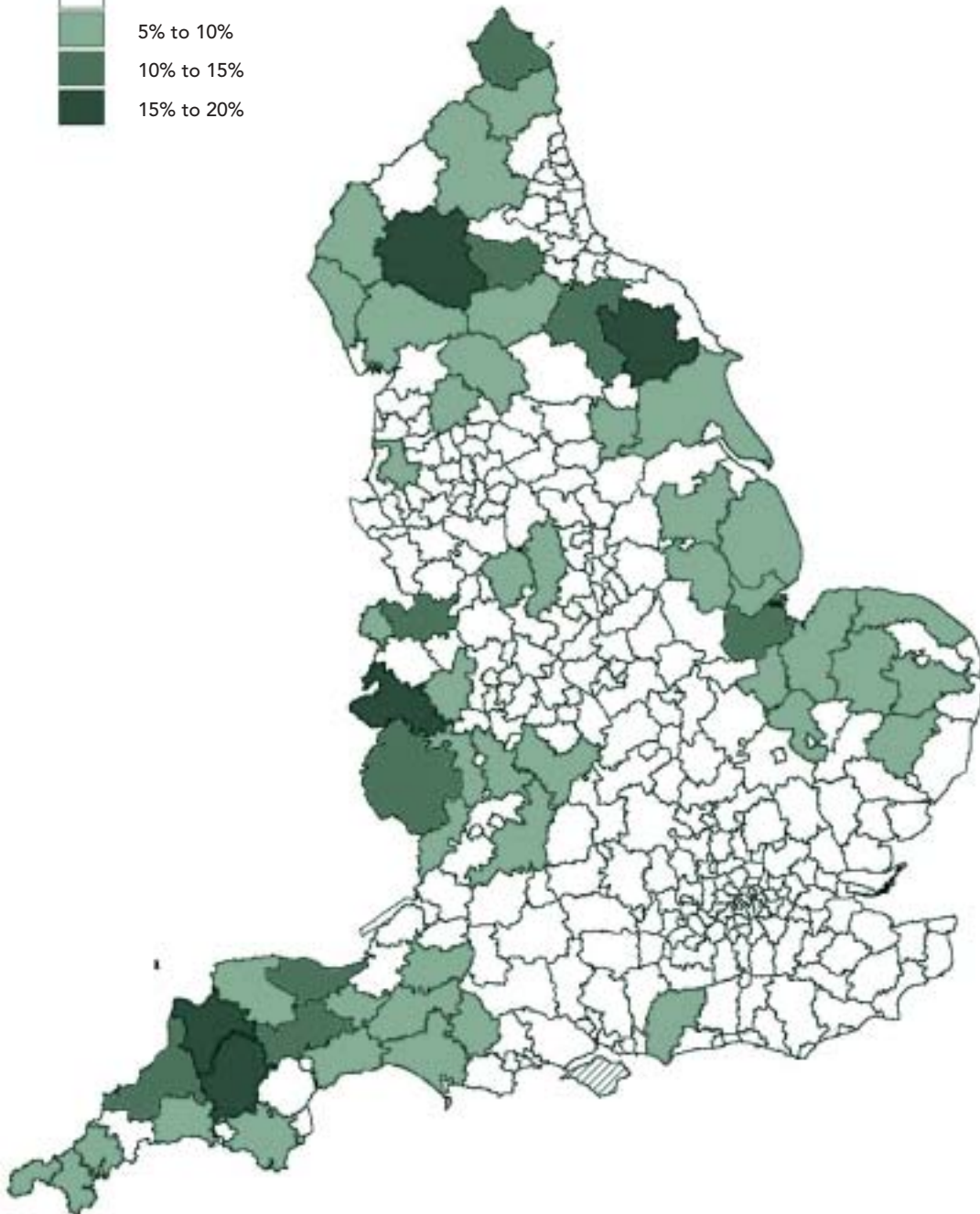
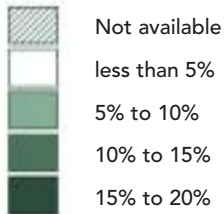
48. Fifty years ago the main contribution which food and farming made to social sustainability was through its central contribution to rural economies, at a time when many of these were depressed by the long term decline in agriculture and other traditional industries.

49. Today food and farming provides an increasingly important indirect contribution – through sustaining the countryside environment upon which the countryside leisure and tourism sectors depend, and which is also important to many other rural businesses. As the discussion of economic sustainability illustrated, agriculture's role in the rural economy has declined, and across rural areas in England agriculture now accounts for broadly 4% of employment. Nevertheless this average disguises the much greater significance of agriculture in some parts of the country, particularly the more remote and less accessible areas (see Chart 23); once upstream and downstream linkages are taken into account this significance is greater still.

Chart 23

Percentage of workforce living in rural areas in England who are employed in agriculture, by Local Authority District (2000)

% of workforce



Sources:

1. June 2000 Agricultural and Horticultural Census, Defra
2. Annual Local Area Labour Force Survey 2000, Office for National Statistics

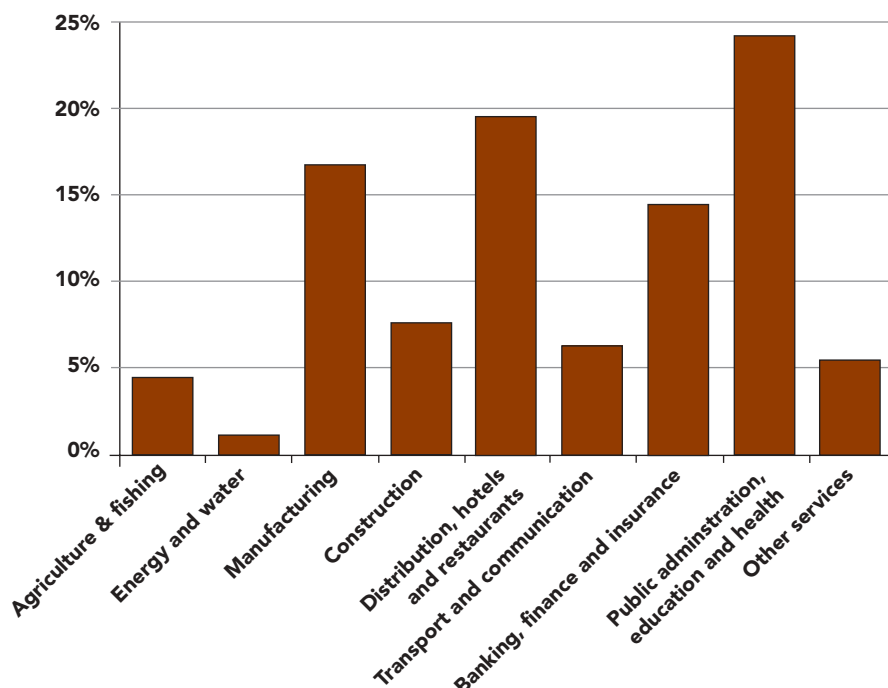
50. At the same time that agriculture's role in the rural economy has been declining, a combination of underlying economic and social trends has resulted in different sources of economic growth in many rural areas (see Illbery (1998) for a discussion). Key drivers include:

- falling communications costs;
- structural shifts in the economy between manufacturing and services;
- together with shifts towards differentiated and customised products;
- rising demand for countryside leisure and recreation; and
- shifts in preferences toward countryside living.

51. The result has been sustained growth in population and employment in rural areas in England, with particularly strong growth in services. These are now the most important sectors of the rural economy in England (see Chart 24). As a result of these underlying trends, most rural economies have been able to adapt reasonably successfully to the long term decline in agriculture; and unemployment rates in rural England have continued to decline over most of the last ten years, although at a slightly slower rate than for urban areas (see Chart 25). But not all rural areas have shared in this growth, and even in otherwise prosperous rural areas there are pockets of deprivation which remain.

Chart 24

Employment by sector for rural areas in England, 2000

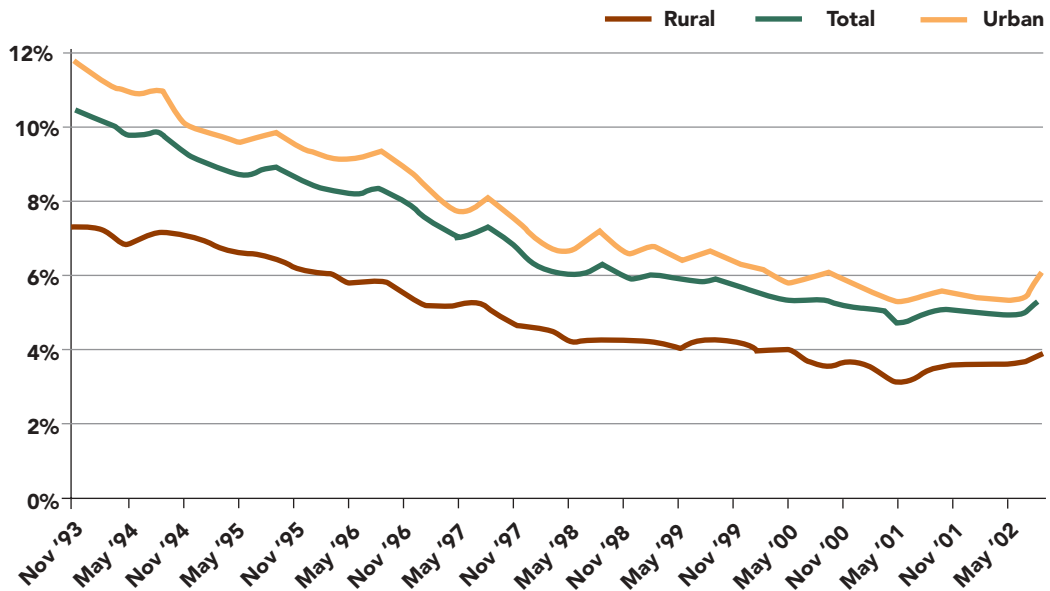


Source: Annual Local Area Labour Force Survey 2000, Office for National Statistics
June 2000 Agricultural and Horticultural Census, Defra

Notes: 1. Totals for those districts classified as such under the definition developed by the Countryside Agency.

Figures relate to people of working age

Chart 25
Unemployment rate



Source: Quarterly Labour Force Survey, England

Notes: 1. Unemployment is defined using the International Labour Organisation (ILO) definition which measures the number of people not in paid employment who are available for work and actively seeking work, rather than those claiming benefits.

2. The rural figures are the totals for those districts classified as such under the definition developed by the Countryside Agency. The urban figures are the totals for the remaining districts in England.

Figures relate to people of working age.

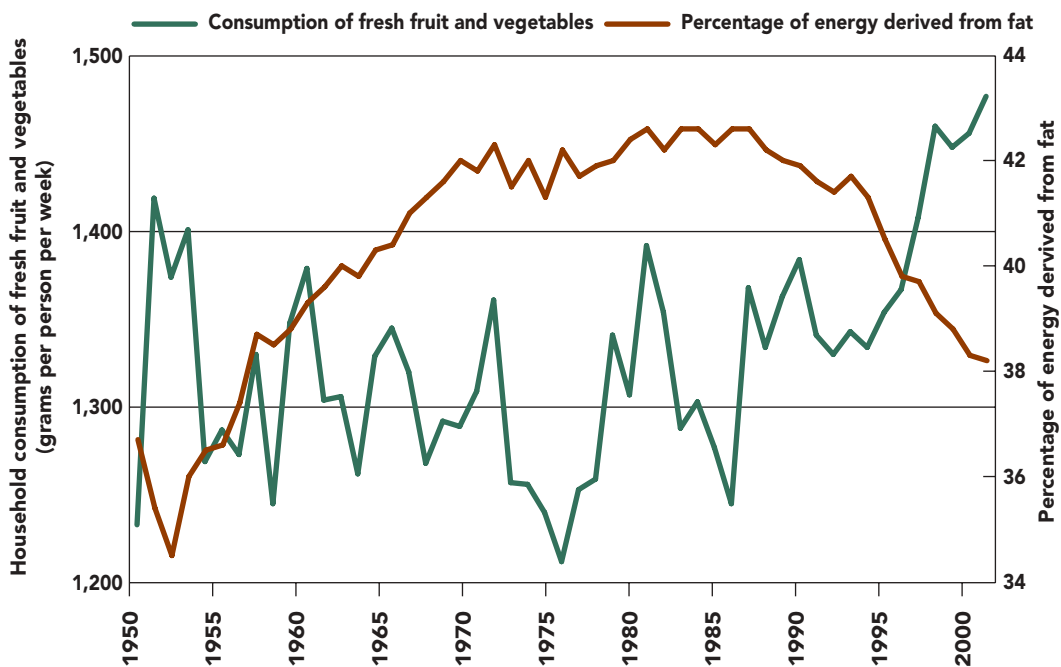
52. This means that food and farming’s contribution to social sustainability through the underpinning of rural economies in England is now increasingly focussed on areas where economic performance is less buoyant and which remain significantly dependent on agriculture.

Public health – Nutrition and workplace safety

53. Food consumption patterns are being shaped by increasingly affluent and informed consumers but current eating patterns, if continued, may also lead to a segmentation of society between the “disciplined” (who take into account health) and the “undisciplined”, leading to subsequent health and nutrition problems. For example, the British Heart Foundation has estimated that treating ill health caused by poor diet costs the National Health Service at least £2bn each year. Obesity has almost trebled in England since the early 1980s; 21% of women and 19% of men are now classified as obese with a further 33% of women and 44% of men classified as overweight. The NAO has estimated that the costs of obesity across the economy as a whole run to £2½bn a year.
54. Food choices are informed by knowledge of dietary recommendations, but also by factors such as taste, availability, price and social and cultural norms and are therefore shaped at every stage of the food chain. In more recent years food consumption patterns have become more favourable (see Chart 26). The consumption of fruit and vegetables has increased by 10% over the last ten years whilst the percentage of energy derived from fat has declined and now stands at 38.2% (by comparison with the targets recommended in Dietary Reference Values of 35%).

Chart 26

Trends in household consumption of fresh fruit and vegetables (a), and percentage of energy derived from fat

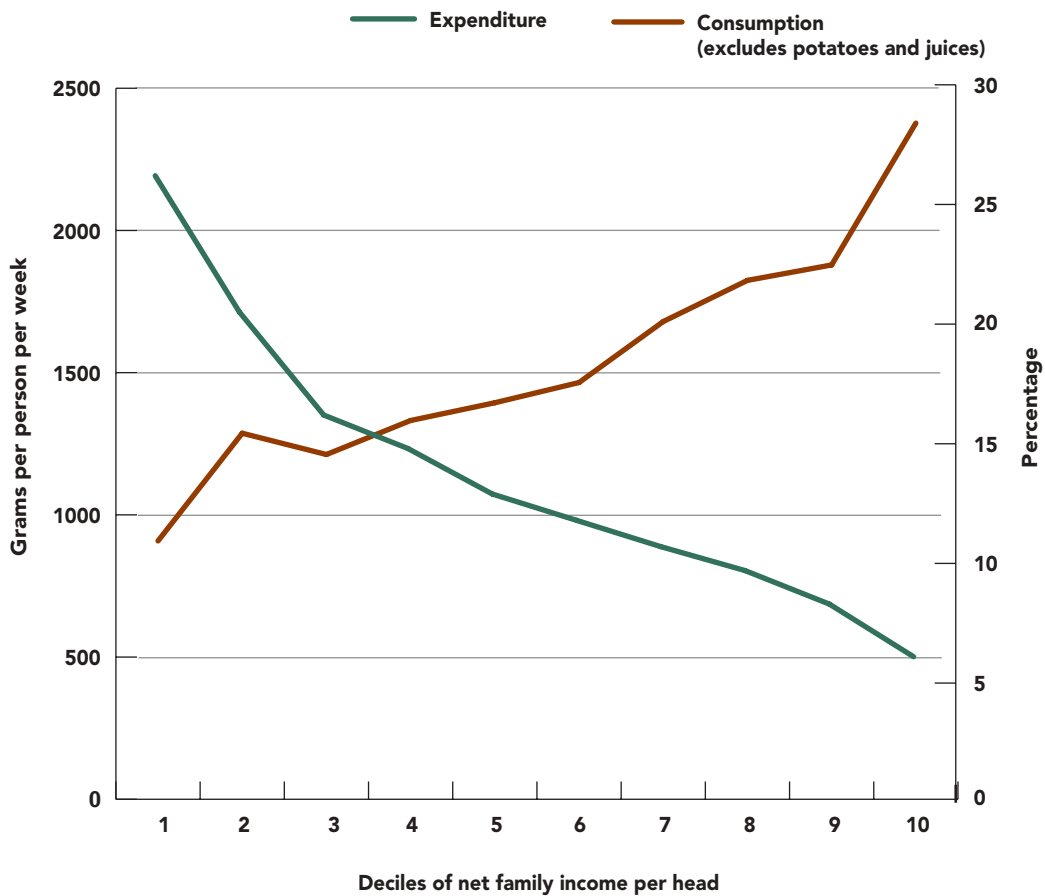


(a) includes only fresh fruit and fresh vegetables (excluding potatoes).
Juices, canned, frozen and other fruit and vegetable products are excluded.
Source: National Food Survey, Defra

55. However, there are marked socio-economic differences in diet and health. For example, the death rate from coronary heart disease is three times higher amongst the unskilled than amongst professionals, and this gap has widened over the latest 20 years for which figures are available. These differences are mirrored in the patterns of food consumption. Expenditure on food and drink is very much more significant in the budgets of lower income families (26% of net family income for the lowest decile) which makes it more difficult to pay any premium for healthy eating (see Chart 27). Food prices kept artificially high by the CAP exacerbate this problem. At the same time higher income households consume far more fruit and vegetables (with the highest decile 2½ times the lowest decile) reflecting both higher spending power but also other household characteristics (e.g. more ready access to a source of supply) .

Chart 27

Expenditure on food and drink as percentage of net family income per head and consumption of fresh fruit and vegetables by income decline: GB 2000

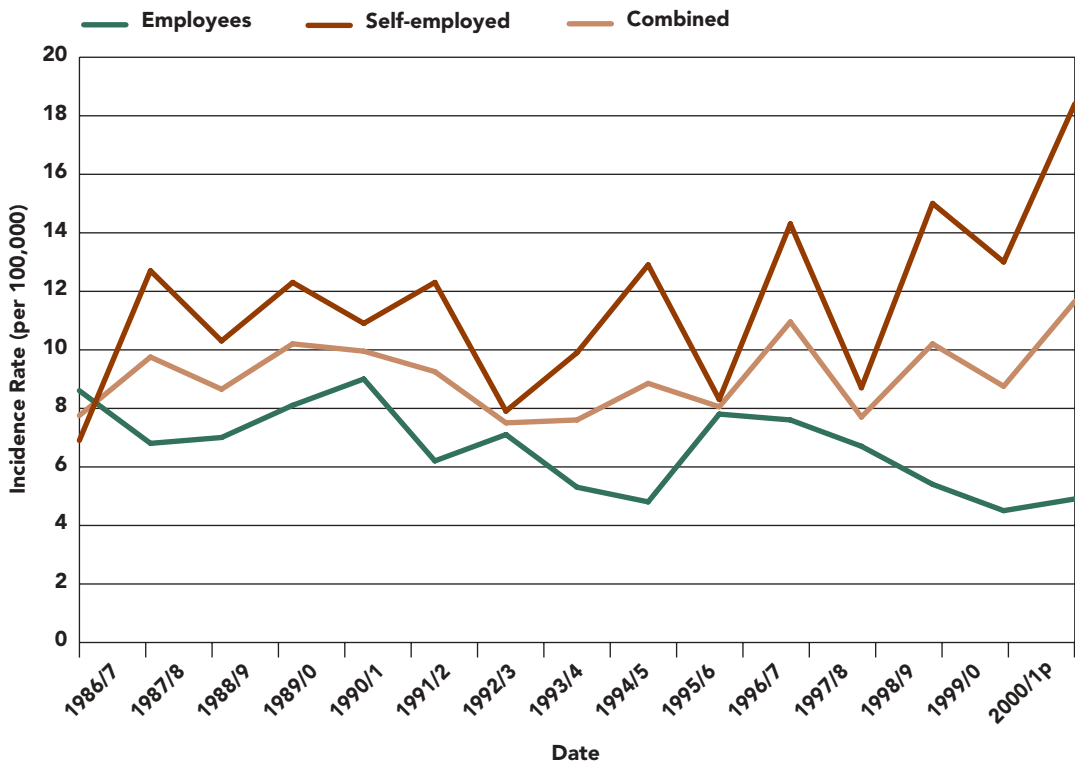


Source: National Food Survey, Defra

56. In relation to occupational health and safety, agriculture has the worst fatal injury rate of any broad employment sector – on average, one fatal accident a week. Over 100,000 working days are lost a year as a result of accidents in the agricultural sector, and these accidents cost the British economy around £130 million. Chart 28 illustrates the sustained trend in fatal injury incident rates.

Chart 28

Fatal injuries – incidence rates



Source: Health and Safety Statistics 1994/95, 1995/96, 1997/98, 2000/01

NB: Injury figures from 1996/7 cannot be directly compared to previous figures due to the introduction of RIDDOR 95

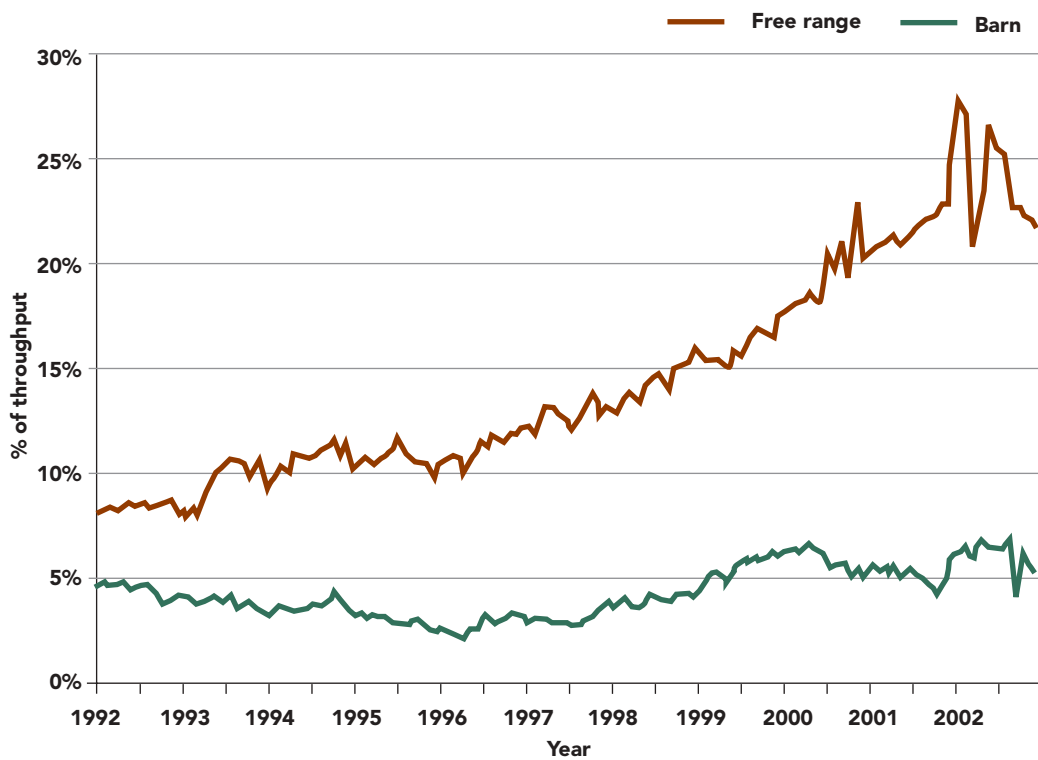
NB: Injury figures from 1991/2 cannot be directly compared to previous figures due to the industry category changing from "agriculture, forestry and fishing", to "agriculture, hunting, forestry and fishing".

Animal welfare

57. Whilst there is a lack of direct evidence on the economic value which people place on animal welfare, there is a range of indicative evidence. This includes the growth in demand for food produced to higher standards of animal welfare and surveys of consumers' willingness to pay for welfare.
58. There are increasing instances of food being marketed on the strength of it being produced in a welfare friendly way. Recently, assured products have increasingly been branded as such, for example through the red tractor logo which specifies legal minimum requirements for animal welfare. There is also evidence that some consumers are willing to pay a premium for food produced to standards or in systems that are perceived to be more welfare friendly. The Freedom Foods scheme set up by the RSPCA in 1994 is a good example. Farms that are affiliated to this scheme are inspected regularly to see that they meet 5 basic freedoms: the freedom from Fear & Distress, from Hunger & Thirst, from Discomfort, from Pain Injury & Disease and to express Normal Behaviour. Just under 2500 farms are currently members. The willingness of consumers to pay a premium for organically produced meat may also be in part due to their perception that organic systems are more welfare friendly.
59. This trend is reflected in retail practice. A number of supermarkets say that they are committed to upholding and improving the standards of animal welfare across all the products they sell and some now sell only free range eggs.
60. Consumers will buy particular foods for a variety of reasons including some perceived aspects of quality, such as "corn fed" or "organic", the expected taste, or the welfare conditions under which the food is produced. Free range eggs are an example of this. Chart 29 shows how the consumption of free range eggs has increased over time, with the share of packing station throughput increasing from 8% in 1992 to around 22% currently. The premium that consumers pay for free range eggs over what they pay for battery eggs provides an indication of the value they assign to the free range system, with free range eggs retailing at nearly twice the price of battery eggs. However, as already noted, not all of this extra value necessarily relates to perceptions of animal welfare: some may relate to other perceived benefits.

Chart 29

UK egg packing station throughput by system



Source: Economics and Statistics Directorate, Defra

61. Some evidence on consumers' willingness to pay for higher welfare standards is available from recent academic studies. One (Glass, Hutchinson and Beattie (2001)) suggested that consumers are prepared to pay more for pork from proposed welfare schemes while another (Burgess, Hutchinson and McCallion (2001)) concluded that the public makes well defined and consistent choices between different welfare schemes, such as Freedom Foods. A public survey commissioned by the Food Standards Agency in September 2001 found that, when prompted, 88% of people rated the conditions in which animals are raised as being very/quite important to them. However, having previously been asked to state the most important factors that influence their choice of food bought, only 10% mentioned production method, 1% explicitly mentioning conditions in which animals are raised, with nearly half (46%) citing price.

62. However the production of food under higher standards can also come at a higher cost of production. For example the EU directive on The Welfare of Laying Hens aims to provide higher minimum standards for birds kept in cages. The costs to UK production of this directive are estimated as being in the region of £46m per year or around 5p per dozen eggs. However this is an average and will vary between the different production systems and between different producers. The banning of veal crates is another example of animal welfare legislation. The Regulation banning the use of Sow Stalls and Tethers also imposed a one off cost on the industry, and raised running costs by between 3% and 11% of annual turnover (CCA Welfare of Livestock Regulations (1994)). These regulations can also lead to an increase in imports from countries with lower standards of animal welfare.

Competitiveness in farming and food

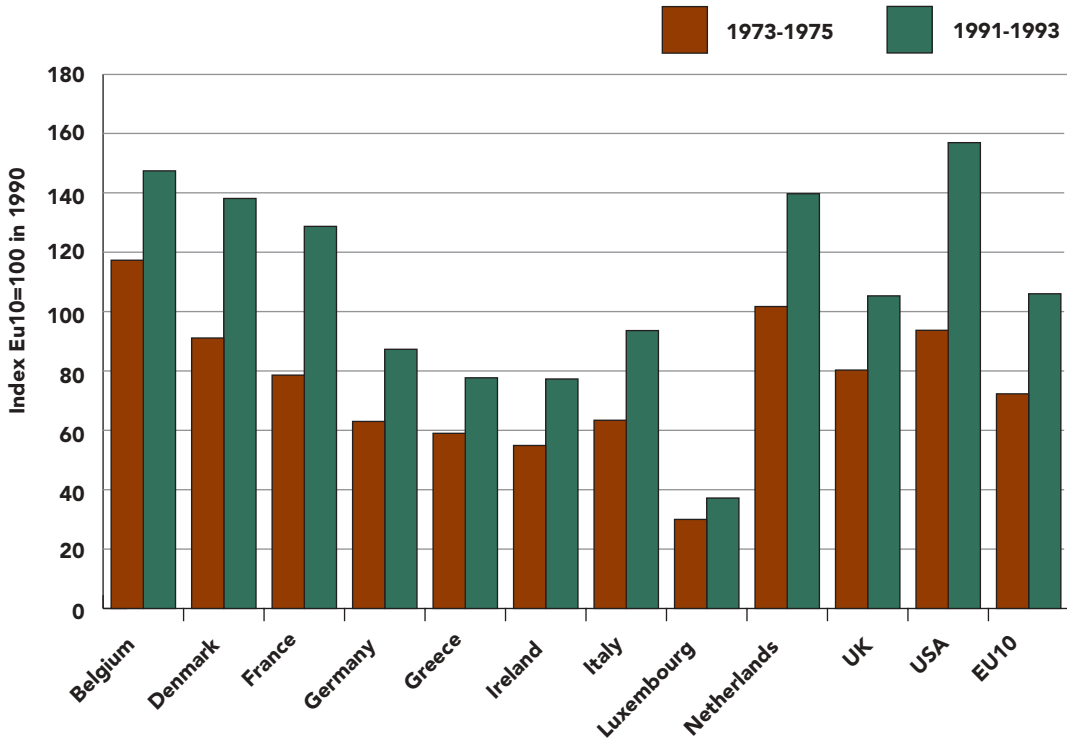
63. This section looks in turn at:
- competitiveness in farming and
 - competitiveness in food and drink manufacturing
64. A key measure of the UK's economic performance is its productivity; that is, how well the economy uses the resources which are available to turn inputs into outputs. Productivity is the main determinant of national living standards. In a similar way, productivity is a key measure of the economic sustainability of UK farming and food. It is an important driver of farm incomes and it is an essential foundation for the environmental and social contributions which farming and food make. However, measuring productivity is not straightforward and comparisons need to be interpreted carefully both because of practical problems in obtaining robust data and also because productivity performance, particularly in agriculture, is often shaped by exogenous factors – to do with climate, topography and location for example – which are not easily susceptible to change.

Competitiveness in farming

65. So how does the productivity of UK farming compare with our competitors? Preliminary research evidence shows that in the mid 1970s the UK's productivity was above the EU average (for the then EU10), although still behind the leading EU countries and the US (see Chart 30 from Schimmelpfennig, D. and Thirtle, C. (1999)). Since then the position has deteriorated. By the early 1990s the UK had fallen back to around the EU average level of performance. And since then the UK appears to have fallen back further (as Chart 31 illustrates), despite accelerated productivity growth in response to the severe financial pressures of the late 1990s. A study by the National Farmers Union concluded that productivity in the UK is now below the top performing EU countries in all the main farming sectors: dairy, cereal, horticulture and livestock (see NFU (1998)).

Chart 30

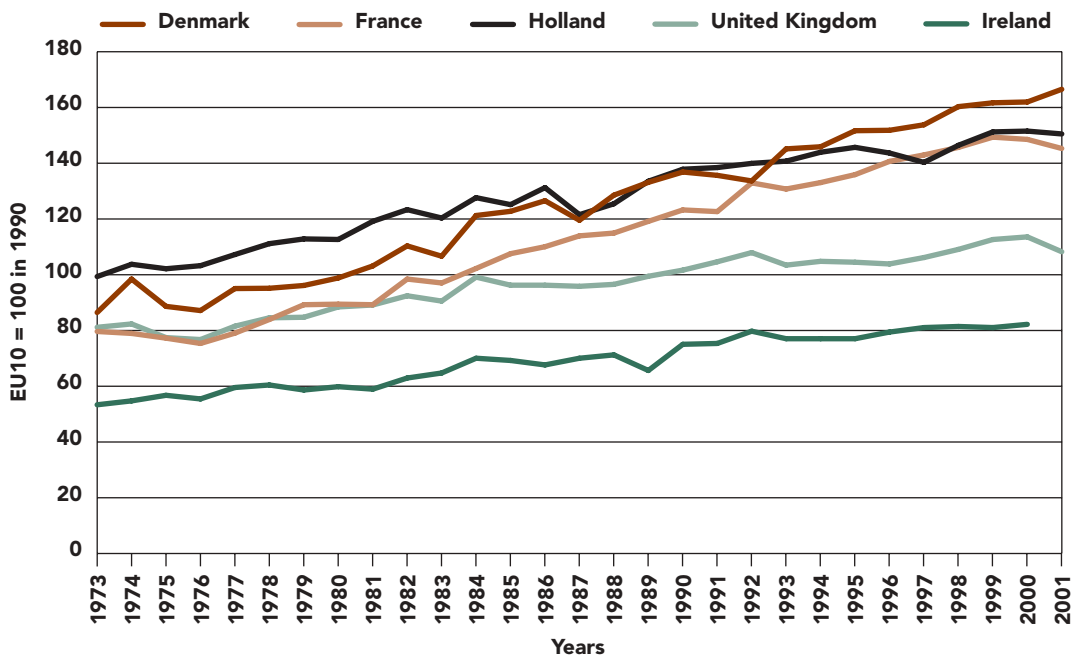
Total factor productivity in agriculture



Source: Schimmelpfennig, D. and Thirtle, C. (1999)

Chart 31

Trends in total factor productivity in agriculture

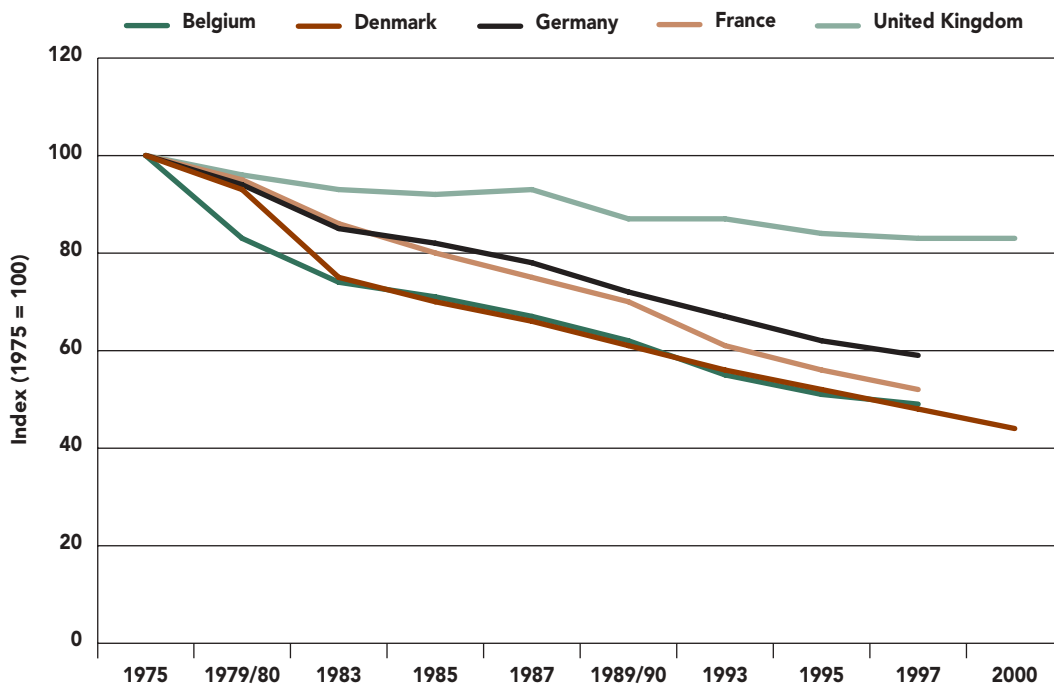


Source: Working paper for Defra by researchers cited in Chart 30 above

66. The UK's slow productivity growth partly reflects a slower pace of restructuring in UK farming. Reductions in the numbers of farms (see Chart 32) and in the numbers of people working in farming (see Chart 33) have generally been at a slower pace in the UK than in the rest of the EU. There is a more detailed discussion of re-structuring in UK agriculture in Maff (1999) and Errington et al (2002).

Chart 32

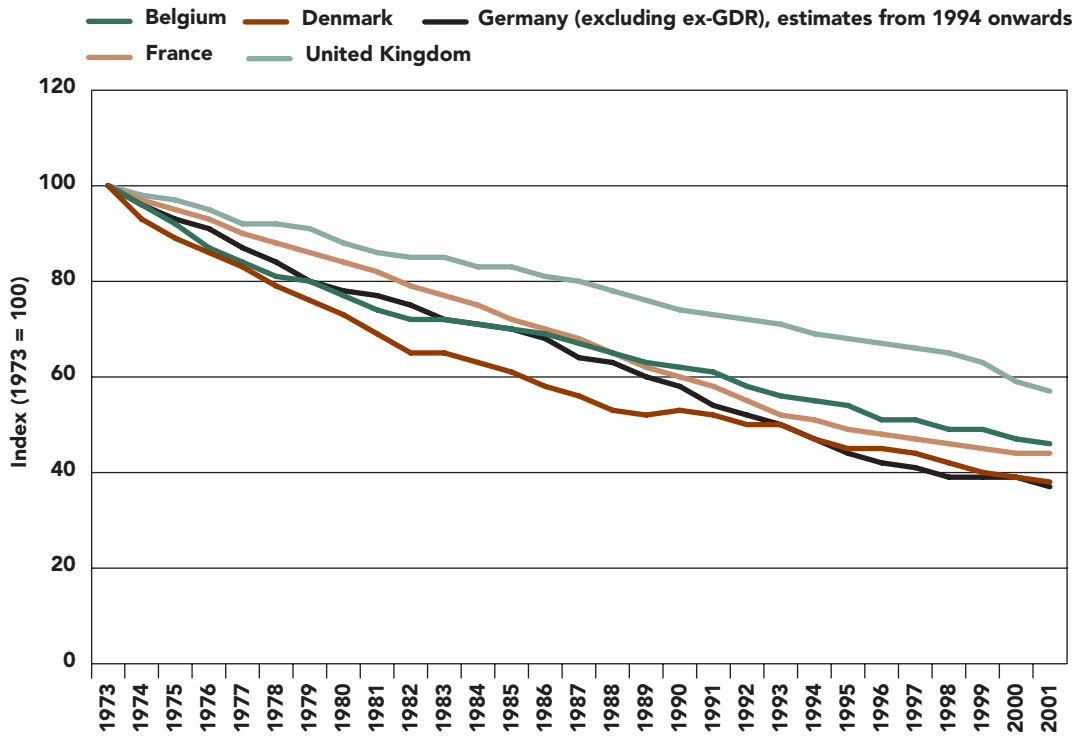
Change in number of agricultural holdings by country



Source: Eurostat

Chart 33

Change in agricultural labour force by country

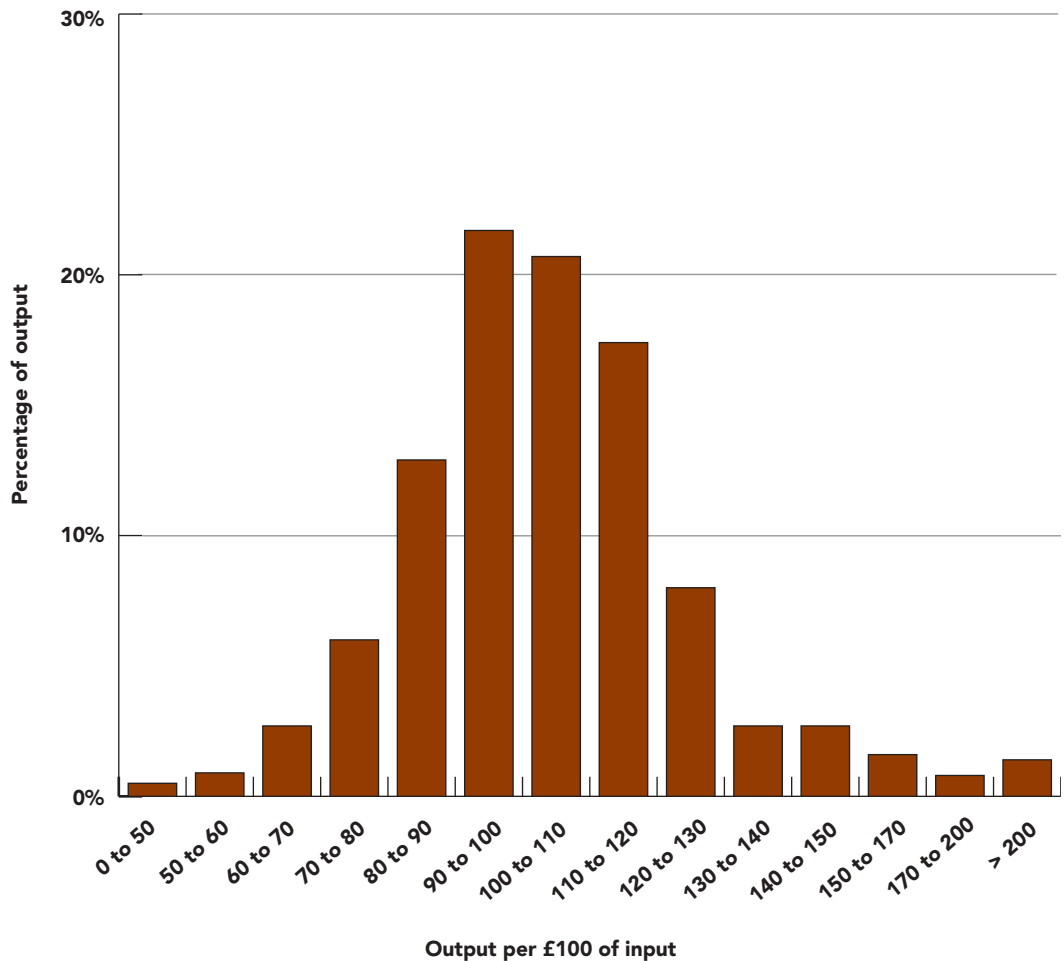


Source: Eurostat

67. Nevertheless comparisons of the productivity performance of different farm businesses in the UK show that there is significant scope to improve performance. Chart 34 shows that there are significant differences across UK agriculture between the better performing farms – in terms of productivity and profitability – and the less successful farms.

Chart 34

All farm types, distribution of performance measures across farms
England 2001/02



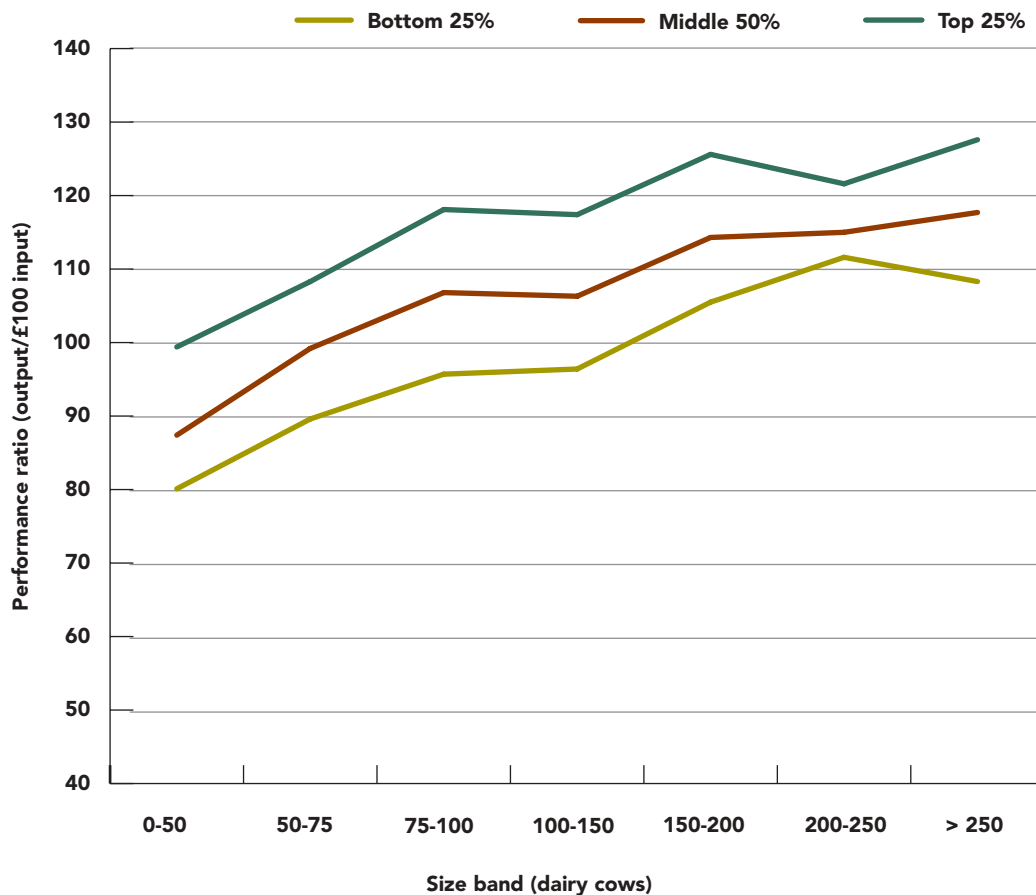
Note: Inputs include an allowance for farmer and spouse labour costs and for capital costs.

Source: Farm Business Survey

68. Research evidence shows that these differences in performance are driven by a combination of differences in costs and differences in the value added achieved from differentiating higher product quality (see Maff (2001) for a discussion of this evidence). Economies of scale are important but equally so too are other factors, relating to skills and business organisation as well as externally determined factors to do with climate and geography (see Chart 35).

Chart 35

Relationship between performance and size (dairy cows) for full time dairy farms, England 2001/02



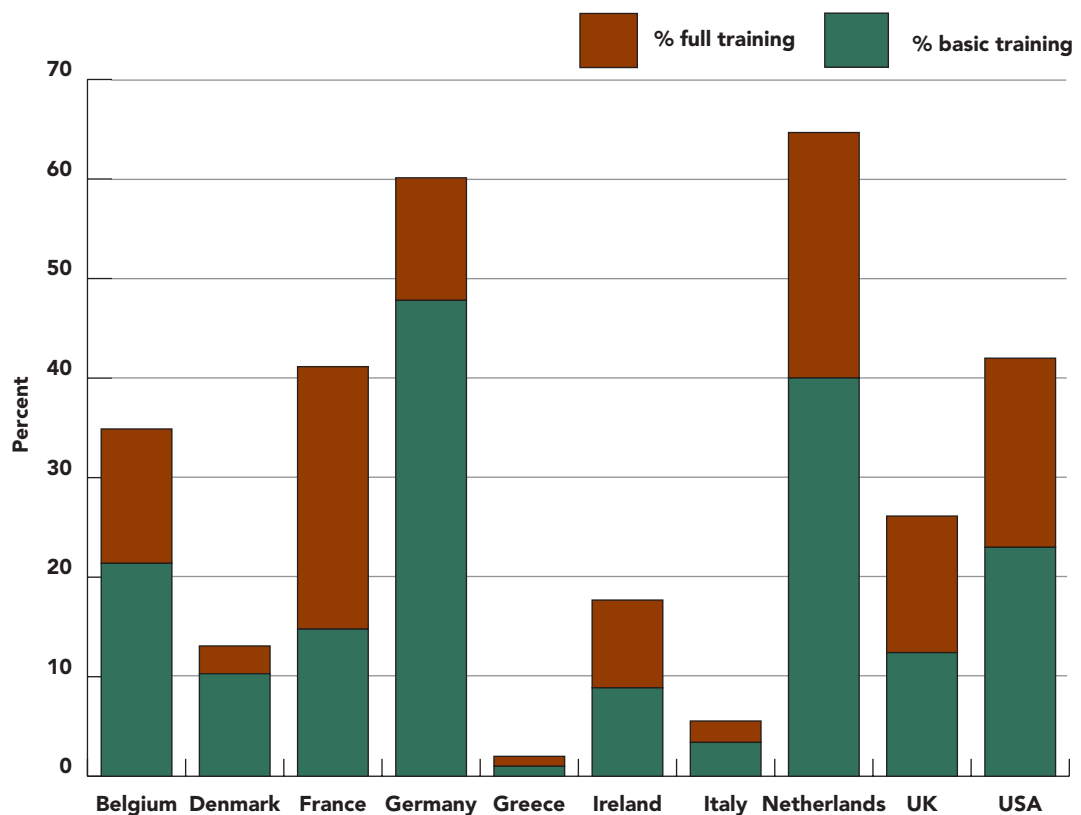
Source: Farm Business Survey

69. What are the key drivers which explain why productivity in UK farming is increasingly lagging behind many other EU countries? In part, there has been a process of “catching-up” by lower productivity countries, but the preliminary research evidence suggests that some countries, but not the UK, have been able to sustain higher levels of productivity growth (see Schimmelpennig, D. and Thirtle, C. (1999)). The evidence on this is incomplete – and sometimes difficult to interpret – but research studies suggest three groups of factors are important:
- Education and skills;
 - Innovation and technology transfer; and
 - Business Structures and Organisation.
70. As in many sectors of the UK economy, the level of education and skills in the agricultural work-force is lower than in many other EU countries (see Chart 36). Initial research findings show that countries with higher skill levels across their economy are also found to have higher productivity in farming, whilst evidence from the UK shows that in some sectors, the better performing farms have a more skilled workforce (see

Maff (2001)). Studies also show that farmers with higher levels of skills are more likely to re-structure their business to improve its performance and that higher levels of skills are associated with greater on-farm innovation and technology transfer (see Errington, A. et al. (2002)).

Chart 36

Percentage of the agricultural workforce with basic and full training in agriculture in the mid-to-late 1990s



Source: Featured in OECD paper on agri-environmental indicators

71. Initial research evidence also shows that Research and Development expenditure (both public and private) and technological spillovers (where businesses in one country benefit by adapting technologies developed in another) are both factors which have helped drive higher productivity performance in the more successful countries (see Schimmelpfennig, D. and Thirtle, C. (1999)). These factors seem to work together. Countries with higher levels of research and higher levels of education are better able to realise the benefits from the transfer of new technologies. In the UK, a Defra Task Force on Inputs concluded that the speed and efficiency with which new technology is applied within farming was an important component in explaining the UK's slow productivity growth.

72. There are also differences in business structures and organisation between the UK and many other EU countries. The development of farmer controlled businesses (or co-operatives) – with their potential for economies of scale, purchasing power regarding input supplies and more effective marketing – has been more pronounced in other EU countries (see Chart 37).

Chart 37

Market shares of co-operatives in the EU in 1997

Percentage	Dairy	Fruit & vegetables	Meat	Grains	Farm inputs
<i>Member State</i>					
Belgium	50	79-90	20-30		
Denmark	93	20-25	66-69	87	59-64
Germany	55-60	60	30		50-60
Greece	20	12-51	5-30	49	
Spain	35	15-40	20	30	
Ireland	100		30-70	69	70
Netherlands	82	70-96	35		40-50
Finland	94		68		40-60
Sweden	99	60	79-81	75	75
United Kingdom	98	35-45	20	20	20-25

Source: Scottish Agricultural College (1998) (based on information from the Plunkett Foundation)

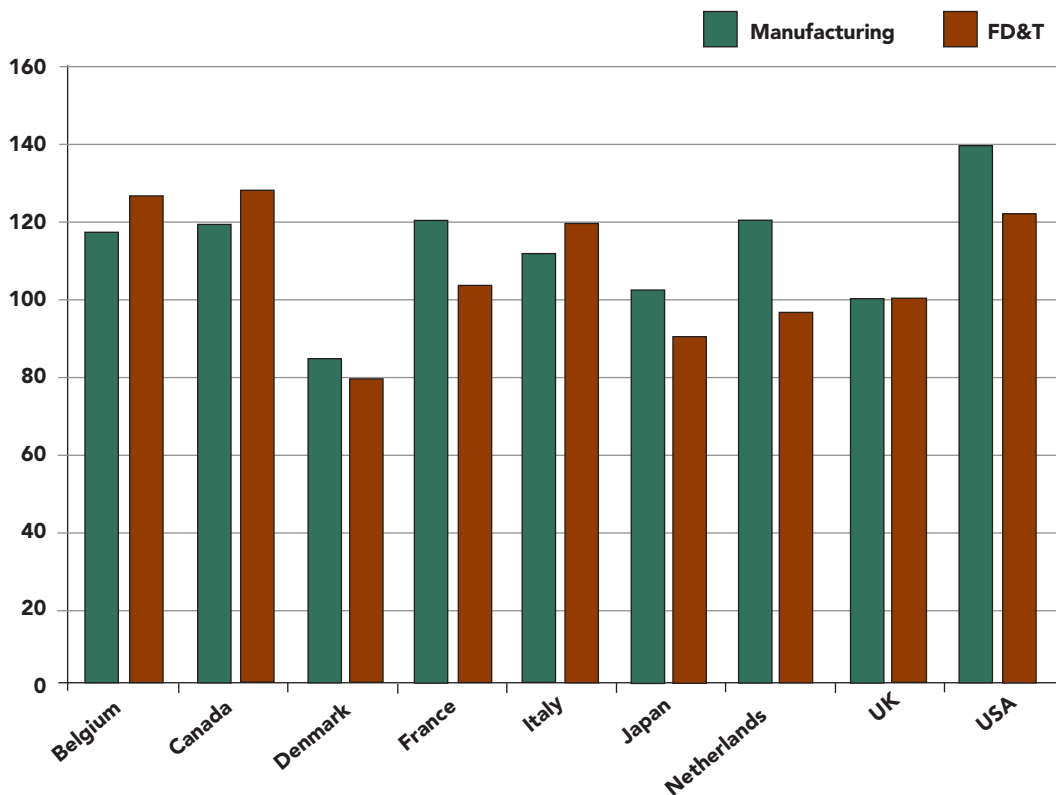
73. Whilst there is only limited evidence on the impact of these differences in business organisation upon productivity, nevertheless evaluation evidence for the UK supports the view that there is scope to improve efficiency in adding value through better linkages in the food chain, and that this would also be to the benefit of farming (see Scottish Agricultural College (1998)). At present the distorted production incentives which flow from the CAP and poor information flows within the food chain have contributed to inefficiency. Evidence from the evaluation studies of processing and marketing development grants show that these schemes have succeeded in promoting the more widespread development of marketing skills and in promoting improvements in product quality.

Competitiveness in food and drink manufacturing

74. Productivity performance in the UK's food processing sector lags behind many of our competitors. Comparisons across a selection of OECD countries in 1994, (see Chart 38) showed that the UK was over 20% behind the productivity leaders – Belgium, Canada, the USA and Italy – with only Japan, the Netherlands and Denmark (out of the countries covered) showing lower productivity. More recent research, which compares a smaller range of countries in 1999, shows that the UK's productivity continues to lag over 20% behind the US, although comparing favourably with France and Germany (see Chart 39).

Chart 38

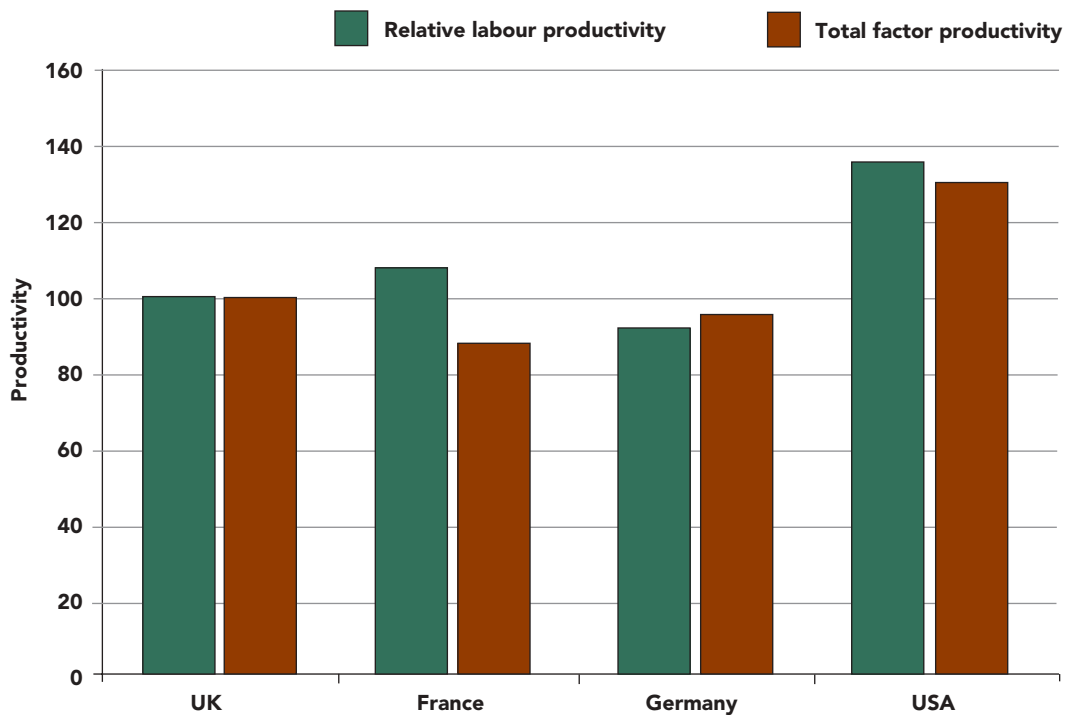
Total factor productivity in the food industry and all manufacturing, 1994* (UK = 100)



Source: Data taken from the Industrial Sectoral Database (ISD) and Structural Analysis Database (STAN), OECD.

Chart 39

Relative labour and total factor productivity in the food, drink and tobacco manufacturing industries (UK = 100)

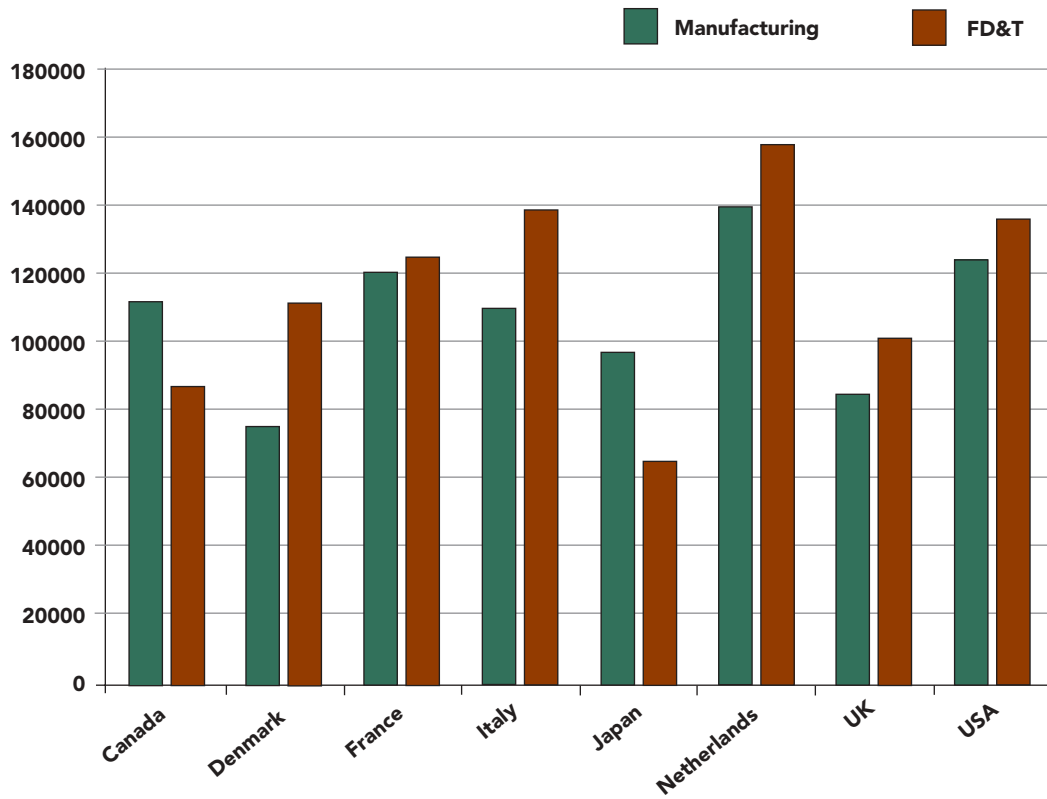


Source: O'Mahony, M. and de Boer (2002)

75. As with farming, the research evidence doesn't give a complete picture on the reasons for the UK's relatively weak productivity performance; but three groups of factors seem important:
- Capital Investment;
 - Education and Skills; and
 - Innovation and technology transfer.
76. As in many other sectors of manufacturing the UK's food and drink sector has a relatively low stock of capital per worker (see Chart 40). This is a major explanation for relatively poor labour productivity in the UK.

Chart 40

Capital stock per worker in food and drink processing and in manufacturing, 1994



Source: OECD data, Defra estimate

Notes: in 1990 prices converted into \$ at purchasing power parity; US estimate is for 1993

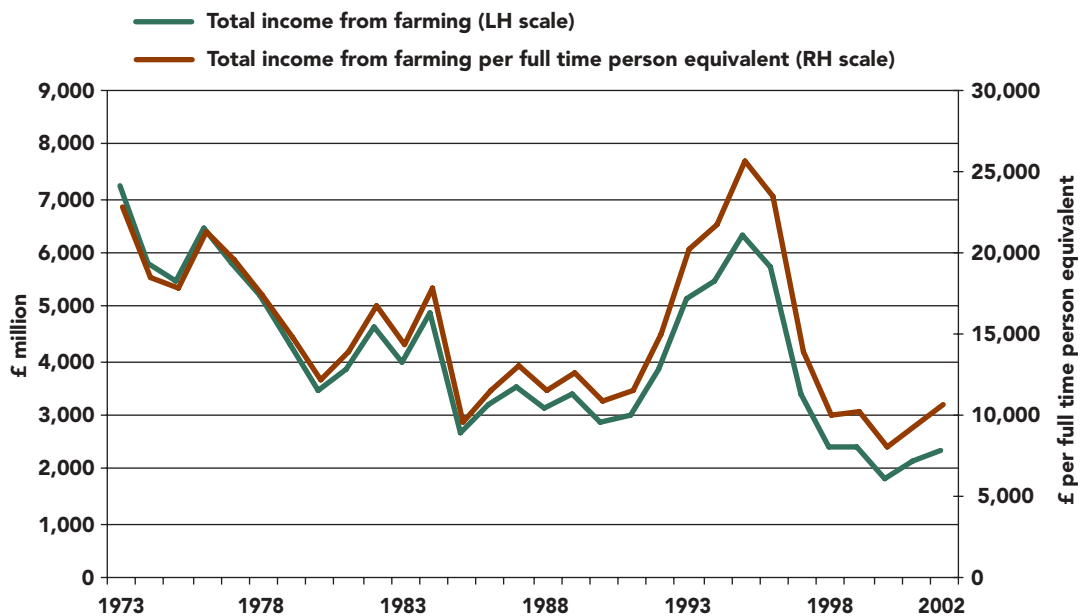
77. The UK food and drink sector also has a work-force with a lower level of skills. A study in 1998 found that the number of employees in the UK food and drink industry with educational qualifications was 30% lower than the EU average and 40% less than Japan, and that the number of employees with vocational qualifications was 20-30% lower than the EU and Japan (see Mason, G., van Ark, B. And Wagner, K. (1994)). Research has shown that this deficit in skills has hampered productivity in some sectors of the UK food and drink industry, particularly for small and medium sized plants.
78. A detailed study by McKinsey (see McKinsey Global Institute Report (1998)) comparing the UK with the US and (West) Germany – also showed weaknesses in innovation and technology transfer. In particular, McKinsey's found that UK companies:
- i. tended to be more likely to manufacture low value added products;
 - ii. had higher levels of product proliferation which resulted in lower levels of automation; and
 - iii. lacked marketing skills.

Current and future business prospects in farming

79. The farming sector faces severe financial pressures which, without a significant shift in competitiveness, are likely to continue. Some prospective policy and regulatory developments – for example, modulation– are likely to increase these pressures.
80. In 2000, the “Total Income from Farming” in the UK (the returns to the labour and entrepreneurial input of farmers, spouses and other directors) was at its lowest level, in real terms, since the depression of the late 1930s. Since then, there has been a small recovery (see Chart 41). For some farm households the downturn will be partly cushioned by other sources of income. More than a half of full time farms in England have diversified sources of income (either through off-farm employment or other types of business on the farm) and for a significant number of these households diversified income is at present more important than the income earned from farming.

Chart 41

Agricultural industry income trends in the UK (real terms at 2002 prices)

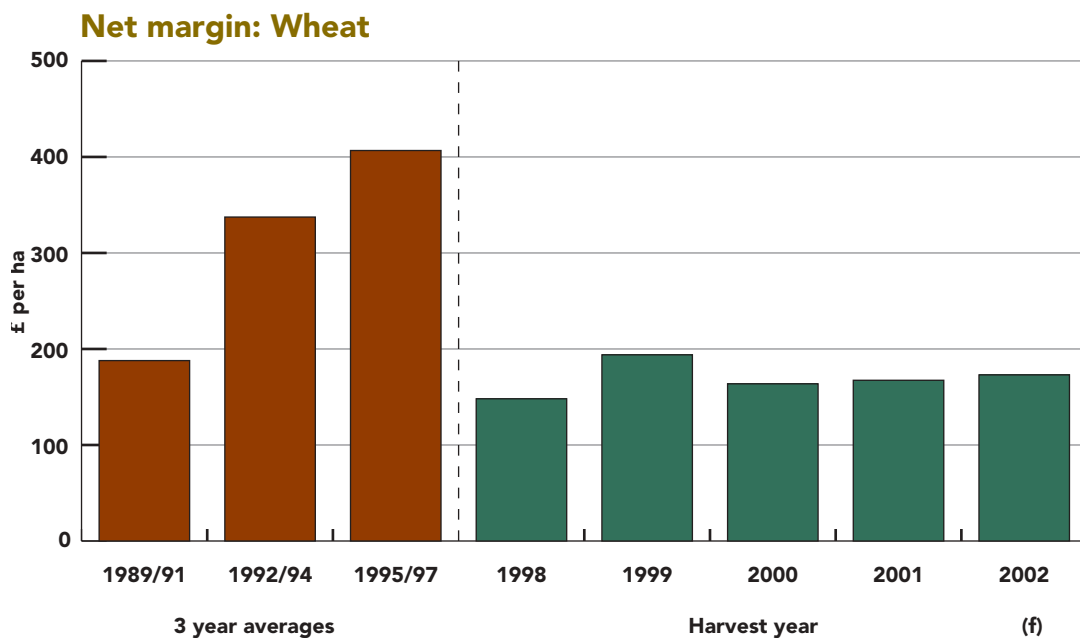


Source: Economics and Statistics Directorate (York), Defra

81. The trends in the chart are shaped by a mix of long-term and short-term drivers. Over the longer-term, the decline in agriculture’s share in the economy will put downward pressure on the aggregate of total farming income as the size of the sector shrinks. The level of income per farmer would be expected to be more stable, as the chart shows, but the decline in the UK’s competitiveness will have exerted downward pressure on this indicator as well.

82. The steep decline in incomes since the mid 1990s has been shaped by a combination of more immediate drivers. The exchange rate is of greatest significance. A Defra Task Force on Inputs showed that farming is particularly exposed to exchange rate movements because the value of much of its outputs is highly sensitive to shifts in the pound/euro rate whilst the prices of most inputs are largely insensitive to the exchange rate (see Maff (2001)). The result is that the decline in the pound/euro rate after the UK left the ERM, in the early 1990s, led to a boom in farming's profitability which was reversed as the pound/euro rate increased in the latter half of the decade.
83. Whilst the exchange rate has been the key driver of the rapid reduction in farm incomes since the mid 1990s, other relevant factors are:
- weak world commodity prices, as growth in the world economy slowed following financial turbulence in the Far East and Eastern Europe in 1997 and 1998; and
 - the impact of BSE and, more recently, foot and mouth disease.
84. Analysis of individual sectors of farming (see Chart 42) show that profitability levels have been low in most sectors, reflecting the over-arching impact of the pound/euro exchange rate.

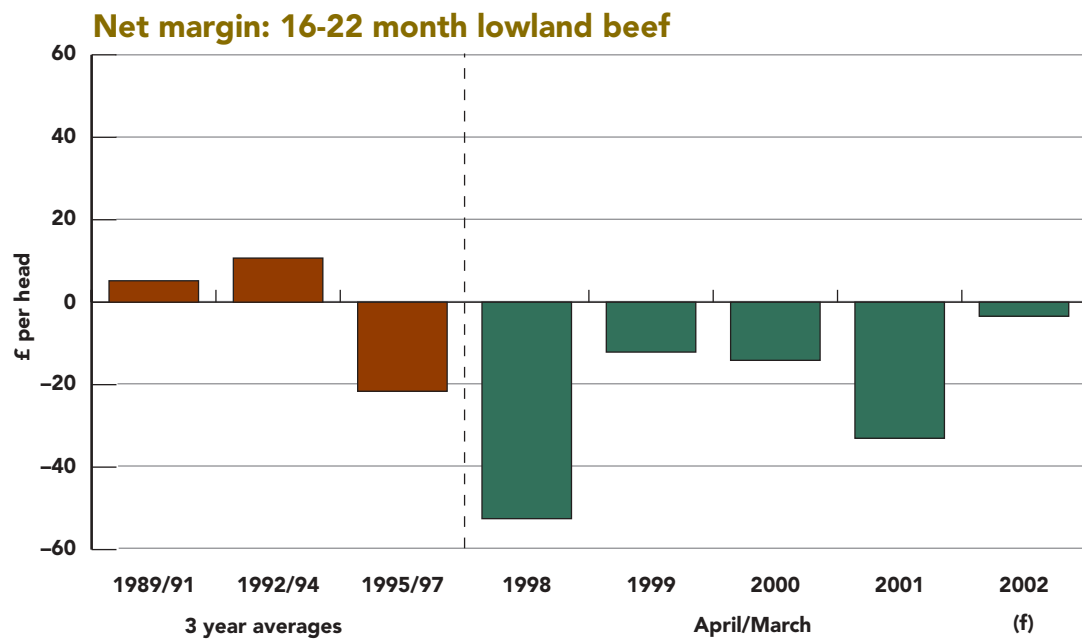
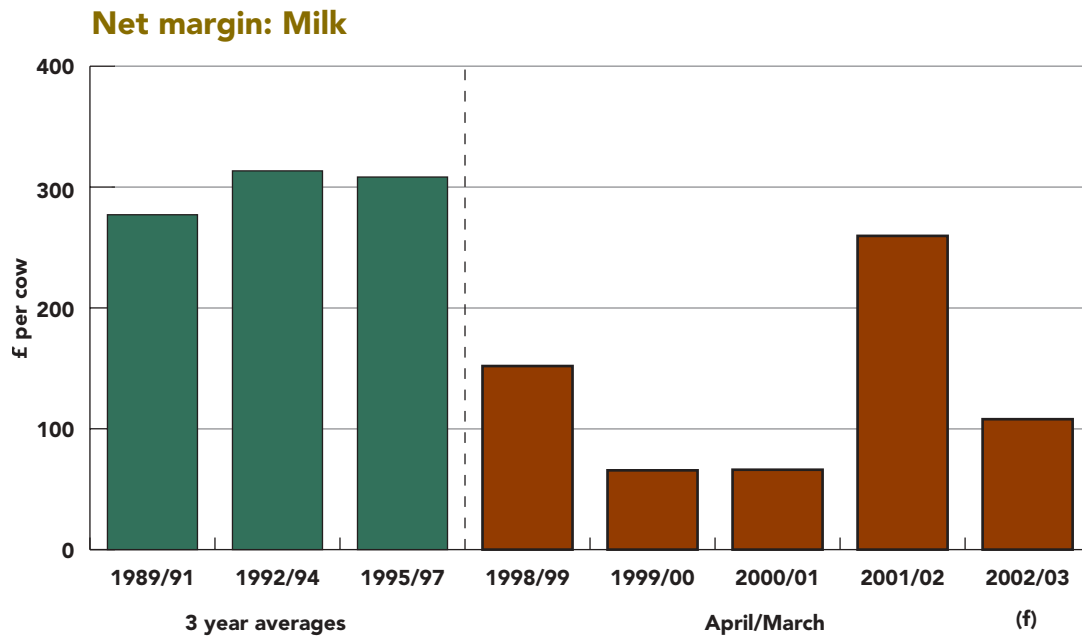
Chart 42
Farm incomes in individual sectors



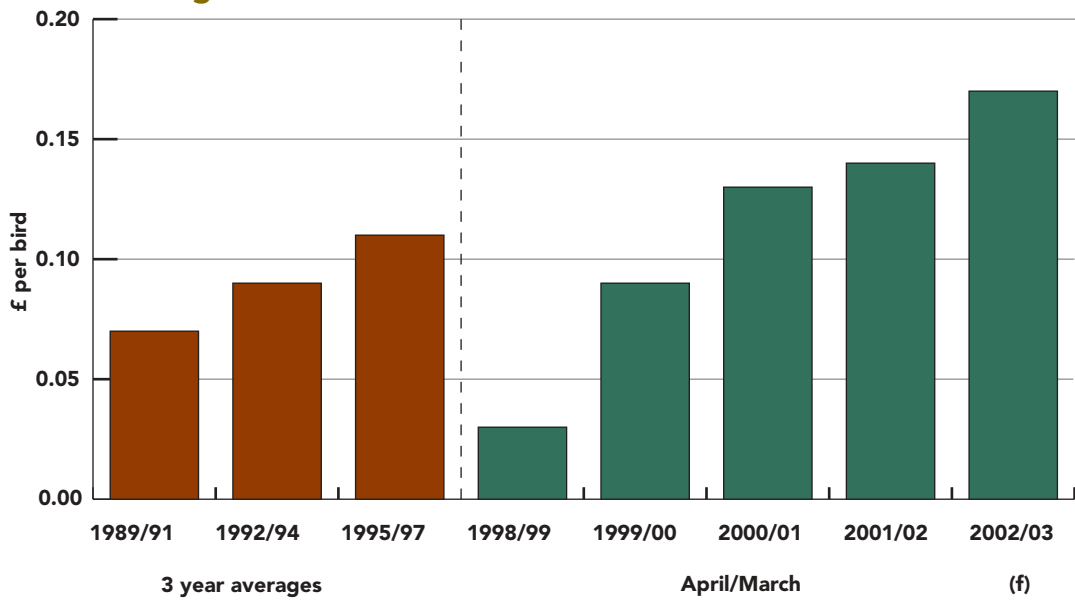
Source: Defra

Chart 42 (continued)

Farm incomes in individual sectors



Net margin: Table chickens



Net margin: Eggs

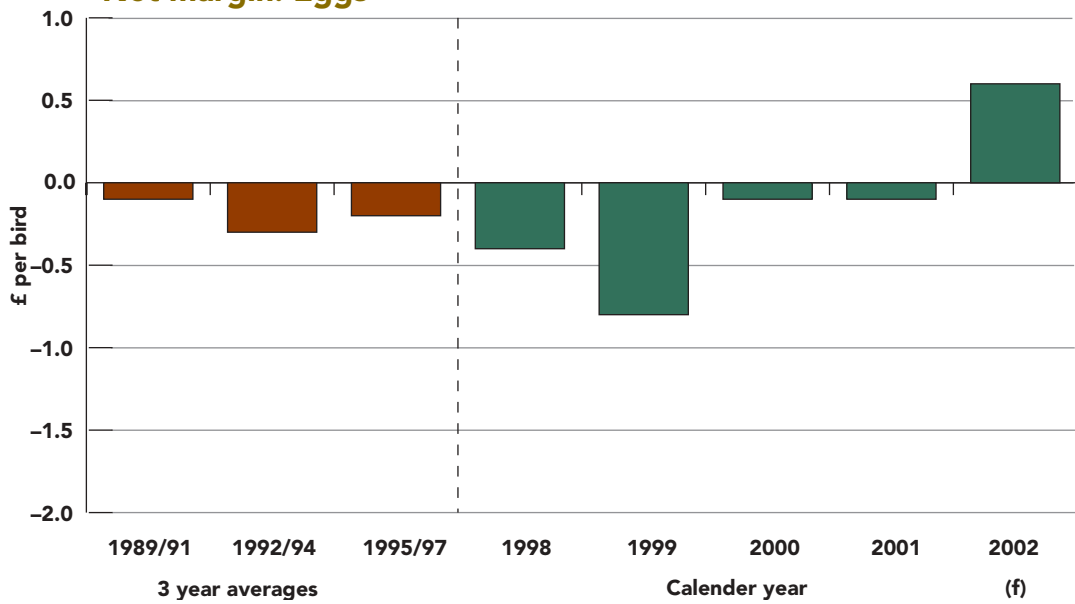
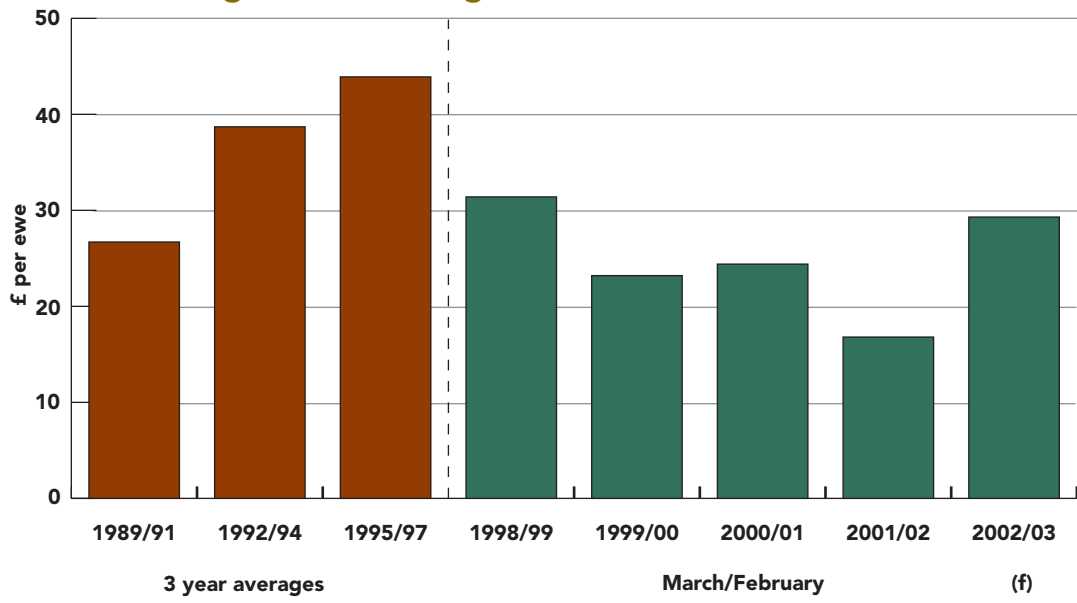
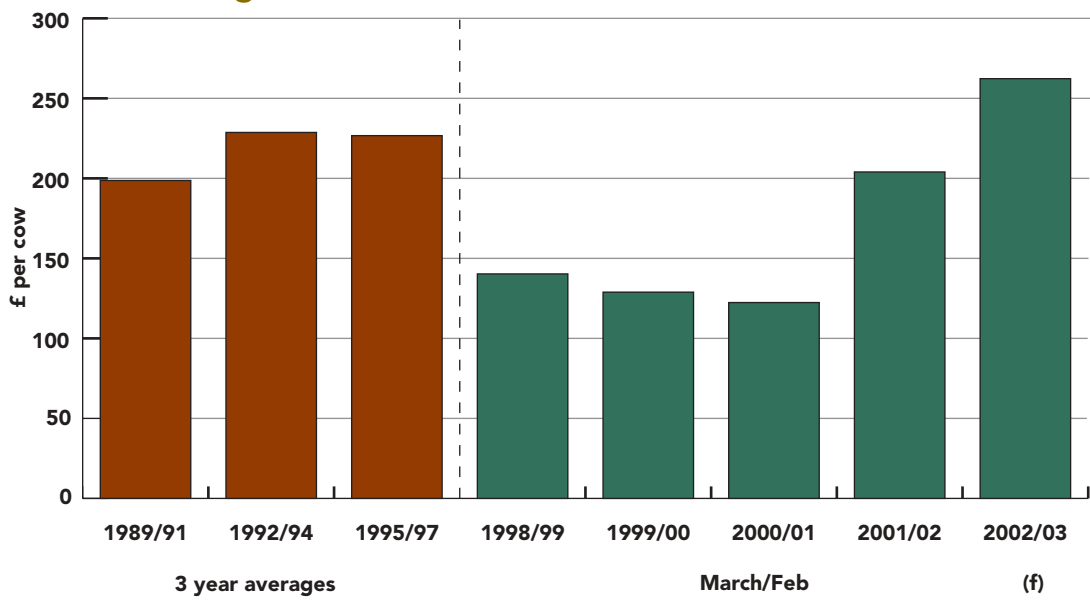


Chart 42 (continued)
Farm incomes in individual sectors

Gross margin: Hill breeding ewes



Gross margin: Hill suckler cows



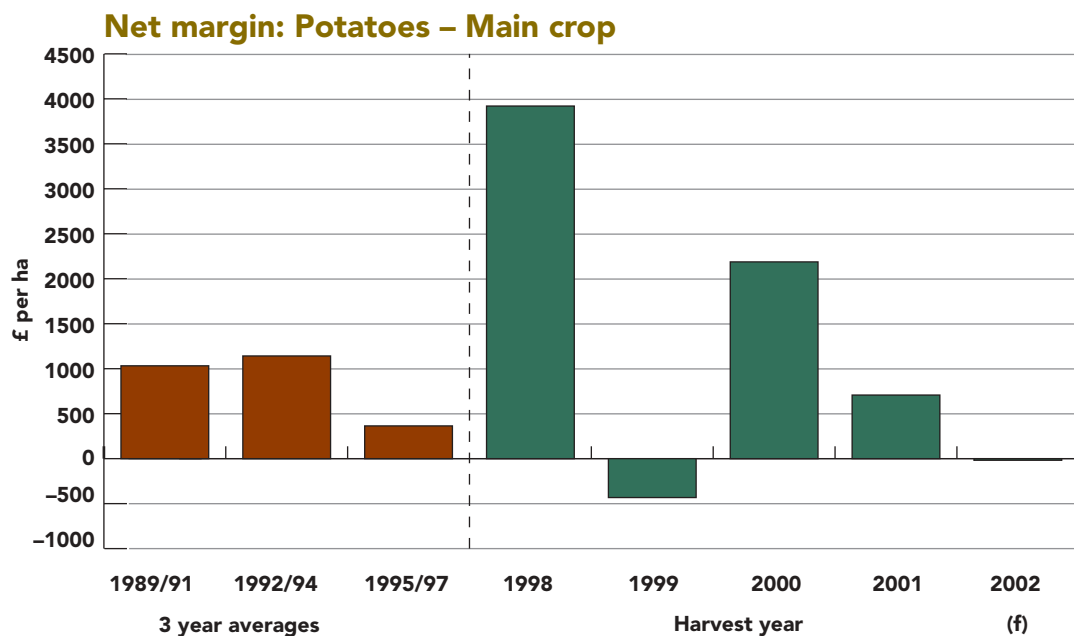
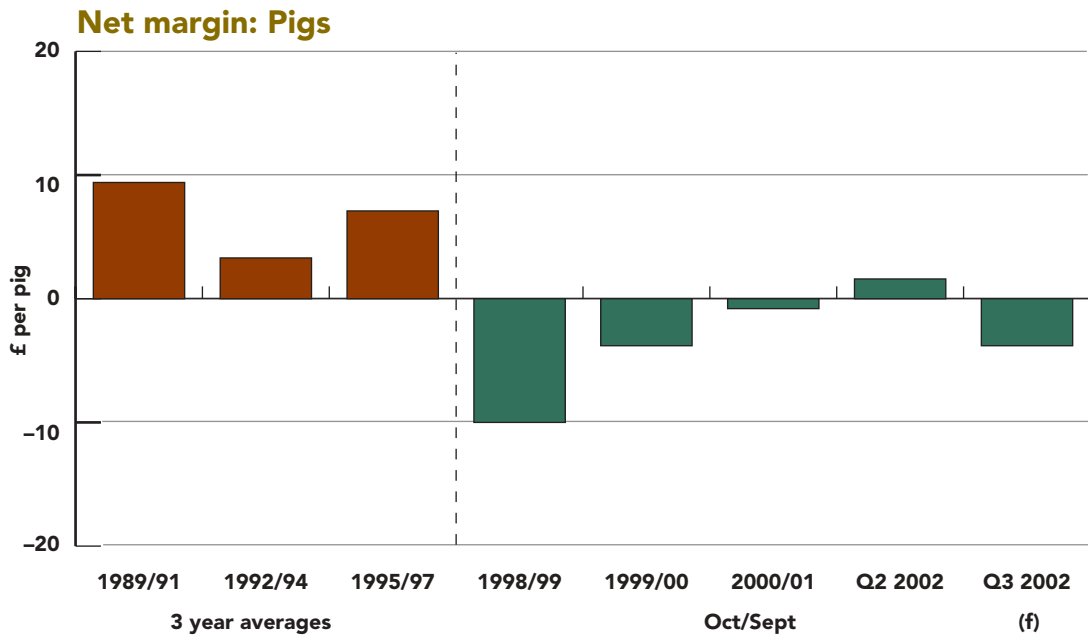
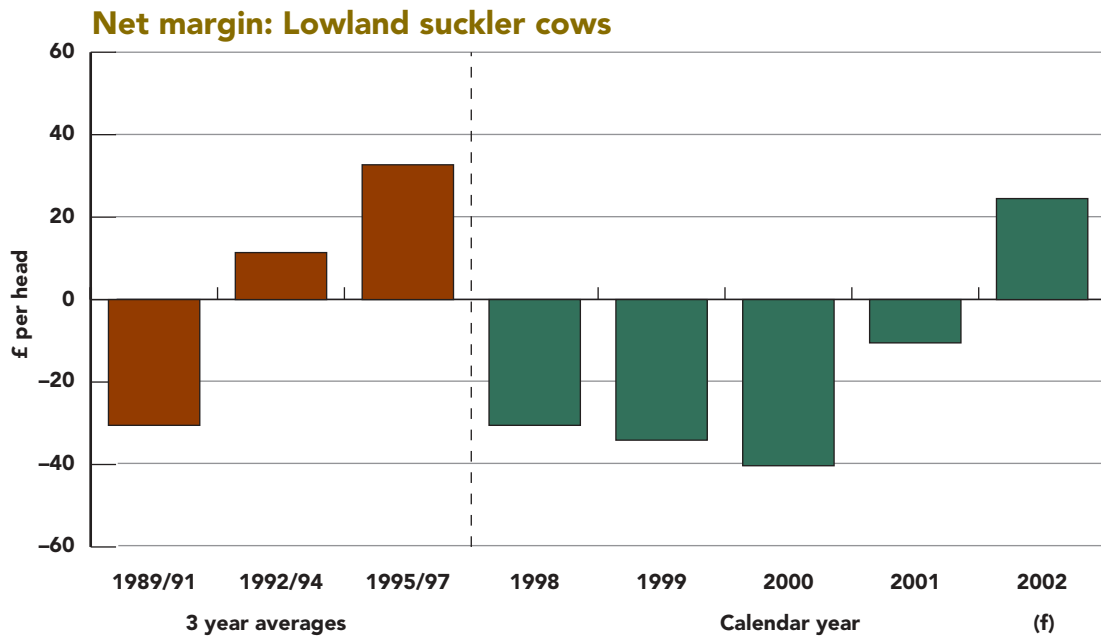
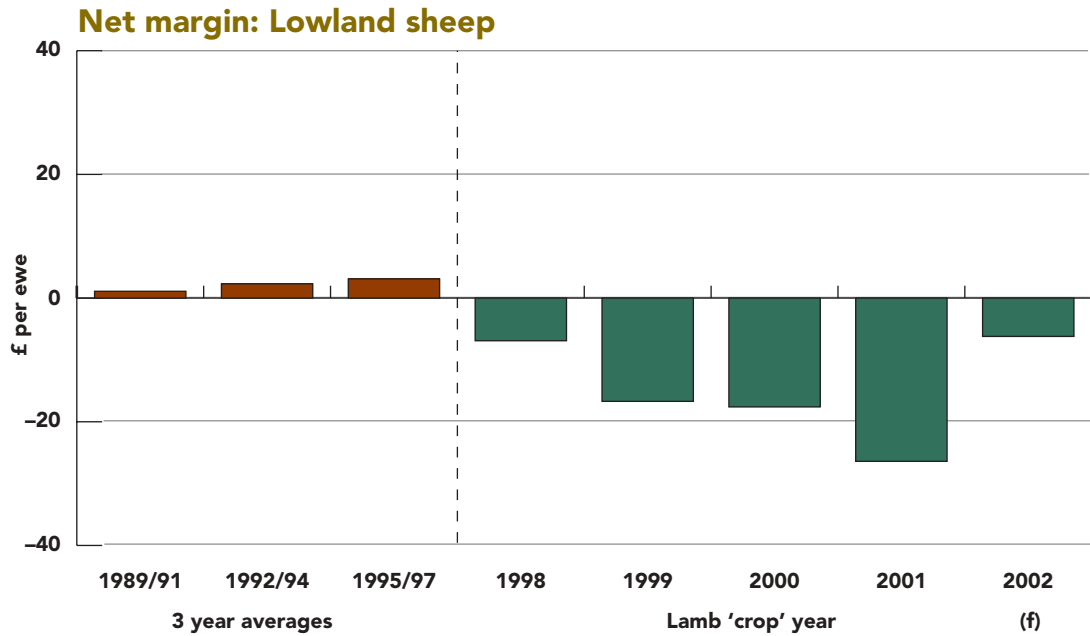


Chart 42 (continued)
Farm incomes in individual sectors

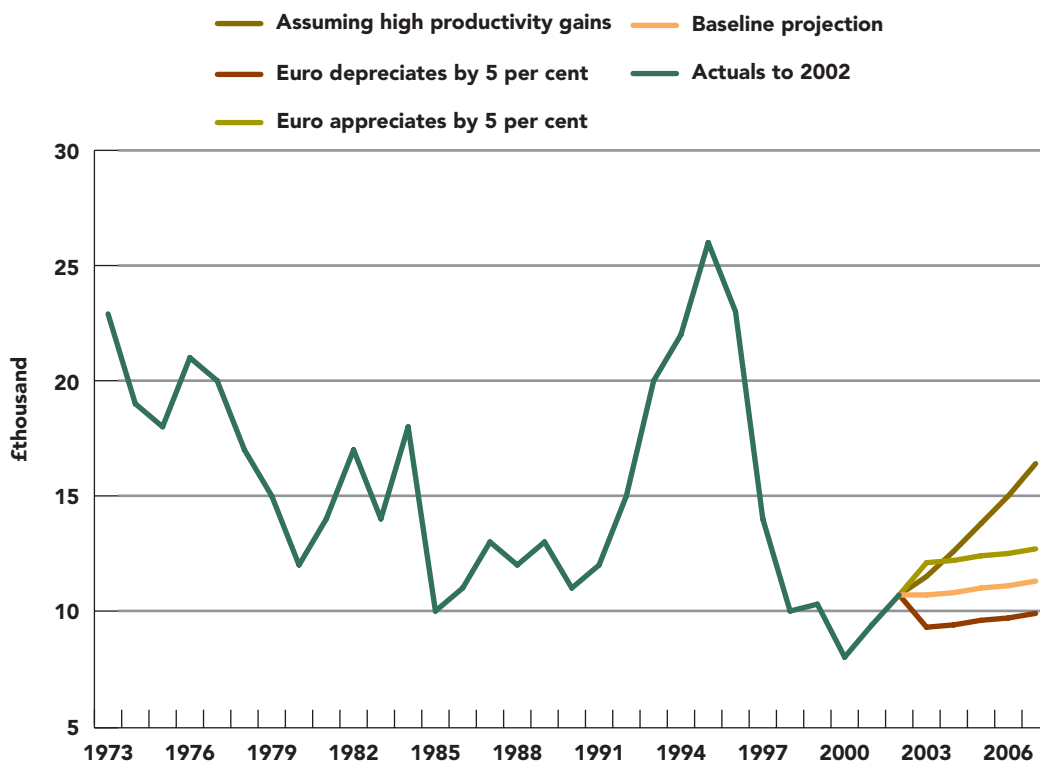


Source: Defra

85. The future business prospects for farming will reflect the inter-action of the key drivers (both long-term and short-term) which have shaped the present position. Chart 43 shows some stylised projections of underlying trends; it should be emphasised that these types of projection have very broad margins of uncertainty and also that agriculture is an industry where specific events – a disease outbreak or poor weather – can shift incomes from the underlying trend in individual years. The methodology used to develop the projections in Chart 43 (and Chart 42) is described in more detail in Maff (2000).

Chart 43

Projections of total income from farming up to 2007: in real terms at 2002 prices per full time person equivalent



Source: Defra

86. The projections indicate that the modest extent of expected recovery in world commodity markets over the next five years is likely to provide for only a marginal increase in the average level of income per farmer; future forecasts of world commodity prices are, however, quite uncertain.
87. A second key driver is the pound/euro exchange rate, and the projections show the potential importance of this. Most private sector macroeconomic forecasters expect the euro to rise against the pound but there is considerable uncertainty on how much of a shift is likely and on what timescale. Many of the forecasters expect a shift of up to 5%, and the chart shows that this would leave incomes at a relatively depressed level.
88. The other key driver is productivity. The previous discussion of competitiveness outlined the slower trend in productivity growth in the UK, as compared with many other EU countries. Chart 43 illustrates what might happen to incomes if this trend could be reversed by sustaining the exceptionally high rates of productivity growth which were achieved (under severe financial pressure) in the late 1990s.

References

- British Retailing Consortium Retail Link (2000) "Waste Not." Retail Link, Summer 2000.
- Burgess, D. E., Hutchinson, W. G. and McCallion, T. (2001) "Does Choosing and Pricing Methods Reveal Similar Public Preferences for Implementing Welfare Improvements for Several Major Farm Animal Species." Paper presented at the Agricultural Economics Society Annual Conference, Harper Adams University College, 10-13 September 2001.
- CCA Welfare of Livestock Regulations 1994.
- Defra, Agricultural and Horticultural Census (June 2000).
- Defra, Agriculture in the United Kingdom.
- Defra, National Food Survey.
- DETR (2000), Transport of Goods by Road in Great Britain, 1999. Department of the Environment, Transport and the Regions
- Errington, A. et al. (2002) "Implications of Changes in the Structure of Agricultural Businesses." Research Paper Prepared for the Department for Environment, Food and Rural Affairs, University of Plymouth.
- Environment Agency (2002) "Agriculture and Natural Resources: Benefits, Costs and Potential Solutions."
- European Commission, Court of Auditors Report (various years).
- European Commission, EUROSTAT.
- Food and Drink Federation (2002) "World Summit on Sustainable Development – Contribution by the UK Food and Drink Manufacturing Industry." FDF, London.
- Francois, J. (2000) "The Economic Impact of New Multilateral Trade Negotiations: Final Report." Tinbergen Institute and the Centre for Economic Policy Research. Report Prepared for DG-II of the European Commission.
- Glass, C. A., Hutchinson, W. G. and Beattie, V. E. (2001) "Investigating Issues of Overstatement in a CVM Study of Willingness to Pay for Pig Welfare Improvements." Paper presented at the Agricultural Economics Society Annual Conference, Harper Adams University College, 10-13 September 2001.
- Hartridge, O. and Pearce, D. (2001) "Is UK Agriculture Sustainable? Environmentally Adjusted Economic Accounts for UK Agriculture." *CSERGE-Economics Paper*.
- HSE, Health and Safety Statistics.
- Ilbery, B. (1998) "The Geography of Rural Change." Longman.
- Lloyd, T., McCorrison, S., Morgan, W. and Rayner, A. (2002) "A Further Investigation into the Relationship Between Producer, Wholesaler and Retailer Prices of Beef, Pork and Lamb." A Report Prepared for Defra. Unpublished.

- Marks, H. F. (1989) "A Hundred Years of British Food and Farming: A Statistical Survey." Edited by D. K. Britton. Taylor and Francis.
- Mason, G., van Ark, B. and Wagner, K. (1994) "Productivity, Product Quality and Workforce Skills: Food Processing in Four European Countries." National Institute Economic Review, 147: pp62-83. Paper originally prepared under the auspices of the National Institute of Economic and Social Research.
- McKinsey Global Institute Report (1998) "Driving Productivity and Growth in the UK Economy." Report published by the McKinsey Global Institute. Website address: www.mckinsey.com/knowledge/mgi/UKProd/
- Maff (1999) "Re-Structuring of Agricultural Industry". Working Paper prepared by the Economics and Statistics Group of the Ministry of Agriculture, Fisheries and Food.
- Maff (2000) "Economic Appraisal of Rural Development Options". Working Paper prepared by the Economics and Statistics Group of the Ministry of Agriculture, Fisheries and Food.
- Maff (2001) "The Structure of Agricultural Input Costs: The Impact of Input Prices and Input Utilisation." Working Paper prepared by the Economics and Statistics Group of the Ministry of Agriculture, Fisheries and Food.
- NFU (1998) "Is UK Agriculture Competitive?: A European Perspective." National Farmers Union (NFU) Economics, NFU.
- O'Mahony, M. & de Boer, W. (2002) "Britain's Relative Productivity Performance: Updates to 1999." Final Report to Department of Trade and Industry/HM Treasury and Office for National Statistics, National Institute of Economic and Social Research (NIESR).
- OECD, Monitoring and Evaluation Report (various years).
- ONS, Annual Local Area Labour Force Survey (2000).
- ONS, Annual Business Inquiry.
Website address: <http://www.statistics.gov.uk>
- ONS, Consumer Trends.
Website address: <http://www.statistics.gov.uk>
- ONS, Quarterly Labour Force Survey.
- Pretty, J. et al. (2000) "An Assessment of the Total External Costs of UK Agriculture." *Agricultural Systems*, Vol 65: pp113-136.
- Roberts, S. (2002) "Sustainable Development Beyond the Farm Gate". A scoping study prepared for Defra.
- Schimmelpfennig, D. and Thirtle, C. (1999) "The Internationalisation of Agricultural Technology: Patents, R & D Spillovers and Their Effects on Productivity in the European Union and the United States." *Contemporary Economic Policy*, Vol 17(4): pp457-468.

Scottish Agricultural College (1998) Evaluation of Marketing Development Scheme and Group Marketing Grants.

Thompson, D., Muriel, P., Russell, D., Osborne, P., Bromley, A., Rowland, M., Creigh-Tyte, S., and Brown. C. (2002) "Economic Costs of the Foot and Mouth Disease Outbreak in the United Kingdom in 2001." *Rev. Sci. Tech. Off. Int. Epiz.* 21(3): pp675-687.

United Kingdom Agricultural Supply Trade Association (UKASTA).

United Kingdom National Accounts: The Blue Book, ONS.

Website address: <http://www.statistics.gov.uk>