The Economic Impact
of
British Forestry

A report prepared by

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and

PACEC

on behalf of
the Forestry Commission

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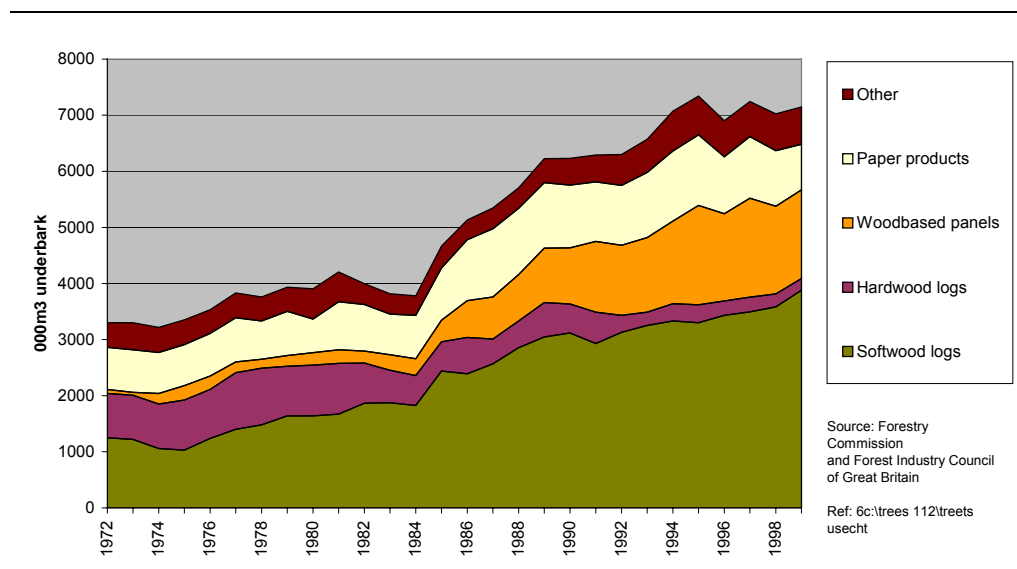
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Contents

1   Introduction and outline

1.1   The economic impact of British forestry

Figure 1.1   Growth of domestic timber use in Great Britain

000m3 underbark

8000
7000
6000
5000
4000
3000
2000
1000
0

1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998

■ Other
□ Paper products
■ Woodbased panels
■ Hardwood logs
■ Softwood logs

Source: Forestry Commission and Forest Industry Council of Great Britain

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1.1.2   Fifteen years ago the trend in the use of British timber switched from one of gently rising undulations to rapid increase. Since that dramatic point the harvesting and processing of British timber has more than doubled, and it is set to increase by as much again over the next 15 years or so, as planting decisions made in the 1960s and earlier bear fruit.

1.1.3   This burgeoning industry provides employment for several thousand people and is the economic underpinning of many firms. It also has welcome and not-so-welcome impacts on our environment, and provides many opportunities for leisure. There are subsidies designed to encourage companies and individuals to take a long term view of the forest resource, to balance it against alternative land uses, and to reflect the fundamental priorities and wishes of society: while less than other resource-based subventions, these are nevertheless not cheap.

1.1.4   The industry is plainly also changing. Originally there was a development programme for highly productive softwood forests in highly marginal areas hardly suitable for productive agriculture. In recent years the trend has been to broadleaved trees, and the reduced prospects for agriculture are among several factors encouraging tree planting on the plains and in the valleys, as well as in the highlands.

1.1.5   What is the effect of all this growth and change? The forest industries themselves welcome feedback on the wider impact they are having. The economic impact of the industry should also be an important factor in decisions by UK, national and local policy-makers. Only with an explicit idea of the impact can we choose rationally how to use what the forest is providing, and how to develop it further. This report attempts

to estimate an essential component of that impact for Great Britain and its constituent countries, the role of wood production and use in providing employment and adding value.

1.2   Outline of this report

1.2.1   The forest industry in Great Britain harvests almost 8 million tonnes of wood per year and supplies it to sawmills, panelboard mills, paper and board mills and for a number of miscellaneous uses. The industry itself provides jobs for 17200 people, and the wood-using industries based on British timber a further 11200, with 1100 engaged in haulage. Probably a further 1200 jobs exist in Northern Ireland.

1.2.2   This report has set these three British employment estimates in an historical and industrial context. It has calculated the numbers employed in the supply chains for the forest industry itself (7400 including the supply chain for transport activities) and the wood-using industries (9500 excluding the jobs in timber and its supply chain). These five sources of employment based on British wood add up to over 45 000 jobs, or 0.17 per cent of all the jobs in the UK. They are split across the member countries of the UK in the ratio England: 48 per cent, Wales: 13 per cent and Scotland: 36 per cent.   (Northern Ireland 3 per cent by assumption only).   In addition, when the jobholders spend their income, this in turn supports a further 20 000 jobs, making more than 65 000 in all, roughly one quarter of one per cent of the workforce.

1.2.3   The value added that the direct and indirect jobs create adds up to £1.38 bn (1997), or 0.22 per cent of UK GDP (with an allowance for Northern Ireland).

1.2.4   The yield of British forests is expected to rise by at least 60 per cent over the next 20 years. Provided that prices and support mechanisms move in such a way that the operations are financially viable, and that the most suitable products are developed, the real value added should be able to increase at a rate of almost 4 per cent per annum. The proportion of GDP accounted for by British forestry and its products and their economic ramifications will then be around 0.4 per cent. In Scotland, where it is highest, the figure will be around 1.6 per cent, and in Wales 1.2 per cent, against 0.2 per cent in England.

1.2.5   After this introduction, Part I, this report is divided into three further parts. Part II sets out the economic view of the industry. It aims to be policy-related and offers conclusions from the consultancy study. Part III sets out how the view and the scenarios were arrived at. It is concerned with methodology, describing how data was obtained and manipulated, setting out the structure of the novel economic model that has been developed, and relating our analysis to earlier work, notably the recent single-country studies of economic impact above, and two previous studies (also carried out for the Forestry Commission) which sought to assess UK-wide impact. Part IV sets out scenarios, that for this study were essentially a device for understanding the model and the economics of the industry, but which in future could be a valuable strategic tool.

1.2.6   This report was prepared in 2001 by Hervey Gibson of cogent**si** (Cogent Strategies International Ltd) and Glasgow Caledonian University, as part of a contract through PACEC with the Forestry Commission.   It draws on earlier country studies by PACEC, by the Welsh Economy Research Unit and associates, and by the Macaulay Land Research Institute.

1.2.7   National economic statistics cannot be collated until after the slowest firms have made their returns, and so the latest year for which this data has a really solid foundation is 1997. However, much of the important information is available for 1998 and 1999, and so where possible we have indicated how things have developed since the base year for our modelling activities.

Acknowledgements

2   The forest industry and its economic context

2.1   Structure of the industry

2.1.1   The establishment and maintenance of forests and the harvesting of wood is the core of the activity studied in this report. We have also investigated the basic processing industries using British timber; the supply chains to forestry itself and the basic processors; and intermediate transport. The diagram below sets out these activities and the main flows of goods and services between them. It shows the life-cycle of a forest from the seed to the sawlog, with the transformation industries that turn a tree into physical products and the suppliers and markets with whom the industry works.

Figure 2.2   Timber activities and flows of goods and services
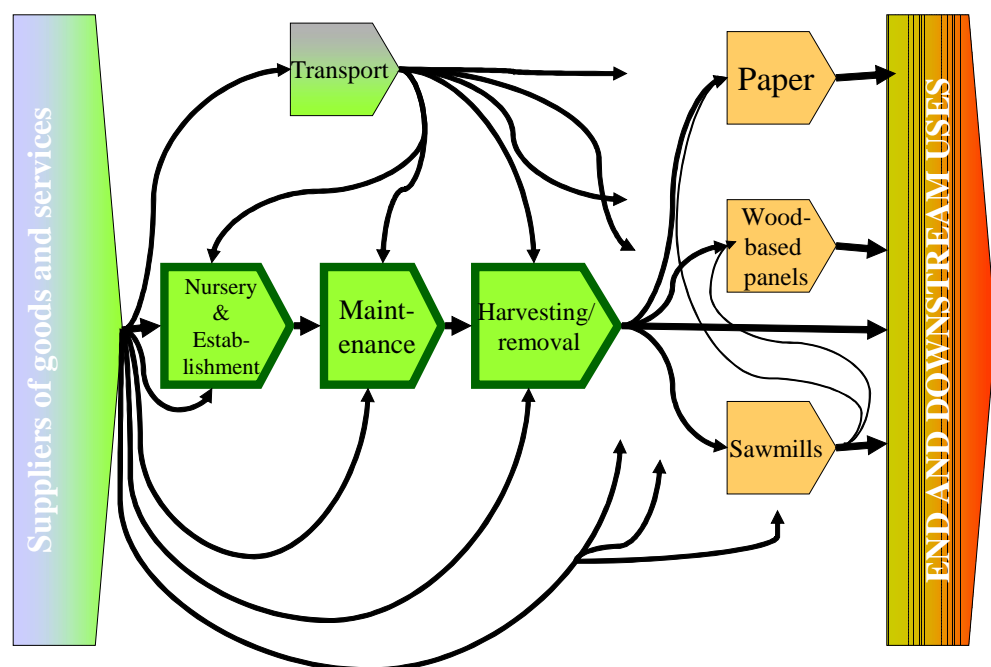
2.1.2   Our method of investigation has been to gather data on or estimate the physical level of activity or product, to set a value on this by pricing the outputs it produces and assessing the incomes for people and companies that it generates, and to trace its economic impacts on other industries forwards and backwards up and down the relevant supply chains.

2.1.3   We have not made any attempt to assess non-market impacts, such as the aesthetic or ecological pluses and minuses of forestry, or even the leisure value except insofar as it is already recorded in the accounts of the nation.

2.1.4   The boldly outlined symbols shown as green in the diagram are the 'forest industry proper', covered by Division 2 of the Standard Industrial Classification 1992 as 'Forestry, logging and related service activities'. 'Paper' includes pulp, paper and

paperboard manufacture in class 21.1 that are sourced by British timber (in practice four mills). 'Wood based panels' and 'sawmills' are that part of Division 20 based on UK-grown timber.

2.2   Forestry

2.2.1   The sales of the forestry industry proper (outwith the industry itself) amounted to some £445 mn in 1997. In addition, if we break the industry into component segments (nurseries, establishment, maintenance, harvesting and non-timber) there were some £180 mn intra-industry sales between these segments

Structure of the industry and key activities

2.2.2   Most of the externally-generated revenue, but by no means all of it, comes from sales of softwood. There are proceeds from higher-value hardwoods and significant revenue from goods and services produced by the industry which are not timber:

	1999 green tonnes	1997 green tonnes	1997 estd forest gate values (£mn)
Softwood removals - logs	3951	3560	165
Softwood removals - small roundwood	2741	3086	114
Hardwood removals	685	821	70
Non-timber activities & products			95
Statistical adjustment	505	62	
Total	7882	7528	445

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2.2.3   Although the volume of timber sales increased between 1997 and 1999 the price fell, and the probability is that sales in 1999 were only about £285 mn, compared with £350 mn in the earlier year.[1] Not only in the recent past have timber volumes been

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[1] There are two important points about sales figures, one of real importance concerning the numbers in the table above, and the second a significant technicality. The external revenue figure of £445 mn we show is a higher estimate than the £420 mn included in the UK national accounts. This is partly due to an error in the national accounts, which as far as we can see have never recorded timber sales to the four integrated pulp and paper mills, sales which today approach £70 mn. We understand for the most recent years (since 1990) this may be because the four integrated mills did not fall into the sample from the 100+ paper mills whose purchasing patterns were investigated when the basic tables were drawn up. (Use of sawmill residues does appear to be counted, however). The consequence is that around one sixth of UK timber sales were ignored or misallocated, and around a quarter of Scottish sales.

The technicality concerns the *intra*-industry sales, figures that essentially are estimated in order to make our model more transparent. We have broken the forestry industry up into separate sub-sectors or segments. In order to trace the relationships between them in economic as well as physical terms we have measured inter-segment 'sales', even where these would have been internal, between say one part of the Commission and another. This gives us much higher intra-industry sales than the national accounts, but it does not impact the overall view because one segment's sales are another's purchases. More detail is given in Part II on methodology.

rising, and the price of timber has been declining. Since the mid 1990s the price falls have exceeded the volume rises, so the real value of timber sales has declined. After peaking in 1988 basic forestry's share of GDP has fallen with it:

Figure 2.3   Estimated value of GB timber removals as % UK GDP
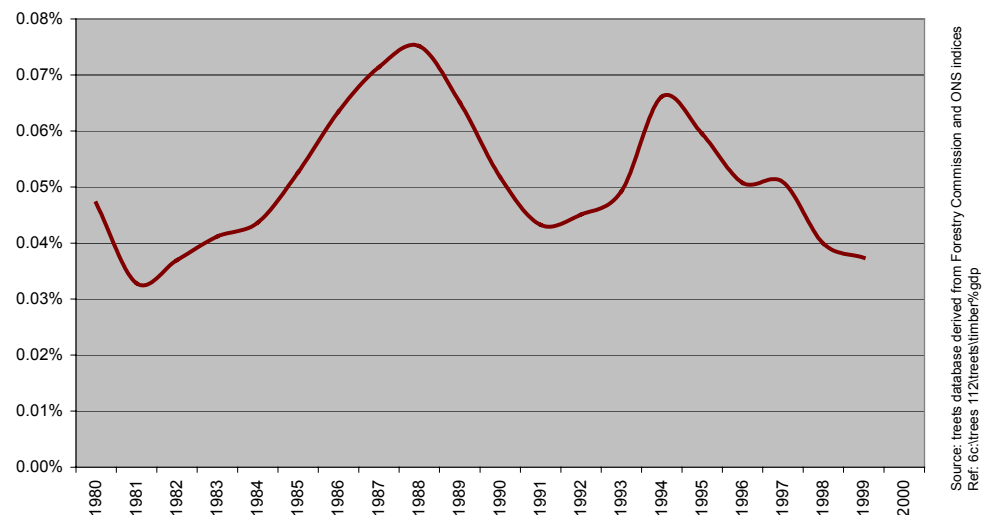
2.2.4   Moreover, and plainly responding to falling prices as well as rising productivity, employment in the forestry industry has also dropped, with the biggest falls occurring in harvesting:

Figure 2.4   Direct employment in GB forestry
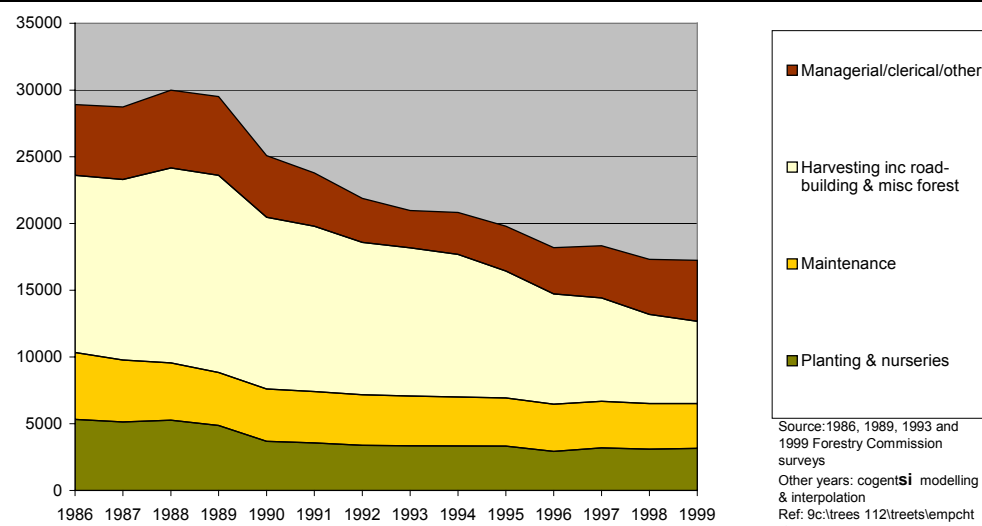
2.2.5   The following sections review output trends, employment, costs and the supply chains in each of the main areas of activity.

Harvesting

2.2.6   In terms of economic context, timber harvesting is the key segment, as it is the main commercial point of contact between the forests and their markets. The volume of timber harvested over the past 30 years has risen from about 3 million tonnes to about 8, as follows:

Figure 2.5   Timber removals

Source: Forestry Commission and Annual Abstract of Statistics Ref: 6c:\trees 112\treets removalscht
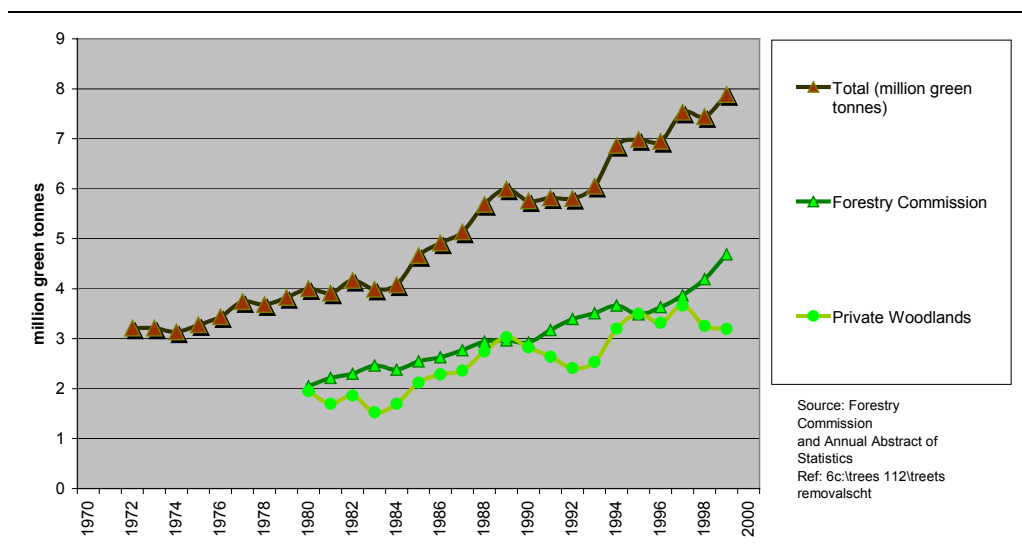
2.2.7   Despite transfers to the private sector, the Commission's removals have increased almost every year, whereas private sector removals increased and then declined at the end of the 1980s following the 1987 storms in England, and declined in response to weak prices at the end of the 1990s.

2.2.8   Presented in growth rate terms the overall development of removals is impressive, particularly when compared with the British economy as a whole:

Figure 2.6   Volume growth – timber removals and GDP

Source: Forestry Commission and ONS Economic Trends
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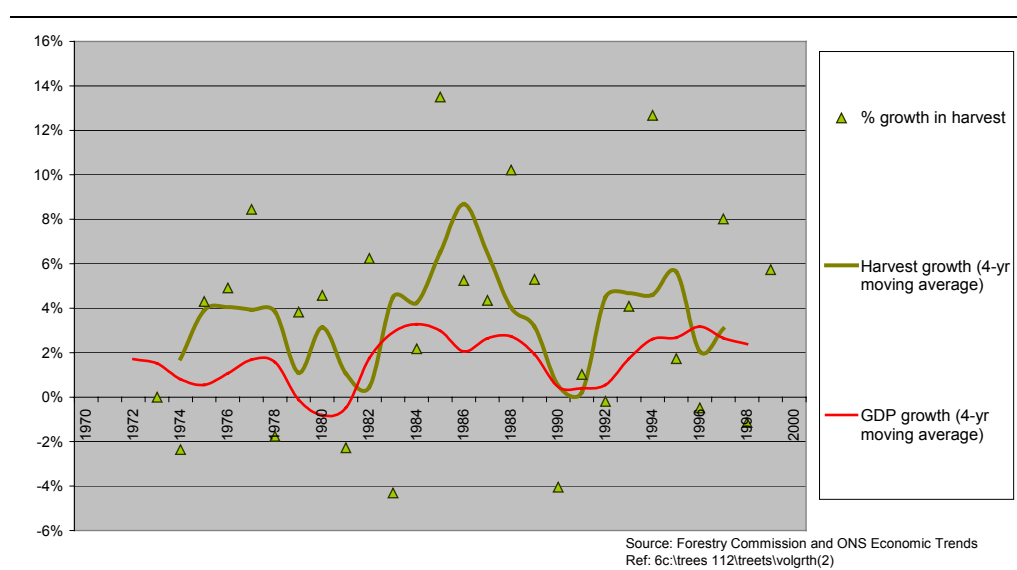
2.2.9   The Commission's 1998/9 employment survey estimates that harvesting and extraction currently employ some 6250 people. The CEIFA[2] model of forest activity estimates that about half of them are engaged in softwood log removal, and a quarter each in hardwood and in thinnings and small softwood recovery. As well as the actual felling, these figures include allocation of 407 workers on forest road construction, 1061 on in-forest haulage and other in-forest work not allocated to establishment or maintenance.

Cost structures, supply chain and multipliers

2.2.10   After allowing for the transfer value of standing timber, which absorbs about half of revenue, the main cost of harvesting is that of the labour involved, which absorbs another quarter. The remaining costs fall into three broadly equal segments: purchases of consumables and wear-and-tear on equipment[3]; construction of roads and in-forest haulage; and services. Many of these last are business services to do with operating harvesting businesses, such as banking, lawyers, accountants, office or depot rental, leasing charges and the like.

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[2] Consolidated Econonic Impact of Forest Activities

[3] the capital cost of the equipment is not included in the input output tables

Figure 2.7   Costs of harvesting and extraction

Source: CEIFA model
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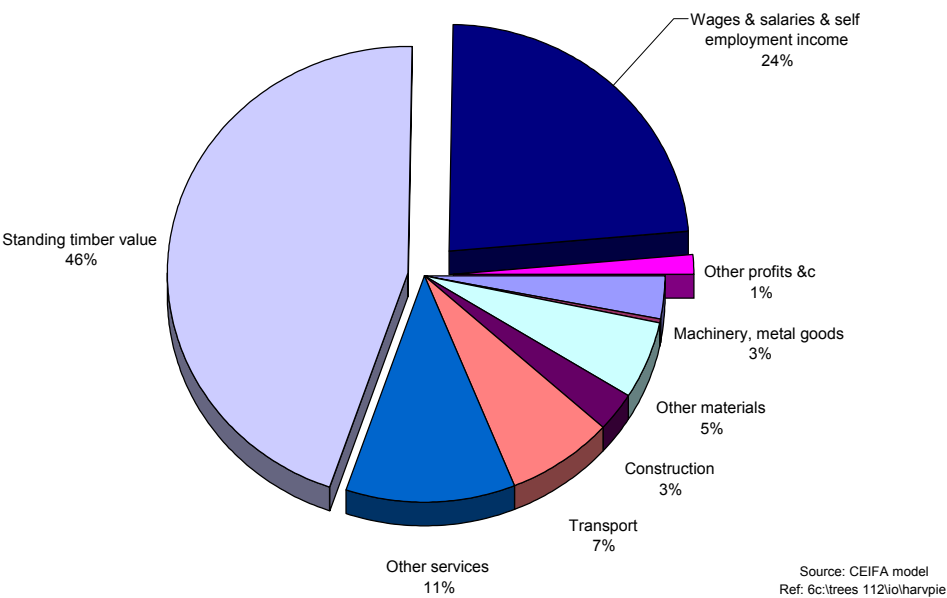
2.2.11   The remaining allocation of 'profit' is highly sensitive to the transfer prices between different segments or activities in the forest, and therefore is treated as a whole at the end of this chapter.

2.2.12   The immediate indirect impact of harvesting, other than that within the forestry sector, is represented by the purchases in the lower right hand quadrant of the pie chart, totalling some £130 mn. The immediate impact in these sectors, and the estimated number of direct jobs in the harvesting/extraction segment itself, is shown in the following table. The table also shows the 'induced' jobs, which are supported when the wages and salaries earned in harvesting and the supply chain are spent.[4]:

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[4] These are model results based on the 1997 input-output tables and so the 'direct' jobs differ slightly from the 1999 survey results.

Table 2.1   **Direct, indirect and induced employment and output multipliers in harvesting and timber extraction**

	Softwood log removals	Softwood srw removals	Hardwood removals	Total
Direct	3018	2095	1200	6314
First-round indirect (ie immediate suppliers *excluding* forest industries)				
Machinery, metal goods	96	83	22	201
Electricity, gas, water	1	1	0	2
Chemicals, fertilisers	0	0	0	1
Other materials	137	119	32	287
Construction	111	96	26	233
Transport	198	172	46	415
Other services	380	329	87	796
Total 1st-round indirect	923	800	213	1937
Subsequent indirect rounds	894	775	206	1874
Total harvesting (direct & indirect)	4835	3670	1619	10125
Employment multipliers (Type I)	1.60	1.75	1.35	1.60
Induced employment	1935	1469	648	4052
Employment multipliers (Type II)	2.24	2.45	1.89	2.25
Gross output (sales) multipliers				
Type I	1.73	1.91	1.40	1.72
Type II	2.92	3.22	2.36	2.90

Source: CEIFA model. NOTE figures affected by rounding   Ref:9c:\trees 112\reptabs\sheet 3

2.2.13   The 'Type I' employment multipliers show the ratio of direct plus indirect (non-forest) jobs to direct jobs. It is important to bear in mind the nature of ratios: a multiplier can be affected by changes in either the top of the fraction, the numerator, or its bottom, the denominator. Thus small roundwood removal, where tight margins and productivity advances have borne down on direct labour, still entails significant supplier labour, so the multiplier is high. In contrast hardwood removal remains labour-intensive, but the material inputs and therefore the jobs deriving from them are similar to those for softwood, so the multiplier is much lower.

2.2.14   The 'Type II' multipliers show the ratio of direct, indirect (non-forest) jobs and induced jobs to direct jobs.

2.2.15   Gross output (or sales) multipliers can be estimated for the three segments. The Type I multipliers are 1.72 for harvesting and 1.56 for planting, maintenance, and non-timber outputs. The Type II multipliers are 2.90 and 2.39.

Maintenance

2.2.16   Approximately 11 per cent of Britain lies under forest, 2.44 mn hectares, up from 2 mn twenty years ago. The Commission estimates that 3364 people maintain this forest. About half the land and forty per cent of the people are in Scotland, and about half the people and forty per cent of the land in England. A tenth of the land and a ninth of the people are in Wales.

2.2.17   The area under forestry grew rapidly – about 1½ per cent per year – in the 1980s, but after the support regime changed over 1988/92 the growth rate dropped back to less than ½ per cent per year, primarily because of a reduction in the rate of new planting:

Figure 2.8   Growth rate of land under forestry

Source: Forestry Commission & FICGB, Annual Abstract of Statistics
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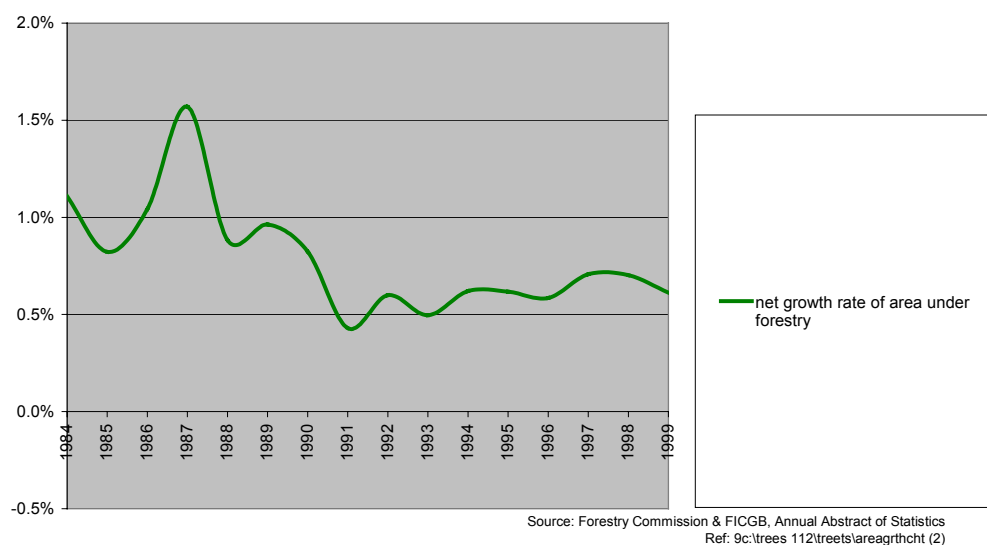
2.2.18   The relative importance of new planting and restocking are shown in the following chart. Historically the estimates shown as the yellow line in the following graph, which are derived as a residual figure after deducting planting from reported changes in area under forestry, would include attrition, but following measured falls this is now believed to be very close to zero.

Figure 2.9   Contributions to changes in the forest
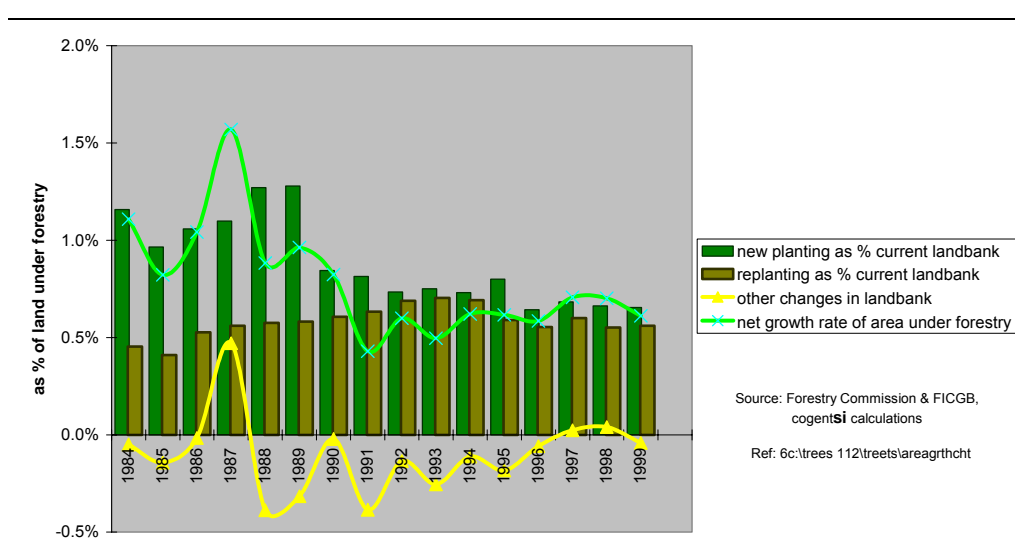
Cost structures, supply chain and multipliers

2.2.19   Other than the notional cost of acquiring established forests, three quarters of the cost of maintaining a forest is labour:

Figure 2.10   Costs of maintenance
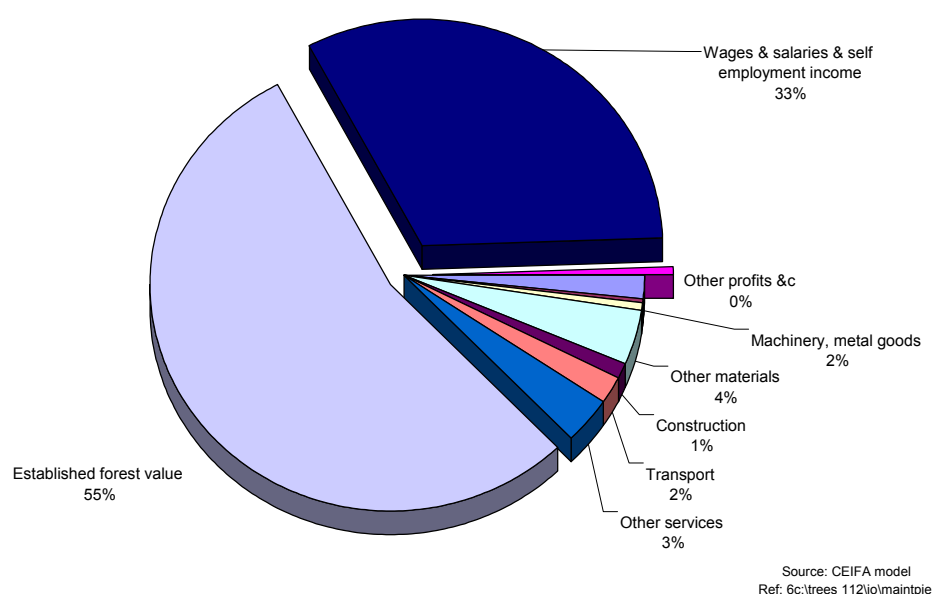
2.2.20   There are large differences in the number of hectares per maintenance worker between countries, but these are probably mainly due to different topographies and types of forest. We estimate statistically that conifers require less than 40 per cent of the labour per hectare as other species:

Table 2.2   Land under forest 1998

	England	Wales	Scotland	Total GB		conifers	others
Conifers	383	167	989	1539			
Other	607	80	213	900	000 hectares		
Total	990	247	1202	2439			
Maintenance workers (98/99)	1680	380	1304	3364			
						conifers	others
hectares/worker	589	650	922	725		1186	446
workers/000 hectares	1.70	1.54	1.08	1.38		0.84	2.24
average 'productivity'=100	81%	90%	127%	100%		164%	61%

Source: CEIFA model, and Forestry Commission   Ref: 6c:\trees 112\reptabs\sheet 5

2.2.21   Dewar (1991) estimated maintenance costs for different types of forest, calculating figures ranging from £22 per hectare for Sitka in the uplands to around £40 for broadleaves and mixed forests. The average in our calculations is just over £28 per hectare on a comparable coverage, which we would consider to be an adequate correspondence.

2.2.22   Between the Commission's 1986 and 1999 employment surveys, the trend in maintenance employment was down at a rate of only 3 per cent per annum, as against 4 per cent for forest establishment and 6 per cent for harvesting.

2.2.23   In addition to the 3364 people currently directly employed, we estimate a further 1521 jobs in the supply chain to the maintenance activity.

2.2.24   The table below shows 'sustainable' maintenance. This is the maintenance that would be required on the basis of the following assumptions of yields and plantation cycle life:

tes/ha	England	Wales	Scotland
Native woodlands & tradl estates	120	110	100
Commercial conifer/ productive high forests	335	335	335
Farmlands & community woodlands	270	260	250
plantation cycle life			
Native woodlands & tradl estates	100	100	100
Commercial conifer/ productive high forests	45	45	45
Farmlands & community woodlands	50	50	50

2.2.25   (The yields for Scotland were taken from the Scottish study and the cycle lives on the advice of the Commission). This implies that in the long run, for every ton harvested, the area to be maintained is as follows:

sustainable wooded hectares per ton harvested			
Native woodlands & tradl est	0.83	0.91	1.00
Commercial conifer/ prod hi for	0.13	0.13	0.13
Farmlands & cty wdlands	0.19	0.19	0.20

2.2.26   This calculation implies that the area under forest would require to be almost a third greater than the area currently being maintained.

Table 2.3   Direct, indirect and induced employment in forest maintenance and output multipliers

	'Sustainable' maintenance	Prorata to 1999 direct employment
Direct	4383	3364
First-round indirect (ie immediate suppliers *excluding* forest industries)		
Machinery, metal goods	145	111
Electricity, gas, water	6	5
Chemicals, fertilisers	12	9
Other materials	281	216
Construction	123	95
Transport	144	110
Other services	296	227
Total 1st-round indirect	1008	773
Subsequent indirect rounds	975	748
Total maintenance (direct & indirect)	6367	4886
Type I employment multiplier	1.45	1.45
Induced	2172	1667
Type II employment multiplier	1.95	1.95
Gross output (sales) multipliers		
Type 1	2.69	2.69
Type II	5.51	5.51

Source: CEIFA model. NOTE figures affected by rounding

Ref:6c:\trees 112\reptabs\sheet 8(2)

2.2.27   The very high gross output multipliers are a consequence of the transfer prices assumed for the maintenance activity.

Nurseries and planting/ establishment

2.2.28   There have been three particular phases in the planting of British forests over the past thirty years, set against an important background trend.

2.2.29   The background trend is a more-or-less steady reduction in Commission planting (including restocking) from 20-25 000 hectares per year in the mid 1970s to 8 000 today. The trend results both from the original post-war targets for the national forest being approached and the consensus for a smaller state role in the economy taking hold. Only in 1980 and over 1985-87 was there any significant upward movement in

the Commission's rate of planting, and these blips were undone as quickly as they arose.

2.2.30   The three phases are more complex. They are characterised by different shifts in the balance between new planting and restocking, in ownership, and in species. However they were all to a significant extent induced by policy initiatives, implemented through grants, tax incentive schemes, and agency action.

Phase	New/restock balance	Ownership	Species
Up to late 1970s	Restocking steady, new planting falls steeply	Commission planting falls 23>15 000, private 22>9 000	Almost all conifers, mainly Sitka
1979-89	Restocking rising from 4>13 000 hectares, new planting erratic in 20-25 000 hectares range with weak upward drift.	Private planting up from 9>30 000 hectares, Commission continues down	Predominantly conifers but broadleaves beginning in late 1980s
1989-99	Restocking stabilises below 15 000 hectares. New planting halves 30>15 000 hectares	After downward 'correction' to 21 000 hectares, private planting stabilises in 20-25 000 range. Commission declines steadily 13>8 000	Broadleaves take off and come to dominate new planting

2.2.31   The three phases are illustrated graphically below.

2.2.32   The downward trend in Commission planting and the three phases as they influenced private planting are clear:

Figure 2.11   Planting – by ownership
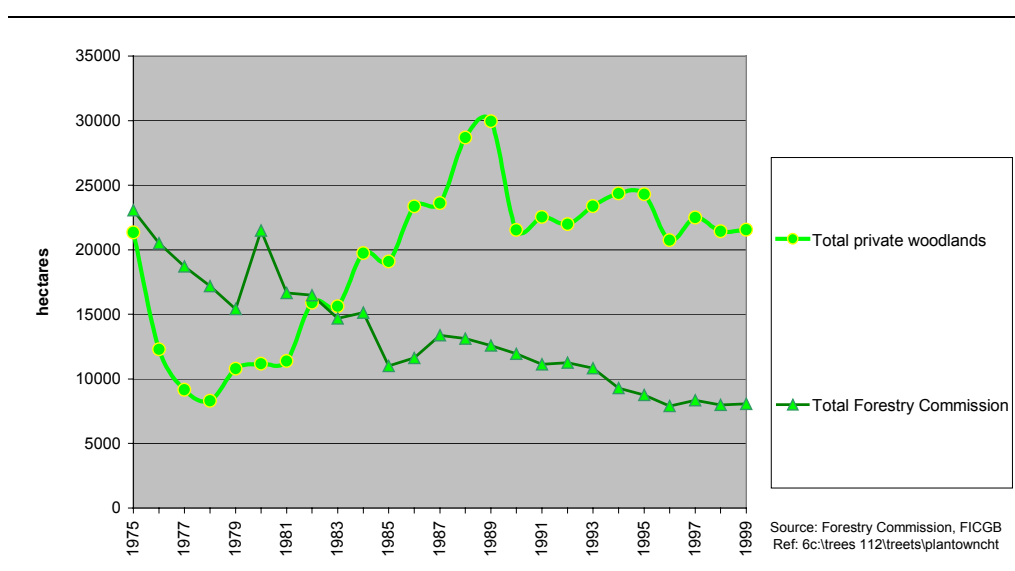
2.2.33   Likewise the phases in restocking, the shifts in new planting and the recent movement from conifers to broadleaves are very apparent over a thirty-year timespan:

Figure 2.12   Tree planting

Source: Forestry Commission & FICGB
Ref:6c:\trees 112\treets\plantcht

2.2.34   For the past few years planting has been steady around the 30 000 hectare per annum rate. Plainly a detailed study would be required fully to assess the sustainability of the forest at this rate of planting. However stocking rates prepared for the Scottish study, suggest this current level of planting is not sufficient to sustain the present level of cropping, which would call for 38 000 hectares, although this clearly depends on the pattern of planting and the rotation length actually achieved.

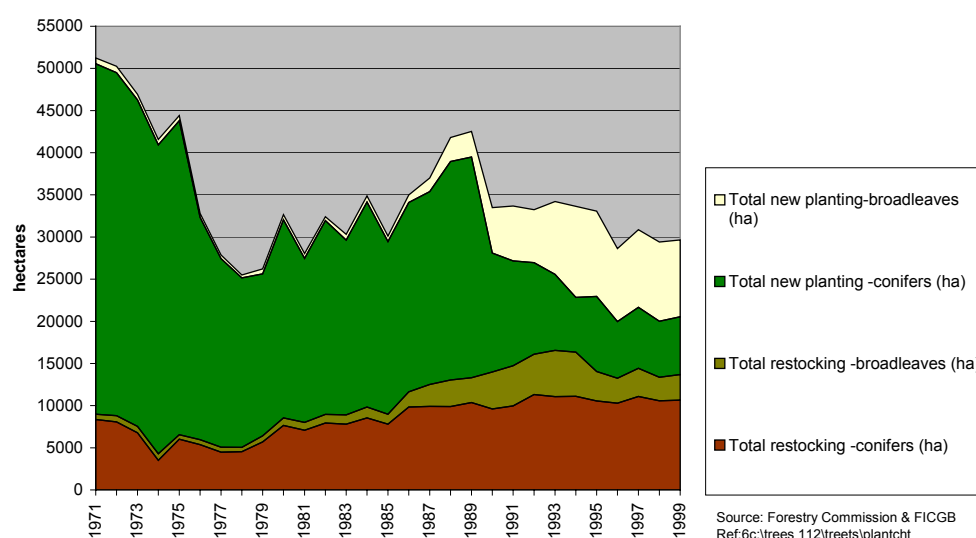2.2.35   In 1999 there were an estimated 3153 people employed in tree nurseries and forest establishment:

Employment	1999				1997
	England	Wales	Scotland	Great Britain	GB 1997 est
Forest Nurseries	421	2	201	624	553
Establishment	1088	252	1189	2529	2641
Total	1509	254	1390	3153	3194

Source Forestry Commission Survey   Ref 9c:\trees 112\reptabs\sheet 2 (2)

2.2.36   Given this level of employment, wage, salary and contractor costs are of the order of £55 mn, and we estimate that, including overhead purchases and service provision, some £34 mn is spent on purchases. Thus the total cost is of the order of £3000 per hectare, which is double the 1995 estimates used in the Scottish study (about £1500 per hectare) and much higher than Dewar's 1991 estimates of £850-1200 per hectare including overheads. However Crabtree's 1996 farm woodland evaluation, which was retrospective, gives a contract cost for farm woodland of £1958 per hectare. Only by excluding services would our model approach these lower figures, but we would still end up with an estimate of £2 500 per hectare for establishment.

2.2.37   We estimate that a further 907 people were employed in the supply chain to furnish the £40 mn worth of purchases. Many of them worked in service industries because

a significant part of forest establishment is in the surveying, land transfer, grant application and planning activities, and in financing the investment and other business services. This brings the overall Type I employment multiplier to 1.29.

Table 2.4   Direct and indirect employment of nurseries and establishment, and output multipliers

	Sustainable planting & nurseries	Prorata to 1999 direct employment
Direct	3972	3153
First-round indirect		
(ie immediate suppliers *excluding* forest industries)		
Machinery, metal goods	25	20
Electricity, gas, water	2	2
Chemicals, fertilisers	7	6
Other materials	84	66
Construction	70	55
Transport	21	17
Other services	371	295
Total 1st-round indirect	580	461
Subsequent indirect rounds	562	446
Total nursery & establishment	5114	4060
Type I employment multiplier	1.29	1.29
Induced employment	1732	1375
Type II employment multiplier	1.72	1.72
Gross output (sales) multipliers		
Type I	2.69	2.69
Type II	5.51	5.51

Source: CEIFA model. NOTE figures affected by rounding

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Other work and products

2.2.38   There were 4568 non-forest workers in the industry in 1999 according to the Forestry Commission survey. This represents a substantial increase from the 2790 reported for 1993, but much of the difference represents enlargements in the scope of the survey, to include relevant local authority workers, for example.

2.2.39   Some of the work is related to and supports wood harvesting, some corresponds to the £95 mn of non-forest sales from the forestry industry (as estimated in the national accounts), and some is management and regulation including the Commission itself.

2.2.40   In addition to a wage bill of some £59 mn, purchases of £16 mn have been allocated to this activity, most of them services. This leads to a Type I employment multiplier of 1.28.

Table 2.5   Direct, indirect and induced employment in non-forest outputs and output multipliers

	Non-timber outputs	Scaled to 1999
Direct	3977	4568
First-round indirect		
(ie immediate suppliers *excluding* forest industries)		
Machinery, metal goods	5	5
Electricity, gas, water	2	3
Chemicals, fertilisers	0	0
Other materials	44	50
Construction	7	8
Transport	9	11
Other services	182	209
Total 1st-round indirect	249	286
Subsequent indirect rounds	241	277
Total non-forest	4467	5131
Type I employment multiplier	1.12	1.12
Induced	1742	2001
Type II employment multiplier	1.56	1.56
Gross output (sales) multiplier		
Type I	1.34	1.34
Type II	2.65	2.65

Source: CEIFA model. NOTE figures affected by rounding

Ref:6c:\trees 112\reptabs\sheet 7

2.2.41   The Type I gross output multiplier is much higher, at 1.34, primarily because the denominator is low, including non-commercial services.

Forestry synthesis

2.2.42   The multiplier calculations for the three previous sections can be brought together. The summary table below differs in two respects from the tables in the individual sections. Firstly it is based on 1997 rather than 1999 employment bases and secondly, in order to provide a coherent supply-chain model through the whole of the

planting and harvesting cycle, the maintenance and establishment figures have been calculated to correspond to the current rate of felling.

Table 2.6   Direct, indirect and induced employment in forest activity and employment and output multipliers (based on 'sustainable' maintenance and planting)

	Softwood log removals	Softwood srw removals	Hardwood removals	'Sustainable' maintenance	Sustainable planting & nurseries	Non-timber outputs	Total
Direct	3018	2095	1200	4383	3972	3977	18646
First-round indirect (ie immediate suppliers *excluding* forest industries)							
Machinery, metal goods	96	83	22	145	25	5	376
Electricity, gas, water	1	1	0	6	2	2	12
Chemicals, fertilisers	0	0	0	12	7	0	21
Other materials	137	119	32	281	84	44	695
Construction	111	96	26	123	70	7	434
Transport	198	172	46	144	21	9	590
Other services	380	329	87	296	371	182	1646
Total 1st-round indirect	923	800	213	1008	580	249	3774
Subsequent indirect round	894	775	206	975	562	241	3652
Total forestry	4835	3670	1619	6367	5114	4467	26073
Type I employment multipliers	1.60	1.75	1.35	1.45	1.29	1.12	1.40
Induced employment	1935	1469	648	2172	1732	1742	9698
Type II employment multipliers	2.24	2.45	1.89	1.95	1.72	1.56	1.92
Gross output (sales)							
Type I output multipliers	1.73	1.91	1.39	1.90	2.69	1.34	2.12
Type II output multipliers	2.92	3.23	2.36	2.90	5.51	2.65	3.69

Comparison with country studies

2.2.43   Just as the country studies did not address very issue and variable in this study, it was not possible for the GB study to reflect the entire range of approaches in the country studies. Therefore a detailed multiplier-by-multiplier comparison, even where these are available, cannot be carried out. Nevertheless several of the results can be validly compared, although it must be recognised that a GB study can be expected to yield higher multipliers, as in an individual country study 'imports' from another country will be considered a leakage, whereas in the GB study they add to the multiplier.

2.2.44   The employment multipliers given in the Scottish study range from 1.18 for harvesting native forests to 2.08 for new native planting and maintenance. For commercial forestry, the largest elements, the Type I employment multipliers are 1.62 for harvesting and 1.28 for planting and maintenance. Combining the first two (softwood) columns and the fourth and fifth (maintenance and planting) columns of our table above gives sectors which would be closely comparable to the Scottish ones, and the multipliers for the combined columns would be 1.66 and 1.37. We therefore conclude that the range and relative sizes of these backwards Type I multipliers are very similar.   This indicates that the higher in-forest productivity in Scotland (which

increases the multiplier because it reduces the denominator) has been broadly offset by the tendency for greater 'leakage' when Scottish forests draw on non-Scottish suppliers (which would decrease the numerator). Thus the figures seem fully consistent, especially when one allows for possible errors in the Scottish study resulting from errors in the published input output table.

2.2.45   The English study quotes Type II employment multipliers of 1.49 for harvesting, 1.29 for maintenance and 1.38 for establishment. These are significantly below our corresponding figures of 2.25, 1.95 and 1.72. Three reasons suggest themselves: firstly the 'wider geographical area' argument quoted above, secondly that the English employment data was based on older data showing substantially lower productivity, and thirdly that crudely measured 'productivity' is generally lower in England. The study also quotes a Type II multiplier of 2.63 for softwood activities and 1.38 for hardwood, but does not indicate whether these are forestry only or processing as well: nevertheless the markedly higher multipliers for softwood are parallel features of the two studies..

2.2.46   The Welsh study quotes Type II employment multipliers of 1.34 for private estates and 1.49 for harvesting. Again, these are below our corresponding estimate of 1.92. The Type II gross output multipliers quoted for Wales of 1.77 and 1.51 are even further below the 3.69 estimated above, at least in part due to the higher prices used in the Welsh study. As far as the present study is concerned, the overall 'Type I' or supply-chain employment multiplier of 1.40 for forestry activities is a useful and memorable 'stylised fact' that can be quoted. For any detailed exercise the detailed multipliers or, better, a special model simulation should be used, and this is what is done in part III of the report.

Incomes

2.2.47   Bearing in mind that within-sector sales shown are just an accounting convention, where we 'sell' planted forests to the maintenance subsector, and 'sell' maintained mature forests to the removals and non-timber subsectors, the sales, purchases and value added of the six subsectors can be summarised as follows.

£ mn	Softwood log removals	Softwood srw removals	Hardwood removals	'Sustainable' maintenance	Sustainable planting & nurseries	Non-timber outputs	Total
Sales income (£ mn)	165	114	70	156	44	95	644
of which within forestry				156	44		200
Purchases (£ mn)							
Machinery, metal goods	6	5	1	9	2	0	24
Electricity, gas, water	1	1	0	2	0	1	4
Chemicals, fertilisers	0	0	0	2	1	0	4
Other materials	11	10	3	23	7	4	56
Construction	6	5	1	7	4	0	24
Transport	15	13	3	11	2	1	44
Other services	23	20	5	18	22	11	99
UK Forestry	58	40	25	44	0	33	200
Total purchased inputs	120	94	39	115	38	50	455
Value added (£ mn)	45	21	31	40	6	45	189
Wages, salaries and self employment	51	35	20	57	56	67	286
Other operating surplus	-5	-15	11	-17	-50	-22	-97

Source:CEIFA Ref 9c:\t112\reptabs\sheet9

2.2.48   We emphasise that the internal pricing and allocation mechanisms mean that it is wrong to overemphasise small differences between sectors, especially as regards operating surplus. Nevertheless the particular implication of the large differences between the first two columns would appear to be that, to the extent they can be separated, logs are substantially more profitable than small roundwood extractions. This would certainly correspond to anecdotal evidence from our interviews with foresters, farmers and sawmills, and also with comments from several in the industry that poor returns to thinning were threatening the long-term crop. The apparent profitability of hardwood may mean simply that we have not allocated enough maintenance costs to broadleaved forests. The small loss on non-timber activities is not surprising, since we have required it to bear a substantial share of maintenance (based on revenues). The loss on establishment and maintenance confirms *prima facie* that subsidy is required to encourage planting and good management. The losses are of the same order of magnitude as the £57 mn subsidy shown in the national accounts. We have made no estimates of subsidies in our figures

2.2.49   Compared to the national accounts these figures show higher external sales reflecting the sales to integrated paper mills and also higher internal sales reflecting the increase in subcontracting and our more detailed sectoral subdivision. There are higher labour costs reflecting the fact that the Commission surveys 'find' more workers than the ONS databases, probably particularly self-employed (whose incomes would count as profits in the national accounts). This is the case even though the Commission aims to measure 'Full Time Equivalents' while ONS is basically a body-count.

2.2.50   After all these influences, the 'bottom line' operating surplus in our table above is negative while the national accounts, even after adjusting for subsidies, are positive. Based on earlier versions of the model, this may be a consequence of a lower estimate of timber prices in our model, incorporating information specially supplied by Forest Enterprise.

2.3   Pulp, paper and paper products

Structure of the industry and key activities

2.3.1   There are four mills using timber inputs to produce paper and board in the UK: a newsprint mill at Shotton on the Dee Estuary in North Wales, a fluted (corrugated) paper mill at Sudbrook in South Wales, a paperboard (ie packaging materials) mill at Workington on the Cumbrian coast in England, and a lightweight coated paper mill (paper for magazines and the like) at Irvine in Ayrshire, Scotland. However these four integrated mills supply only around 11 per cent of the UK paper and board requirement, and 15 to 20 percent of the markets they have chosen to enter. The rest is supplied about sixty per cent by product imports, and about forty per cent by around 100 mills that manufacture paper and board from recycled paper and other fibres and from imported pulp. Many of these latter mills combine the two, but for statistical analysis we have divided them into stereotypical 'recycling' mills and 'imported pulp' mills.

2.3.2   Our estimate of the revenues of the four mills, which we have based only on public information, is £542 mn per annum. This is used as follows:

Figure 2.13   Integrated paper – costs and incomes

Source: CEIFA model
Ref: 6c\trees 112\reptabs\intpapcht
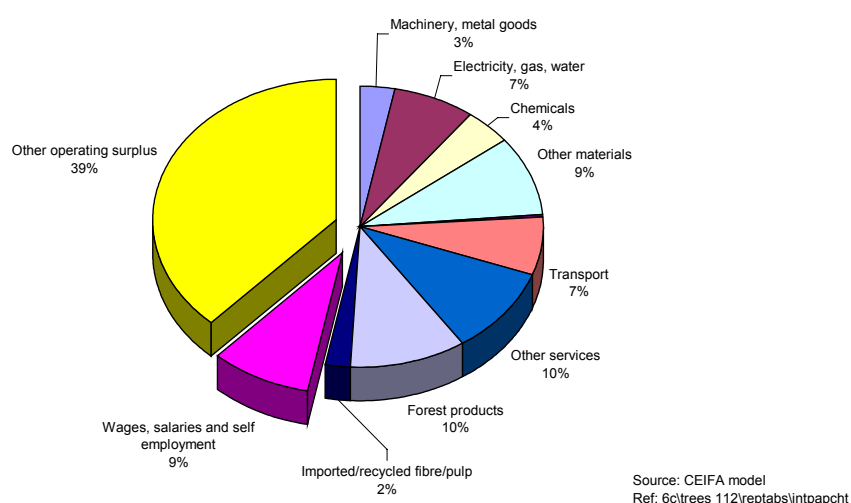
2.3.3   'Other operating surplus' corresponds broadly to profit plus depreciation in company accounts. The £160 mn shown above is thus before funding of the investment programme, which the FICGB reports as almost £50 mn per annum over the past decade. Further details are given in Part II.

2.3.4   The direct employment in these mills is estimated as 1600, with the Welsh mills being both the largest and the smallest.

2.3.5   To avoid double counting the multiplier calculations below <u>exclude</u> the forest employment generated in the supply chain for pulp and paper, as they do for the other user industries. Even so, they lead to remarkably high employment multipliers,

essentially because the mills are very capital-intensive, so the employment in the denominator of the multiplier {(direct employment + supply chain employment)/direct employment} is small. In the table below the overall employment multipliers for the integrated mills are compared with the paper industry *not* based on UK timber -–ie that part which uses recycled paper and imported pulp.

Table 2.7   Direct, indirect and induced employment in paper mills and employment and output multipliers

	Integrated based on British timber	Based on imported & recycled fibre
Direct	1600	28352
First-round indirect (ie immediate suppliers *excluding* forest industries)		
Machinery, metal goods	210	817
Electricity, gas, water	115	456
Chemicals, fertilisers	143	1054
Other materials	566	10520
Construction	19	106
Transport	660	1708
Other services	1098	4383
Total 1st-round indirect	2811	19044
Subsequent indirect rounds	2720	18430
Total direct & indirect	7131	65825
Type I employment multipliers excluding forest	4.46	2.32
Induced employment	3672	
Type II employment multiplier excluding forest	6.75	
Gross output (sales) multipliers (excluding forest)		
Type I	1.82	
Type II	2.31	
Gross output (sales) multipliers (including forest)		
Type I	2.23	
Type II	2.54	

Source: CEIFA model. NOTE figures affected by rounding   Ref:6c:\trees 112\reptabs\sheet11

2.3.6   It would also appear, from our attempts to reconcile the data reported in Part II, that as well as generating more upstream jobs the mills based on integrated processes earn higher gross margins on sales than do those using recycled fibre and substantially higher than those using imported pulp. Critically, even if the cost of new investment is charged to the integrated sector and not to the others, overall margins seem at least as good for mills based on British timber as they are in the paper industry as a whole.

2.4   Wood-based panelboard

2.4.1   There are around eight wood-based panel factories in Britain, including some at the margin of the industry which have closed and reopened intermittently in recent times. The product range which has been covered over the years includes particleboard/chipboard (PBCB), medium density fibreboard (MDF), oriented strandboard (OSB), cement-bonded particleboard and hardboard.

2.4.2   The main inputs to the industry are as follows:

	MDF	OSB (tonnes)	PBCB	Other	Total
Output 000 m^2	410	200	1920	8	2538
INPUT 000 TONNES					
Hard Roundwood			118		118
Soft Roundwood	135	378	1176	8	1697
Hardwood Residues			26		26
Softwood Residues	607		849		1455
Imported residues			49		49
Recycled wood			115		115
Total wood fibre	742	378	2333	8	3461

Source: FICGB & CEIFA model   Ref:6c\trees 112\T1997a\Panelboard

2.4.3   The industry employs approximately 2000, and based on public information we estimate the split as follows across the member countries of Great Britain:

	England	Wales	Scotland	Total
Employees	556	519	925	2000

2.4.4   Based on our own estimates of inputs, reconciled where possible with the details in the country reports and for timber and wood processing in the national accounts, the multiplier calculations are as shown below. Again, to avoid double counting the employment multiplier calculations below <u>exclude</u> the forest employment generated in the supply chain for boardmills, as they do for the other user industries[5]. They therefore are very high in comparison to other sectors of the economy, once again no doubt because the board industries are quite capital-intensive:

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[5] . The scenarios in Section 3 relax this assumption

Table 2.8   **Direct, indirect and induced employment in wood-based panels and employment and output multipliers**

	MDF	OSB	PBCB	Other panelboard	Total
Direct	705	172	1112	11	2000

First-round indirect (ie immediate suppliers *excluding* forest industries)

	MDF	OSB	PBCB	Other panelboard	Total
Machinery, metal goods	25	28	111	1	165
Electricity, gas, water	3	3	13	0	19
Chemicals, fertilisers	4	5	20	0	29
Other materials	20	22	89	1	133
Construction	1	1	4	0	6
Transport	50	55	219	2	326
Other services	57	63	250	3	372
Total 1st-round indirect	160	177	705	7	1049
Subsequent indirect rounds	155	171	682	7	1015
Total panelboards direct + indirect	1019	520	2498	26	4063
Type I employment multipliers	1.45	3.03	2.25	2.26	2.03
Induced employment					2025
Type II employment multiplier					3.04

Gross output (sales) multipliers (excluding forest)

Type I	1.34
Type II	1.68

Gross output (sales) multipliers (including forest)

Type I	1.94
Type II	2.39

Source: CEIFA model. NOTE figures affected by rounding   Ref:6c:\trees 112\reptabs\sheet 12

2.4.5   Thus the overall Type I multiplier is 2.03, with higher figures for the more recent more capital-intensive plants and lower ones for the older ones. The Scottish study suggested a Scottish multiplier for the timber products sector of 1.79. That included sawmills, and of course took account of 'leakages' in the supply chain from Scotland to the rest of the UK, and so the figures appear compatible to us. The English study found a Type I multiplier of 2.28 for processing, which seems high, particularly since English panelboard mills are supplied by Welsh and Scottish timber.

2.4.6   The gross output multipliers are 1.34 (Type I) and 1.68 (Type II), which compares with a Welsh estimate for Type II of 1.25 for panelboard and paper. In view of the non-Welsh sourcing of timber for the Welsh mills, these seem coherent with our estimates.

2.5   Sawmills and other timber

2.5.1   As well as major sawmills, this section also covers minor timber processing such as fencing and kindling preparation.

Industry structure and key activities

2.5.2   Around 400 mills saw British grown timber in Great Britain, and there has been recent significant expansion of relatively large, capital-intensive high-tech mills. Around 4 million tonnes of timber is processed, and the log market is the most attractive for growers.

2.5.3   These employment figures reflect both the input and product mix, and economies of scale and the better technology in recent mills:

Employees	England	Wales	Scotland	GB
Hardwood	1341	48	48	1438
Softwood	3698	957	1656	6311
Total sawmills &c employees	5039	1005	1704	7748

2.5.4   The employment multiplier calculations lead to a low figure of 1.25 (Type I) and 1.82 (Type II), reflecting the fact that besides the timber itself, there are relatively few purchased inputs in a sawmill. Once again, to avoid double counting the employment multiplier calculations below exclude the forest employment generated in the supply chain for sawmills, as they do for the other user industries.

Table 2.9   **Direct, indirect and induced employment in sawmills and output multipliers**

Direct	1438	6311	7748

First-round indirect (ie immediate suppliers *excluding* forest industries)

Machinery, metal goods	26	125	150
Electricity, gas, water	3	14	17
Chemicals, fertilisers	4	18	22
Other materials	21	100	121
Construction	1	4	5
Transport	51	247	297
Other services	61	297	357
Total 1st-round indirect	165	805	970

Subsequent indirect rounds	160	779	939
Total sawmills & indirect	1762	7896	9658
Type I employment multipliers	1.23	1.25	1.25
Induced employment	803	3598	4401
Type II employment multipliers	1.78	1.82	1.81

Gross output (sales) multipliers (excluding forest)

Type I	1.29
Type II	2.00

Gross output (sales) multipliers (including forest)

Type I	2.44
Type II	3.28

Source: CEIFA model. NOTE figures affected by rounding   Ref:6c:\trees 112\reptabs\sheet 14

2.6   Synthesising the forest products sector

Multipliers

2.6.1   The following table brings together the multiplier calculations for the main sectors.

Table 2.10   **Direct, indirect and induced employment in major sectors and employment and output multipliers**

	Forestry	Papermills	Boardmills	Sawmills &c	Total
Direct	18646	1600	2000	7748	29995
First-round indirect (ie immediate suppliers *not shown elsewhere in table*)					
Machinery, metal goods	376	210	165	150	901
Machinery, metal goods	12	115	19	17	164
Electricity, gas, water	21	143	29	22	214
Chemicals, fertilisers	695	566	133	121	1515
Other materials	434	19	6	5	464
Construction	590	660	326	297	1873
Transport	1646	1098	372	357	3472
Total 1st-round indirect	3774	2811	1049	970	8604
Subsequent indirect rounds	3652	2720	1015	939	8327
Total sectors shown	26073	7131	4063	9658	46925
Type I employment multipliers	1.40	4.46	2.03	1.25	1.56
Induced jobs	9698	3672	2025	4401	19796
Type II employment multipliers	1.92	6.75	3.04	1.81	2.22
Gross output (sales) multipliers (excluding forest)					
Type I		1.82	1.34	1.29	
Type II		2.31	1.68	2.00	
Gross output (sales) multipliers (including forest)					
Type I	2.12	2.23	1.94	2.44	1.60
Type II	3.69	2.54	2.39	3.28	2.30

Source: CEIFA model. NOTE figures affected by rounding   Ref:6c:\trees 112\reptabs\sheet 15

2.6.2   The 'stylised fact' of an overall employment multiplier of 1.56 is a useful simplification.

2.6.3   Our results are broadly compatible with the range of multipliers in the Scottish study. Except for sawmilling, they are significantly higher than the multipliers recorded for the Welsh study (for sawmilling we estimate 1.64 versus 2.65, for forestry 1.92 versus 1.46. For paper and panelboards 3.0-6.7 versus 2.29). However the difference can be substantially explained by the openness of the Welsh economy. The multipliers can also be compared with the English study, which quoted an overall Type I multiplier of 1.63, equivalent to 2.28 for processing (presumably including forest jobs) and 1.28 for forestry. Differences in composition of the industries in each country, taken with the fact that the English study may have exaggerated local sourcing due to its reliance on geographical patterns from an earlier (McGregor & McNicoll) study, indicate that the figures are also broadly compatible.

2.6.4   If there is one 'compare and contrast' conclusion to be drawn from the table above, it is that the employment multipliers are substantially higher for the more capital-intensive and newer industries. In policy terms, this leads to the view that capital-

intensive inward investments are certainly not unwelcome: while, if they are to compete internationally, they necessarily add few direct jobs, they provide significant upstream employment, or indirect jobs.

3   Methodology

3.1   Introduction to Part III

3.1.1   At first sight the request for proposals for this study looked simple: take three separate national studies of the economic impact of forestry – one for England, one for Wales and one for Scotland – and combine them to produce an estimate for Great Britain. The reality turned out to be quite different.

3.1.2   Individually, and given the information sources it had drawn upon, each study stood up on its own. But we found that the three national studies were not consistent in terms of the structure they had used to look at the industry, were not consistent in terms of their modelling approach, and were not consistent in terms of the value ascribed to timber, its inputs, and its products. Two of them *were* consistent with the UK national accounts, but that was unfortunate because the detailed version of the national accounts, the UK input output tables, completely missed out all use of timber to make pulp (15 per cent of timber use) because of a sampling error. So we had to start again, using what we could of the excellent work done by the three research teams responsible for the original studies.

3.1.3   In starting again on the data, we have also returned to basics in terms of input output methodology, basing our model on actual production relationships before applying a veneer of prices. What we have done is to build a mathematical model of the *physical* flow of timber and other resources into the timber-using industries, from the forests and the land, and of the physical transformation processes. We have then applied prices to these flows to give a model of the *value* flows in the forest and forest products industry.

3.1.4   The physical method is in contrast to the value method used in each of the country studies. To us as model builders the advantage of the physical approach is that the physical coefficients are much more constant from time to time and place to place than the value coefficients. The model is therefore much more robust and it is easier to synthesise and to compare the different industries and different countries. To the Commission and other users the advantage is that more of the workings of the model are transparent and comparable with other work going on in other branches of the industry.

3.1.5   The transparency means, of course, that errors, infelicities and approximations are more likely to become apparent. While this may occasion discomfort for us or for others, it is clearly in the best interests of all concerned that discrepancies should be exposed and addressed, rather than hidden in an impenetrable thicket of economic calculation.

3.1.6   This section of the report firstly reviews the previous work, secondly it sets out the structure of the model, and thirdly it covers the data sources and methods used.

3.2   Previous studies

3.2.1   Both the Welsh study and the Scottish study provide useful literature summaries on the use of input output methods to assess the economic impact of forestry, and the reader is referred to them for general discussion of the strengths and limitations of the approach. Apart from the three country studies, two previous studies of the economic impact of UK forestry are of particular interest. Firstly the study by Peter McGregor and Iain McNicoll, summarised in McGregor and McNicoll (1989a) and (1989b), and secondly the study by B G Jackson summarised in Jackson (1974). The Forestry Commission commissioned both.

McGregor & McNicoll

3.2.2   The first study is an input output study of the UK economy, based on the UK 1984 input output tables. It concluded that there were substantial benefits, especially downstream benefits, from expanding UK forestry activity.

3.2.3   The study had to expand the UK input output tables, notably to separate out forestry from the fishing industry with which it had been grouped. There was no further attempt to disaggregate forestry, with the result that questions of the impact of forestry all made the assumption that the mix of planting, felling, maintenance and haulage would be the same in any scenario as it was in 1984.

3.2.4   The study also dichotomised industries into 'national' industries and 'local' industries. National industries included forestry itself and all the wood-using industries, and for them each constituent country had a fixed share of input and outputs, depending on its share of employment. For local industries output was driven by local demand, which might derive from national industries (on the fixed share assumptions) or from local ones. This probably affected mainly haulage and local business services, and local retailing when household expenditure was taken into account.

3.2.5   Further the study examined feed-forward effects, specifically the scenario where a consequence of 'abolishing' forestry would be not only that wood-users would switch to importing supplies, but also that some sawmills would close because there was no market in unsawn logs.

3.2.6   That study has in common with the present one that it extended the published input-output table, and that it began a regional disaggregation. At the time the extension was an important contribution, so much so that it helped to support the separate identification of forestry in subsequent UK tables and may have contributed to the distinction drawn between planting and harvesting in the Scottish tables published for years from 1979 onward.

3.2.7   However, the present study extends on a much more ambitious scale: whereas McGregor and McNicoll expanded the forestry-and-fishing industry to two sectors, the present study expands the pulp paper and board industry to seven sectors, the timber products industry to six sectors, and the forestry industry to about ten sectors.

3.2.8   Similarly the present study takes a much more detailed view of geography. Instead of the simplifying assumption (following Leontief) that an industry is either national or local (and the former in strict uniform proportions across the UK), the present study estimates the pattern of supply for each of the (forest-related) products separately for each country of consumption. Thus McGregor's and McNicoll's study model implies that a sawmill in Scotland will draw on exactly the same domestic (UK) sources of timber as one in Wales, while the present study has an algorithm for allocating the sources of supply for each use in each country.

Jackson

3.2.9   The second study has in common with the present study that it takes a detailed view of product mix, and that it combines both prices and physical units, including the use of physical input-output coefficients. Distinguishing as it does between several different species of timber it is in fact more detailed on the product side. However it differs from our model in that it was a specific attempt to build an optimising model (a linear program) as a mechanistic way of developing strategies for future resource exploitation. Our model, by contrast, seeks merely to be descriptive and speculative. Our model will not tell you the 'best' way to exploit and develop the forest resource by some single criterion - rather it encourages you to propose a strategy and explore how 'good' it is by a number of different criteria.

The English study

3.2.10   The English study is the only one of the country studies not to adopt a formal input-output approach. Instead a detailed enquiry of operators was used to estimate first round effects, with summary estimates of subsequent multipliers based on macroeconomic considerations. The study concentrated on variations in impact for different types of woodland, which are therefore almost entirely an arithmetic consequence of the cost structures reported.

The Welsh study

3.2.11   The Welsh study is fully integrated with the overall modelling of the Welsh economy, and in particular the forestry study disaggregates the row and column of the Welsh Input Output table. Exemplary at the level of enquiry within the local economy, for sampling, confidentiality and compositional reasons the Welsh study nevertheless had to be limited in its ability to spell out in full detail the underlying economics of different sorts of timber-processing in Wales, for example to distinguish between paper and panelboard production. However, while not published these distinctions were fully covered in the analysis, and summary tables of within-industry transactions and of various multipliers are provided. Thus in an industry where Wales houses a substantial proportion of GB economic activity, the interactions between that activity and the UK total can be set in context.

The Scottish study

3.2.12   The Scottish study should have started with an in-built advantage: Scottish IO tables separately identifying forestry, have been prepared for 1973, 1979, 1989, 1992, 1993, 1994, 1995,and 1996. (Scottish IO tables for 1998 were published whilst this report was in draft.   There are no 1997 Scottish IO tables and there will be no official publication). However it suffered because the major error in the UK tables (omitting flows of timber to the integrated paper mills) was directly reflected in Scotland, where it has a much greater weight proportionally.

The Scottish study

A comparative table

Feature	English	Welsh	Scottish	GB/UK (this study)
Contractor	Public and Corporate Economic Consultants (PACEC)	Welsh Economy Research Unit	Macaulay Land Use Research Institute	cogentsi (Cogent Strategies International Ltd) through PACEC
Date completed	Jan 2000	Nov 1999	Sep 1999	August 2001
Base date for study	1996, some 1993	1993-98	1995, some 1993	1997, some 1999
Source input-output tables	Created from survey – first round only, seven non-forest sectors	Survey integrated with Welsh Input Output project	Scottish Office 1995 Tables, condensed from 128 industries to 35 and extended to six forest sectors from two, supplemented by survey	UK and Scottish tables, corrected and extended to cover domestic use (UK). Six-ten forest sectors, six paper sectors, seven board & sawmill sectors
Other data sources used in modelling	National accounts summary multipliers. LEPS database	Nomis and additional Welsh economic statistics, interviews	Forestry operations analysis by John Clegg and survey on travel/transport	Other three studies, Canadian and Swedish IO tables, Forestry Commission time series and FICGB physical data, UK trade statistics, interviews
Forest types distinguished	Four	Three	Four	Three
Multipliers presented – variables	Employment and gross output	Gross output, income and employment	Gross output, income and employment	Gross output, employment
Multipliers presented – type	Type II (but Type I readily calculated from table presented) and first round distinguished	Type II (and Type I supplied privately)	Types I and II	Types I and II
Multipliers presented – scope	Detail shown for all forestry and direct uses combined into one, final results by sector and forest/wood type	Two forest, two end-uses, haulage	Eight types of forest and four direct uses individually	Six forest activities and four end uses individually
Problems	Sourcing geography not correct (based on McGregor & McNicoll)	Comparability of classifications	Errors in Scottish tables – flow to paper industry omitted, and inputs of timber to timber harvesting omitted, so supply chains incorrect	Starts from a year between FC employment surveys

3.3   A novel model

The logic of the model

3.3.1   Like all of the country studies, the model is essentially an input-output structure. With one small exception it is demand-driven and strictly linear, in that an X per cent increase in gross output will result in an X per cent increase in all the appropriate inputs: an increase in *all* outputs will lead to an exactly proportional increase of all inputs. The exception to complete linearity is the treatment of by-products. Because

these are not realistically handled in a formal input output model we have departed slightly in the case of sawmill residues and small roundwood. Rather than being 'pulled through' by the using sectors (paper and panelboard), like all other inputs, the model first of all calculates the production level of sawmills on the basis of sawnwood demand. The residues are then 'pushed' into the using sectors, and those sectors adjust their small roundwood demand to give themselves enough fibre to meet the demand for their own products.

3.3.2   Thus the model is conventional, and its results can be compared with most impact studies. It shares some of their limitations: it concerns itself only with current (ie revenue account) inputs and does not calculate the effect of changes in product demand on capital investment and the further consequences of that. It does not contain any automatic mechanism for predicting or allowing for price changes, other than simple arithmetic calculation (although it contains very detailed cost structures and can be used for detailed examination of the consequences of price change, so it is a useful tool in forming judgements of their likely size and effect). In common with other input-output applications, some inputs which are unlikely to be proportional to gross output (bank charges, for example) are nonetheless treated as such.

3.3.3   Thus the model is the most detailed economic model of the GB forestry sector built since 1974, and the most realistic ever. Considerable effort has gone into eliminating some of the limitations of other economic impact models, and additional detail and scope mean that the model can be used for a wide range of applications. It also breaks new ground in having a realistic description of the geography of the industry, in terms of the flows of timber and products between the constituent countries of Great Britain.

Mode of operation

3.3.4   The normal way to operate the model is to input a set of demands for timber products to be based on British timber. The full list includes paper output by each of the integrated mills, outputs of four different types of panel board, sawn timber (hard and softwood separately), and miscellaneous products. This is done in the appropriate physical units, and prices can also be supplied or the default price levels can be used.

3.3.5   The model calculates the necessary timber inputs and the by-products, distinguishing three types (softwood logs and small roundwood, and hardwood) and working out the deliveries required in each country. It then sources these in relation to recent sourcing patterns, and calculates the transport implications of this, the area of land to be planted, and the number of saplings needed to replenish the forest.

3.3.6   We have based these prices on trade statistics, industry intelligence, and estimates designed to be consistent with the price base of the national accounts and UK input output tables. For the downstream uses of the products based on wood we have used the UK input output tables.

3.3.7   Separate productivity estimates are made for each product and activity in each country of production, to give a detailed estimate of the labour force. Non-forest inputs are also estimated, including volumes of specific inputs such as fuels and fillers and financial totals for general materials and services.   Price and wage assumptions are made for every product, allowing a schematic cost-of-sales and profit-and-loss statement to be prepared for each section of the industry and in many cases for geographical areas.

3.3.8   The model then calculates derived demand that arises because the non-forest inputs already identified must themselves be produced, and that requires inputs. Again the value and the labour requirements are estimated.

3.3.9   The model goes on to estimate the economic consequences of all the employment and mixed (ie self-employment) incomes being spent, again in terms of both money and labour.

3.3.10   Finally, in order to estimate the regional impact of forestry, the supply patterns for non-forest goods and services are calculated in the form of a compromise between the balance of demand across countries and the geographical distribution of supply for each product.

Basic model input: timber product outputs

3.3.11   A set of 15 assumptions about timber product outputs, covering five sectors, normally drives the model. The parameters below are the base ones relating to1997:

Figure 3.14   Timber product outputs

Timber product outputs

Paper & Board	tes of paper	
Newsprint	439	
Magazine	223	
Paperboard	176	*Total*
Fluting	132	969.5

Panelboards &c	000 m^3	
MDF	410	
OSB	200	
PBCB	1920	*Total*
Other	8	2538

Sawn Softwood		
England	827	
Wales	333	*Total*
Scotland	823	1983

Other softwood uses		
Fuelwood	100	
Fencing	323	*Total*
Other	33	456

Sawn Hardwood		
England	133	
Wales	5	*Total*
Scotland	6	144

Other hardwood uses		
Fuelwood	150	
Fencing	30	*Total*
Other	25	205

3.3.12   These particular assumptions derive from the Forest Industry Handbook 1998. Each of them can be varied, and its effects traced through the system. In section **IV** we examined a total of seven scenarios and the effect they have on the economy

3.4   Data

3.4.1   This section reviews some important data issues encountered in building the model

Forestry

Timber – balancing deliveries to mills and removals from forests

3.4.2   Although the outputs of each end-use industry are known, and their reported purchases can be balanced on the basis of technical requirements and efficiencies, the timber consumed by and delivered to the mills does not necessarily balance with removals. Firstly there is the question of reconciling the amount of timber overall, and second the need to account for trade in raw timber. For example, the sawmill survey is precisely that, a survey of users, and there is no attempt to balance in detail with a survey of sources, to whit the removals of logs from the forest. The estimation of removals from the private sector is indeed a very uncertain adventure, probably the least reliable element of estimation. This is evidenced by a Forestry Commission paper by Rothnie and Selmes that forms the basis for the current supply and demand forecasts (Whiteman 1996). Comparing with earlier papers by Morris (1991) and Thompson (1991), Rothnie and Selmes were obliged to revise up the late-90s log removal from the private sector by 34 per cent. Rothnie and Selmes say that 'A check against the current level of removals from private sector woodland estimated by the Home Grown Timber Advisory Committee indicates a close match between the first period of the forecast and current removals'.

3.4.3   Rothnie and Selmes estimate total log removals of 4493 000m^3 standing overbark, equivalent to 3612 000m^3 underbark while the sawmill survey gives 3584 000m^3 underbark log input (including estimates for small mills) in 1998 and 3431 in 1996, with a FICGB 1997 estimate of 3500.

3.4.4   Tracking these across the total softwood cut on an annual basis from 1987 the latest edition of British Timber Statistics published by the Commission compares softwood roundwood removals and deliveries and finds significant imbalances. In the graph below we have taken this methodology back to 1980, and it transpires that until 1997 estimated deliveries exceeded recorded removals, sometimes by more than 12 per cent. The gap is actually bigger than shown on the graph, because up until 1993 deliveries to small sawmills were not recorded.

Figure 3.15   Removals/deliveries discrepancy
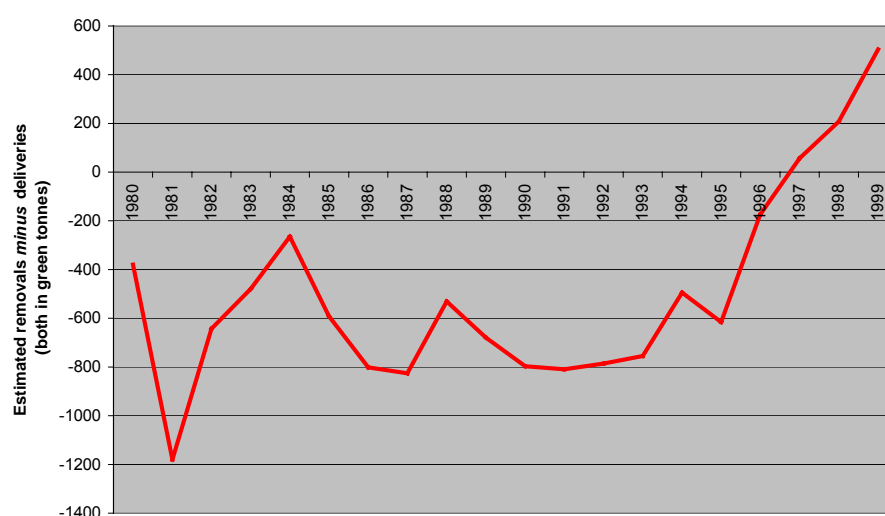
3.4.5   Fortunately, in the base year for the current exercise the discrepancy was minimal, less than one per cent of the total volume of timber. However, the fact that discrepancies of the order of 12 per cent can arise is a useful warning against over-precision.

3.4.6   It is not possible to perform this exercise for hardwood as there are no direct estimates of the hardwood cut: any statistics which may appear are in fact calculated from reported deliveries, on the assumption that the discrepancy is zero.

Timber sources, land and planting

3.4.7   In order to capture the main types of forest and to reflect the detail in the three country reports we have specified three broad types of woodland:

Type 1 consists of native forests (Scotland) and traditional estates (England).

Type 2 consists of productive high forests and conifer plantations

Type 3 consists of farm and community woodlands

3.4.8   The model sources the softwood timber and logs from each country according to the following proportions:

Table 3.11   Sources of supply for panels

To>> v From v	England	Wales	Scotland	
England	69%	0%	0%	23%
Wales	15%	100%	0%	11%
Scotland	16%	0%	100%	66%
Total	517	87	930	1533

3.4.9   Similar tables are used for logs, srw for paper, hardwood, and residual srw (which is always home-country supplied). For example:

Table 3.12   Sources of softwood logs

To>> v From v	England	Wales	Scotland
England	48%	11%	4%
Wales	28%	80%	0%
Scotland	24%	9%	96%

3.4.10   Overall the srw sourcing works out as follows:

Table 3.13   Sources of supply for softwood small roundwood

To>> v From v	England	Wales	Scotland
England	71%	0%	0%
Wales	8%	56%	0%
Scotland	21%	44%	100%

3.4.11   The hectares requiring planting for sustainability are then calculated based on the following forest patterns:

	England	Wales	Scotland	Implied GB
Native woodlands & tradl estates	22%	8%	28%	23%
Commercial conifer/ productive high forests	63%	83%	68%	70%
Farmlands & community woodlands	15%	9%	4%	7%

3.4.12   and the following yields (based on the Scottish study):

tes/ha	England	Wales	Scotland
Native woodlands & tradl estates	120	110	100
Commercial conifer/ productive high forests	335	335	335
Farmlands & community woodlands	270	260	250

3.4.13   and the hectares required to be afforested for sustainability based on the following lifetimes:

plantation cycle life (years)	
Native woodlands & tradl estates	100
Commercial conifer/ productive high forests	45
Farmlands & community woodlands	50

3.4.14   The principal purpose of the model is to gauge the implications of different scales of forest activity, and so in normal model operation then the input requirements for planting and for maintenance are based on these calculated figures, that is the model in effect calculates 'full cycle steady state' multipliers. These cycle times were based on inputs to the Scottish Study and are somewhat lower than those used elsewhere, and it may be that the planting called for in the model is rather higher. If it is required to examine short-term impacts, then it is possible to over-ride the model calculations with a pre-determined acreage.

Forest Supply chain

3.4.15   In a conventional analysis of multipliers and economic impact the supply chain to the industry in question is crucial: it is mainly by what we buy that we influence the size and structure of the rest of the economy. There are two official sources for the cost structure of the forestry industry in the UK: the input output tables prepared by ONS as part of the national accounts, and the similar tables prepared by the Scottish Executive for Scotland. Similar information is available for Wales from the Welsh study, and information for England was collected for the English study. The details of the supply chain have been filled using these, and we have also reviewed input output tables for two important timber-producing countries, Canada and Sweden

The UK

3.4.16   Although we know the *market* information in the UK input output tables is wrong, as discussed in the pulp and paper section, for example, the cost information is likely to be less seriously affected, although it will not be exactly right. The pattern of (non-labour) costs shown is as follows:

Figure 3.16   Inputs to the UK forestry industry
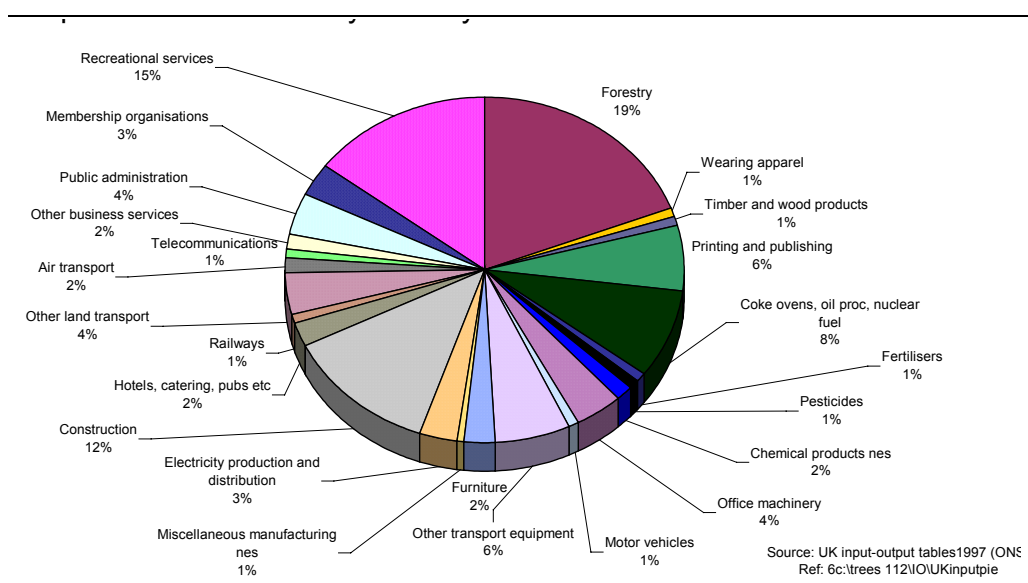
3.4.17   As a summary of major items this may be reasonable: however it appears to have suffered from over-simplification at the data-collection stage. Out of the 123 industries identified in the UK input-output table, the forestry industry according to the tables buys from only 24. The industry, apparently, does not make use of banking services or insurance, does not trade in real estate, does not use lawyers, accountants, or consultants, or even consume paper. It seems to be able to chop down trees without buying tools or parts or any other metal goods, or special-purpose, general-purpose or agricultural machinery (true, the basic purchase of some of these items has perhaps been treated as capital spending, but the equipment does not seem to need spares!). What appears to have happened is that the cost structure shown above has been taken as a summary: it seems particularly deficient as far as

services are concerned, unless the surprisingly large 'recreational services' is a misallocation.

Scotland

3.4.18   The Scottish tables, in which the Commission is credited with supplying the data, are rather better, in that they identify 42 industries as suppliers – which, of course, leads to the unfortunate implication that many items are consumed within the Scottish forestry industry but not in the UK. The Scottish pattern is as follows:

Figure 3.17   Inputs to the Scottish forestry industry

Source:Scottish input-output tables1996 (Scottish Executive)
Ref: 6c:\trees 112\IO\SCOTinputpie
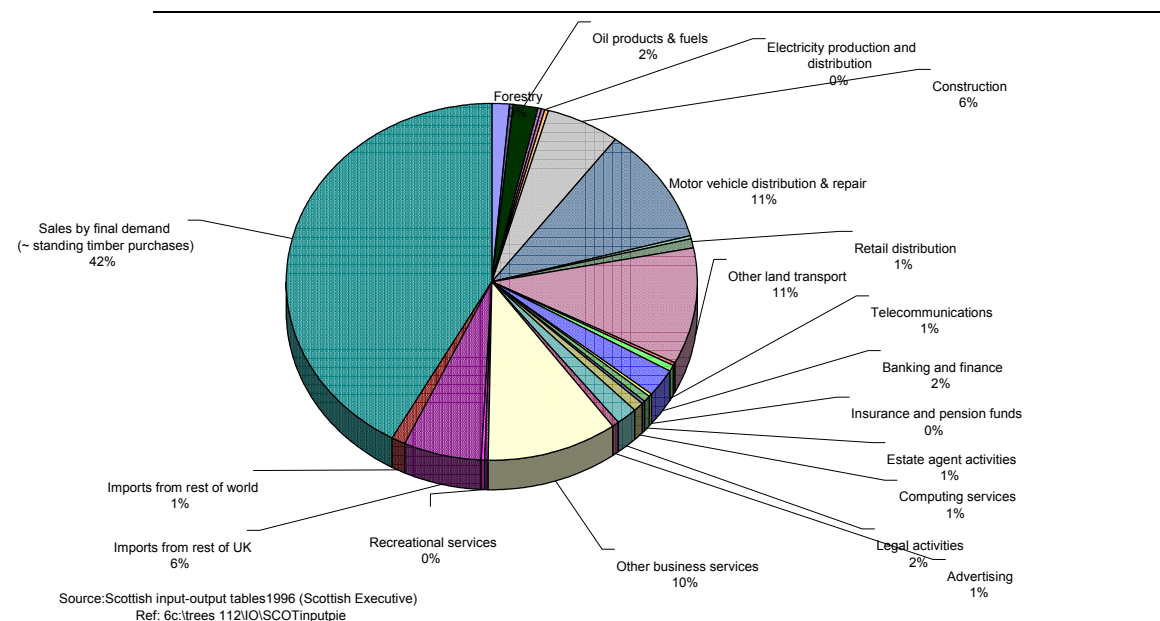
3.4.19   Thus the services are better represented, although again there is evidence of misallocation (for example the large purchases from the motor trade are presumably in part purchases of vehicles (where these are not capitalised) and spares, which should actually be recorded as purchases from the vehicle industry plus a distribution margin).

3.4.20   In both cases the omission of the smaller industries is serious, and likely to affect both the multipliers and the geographical allocation of resources. It therefore clearly became necessary to estimate a cost structure for the industry especially for the present project. As an aid in this the cost structures shown in the input output tables for two countries with substantial forest activity, Sweden and Canada, were appraised:

Sweden

Figure 3.18   Inputs to the Swedish forestry industry

Source: Input-outputtabeller foer Sverige
Statistiska Centralbyraan
Ref: 6c\trees 112\IO\Sweden input pie
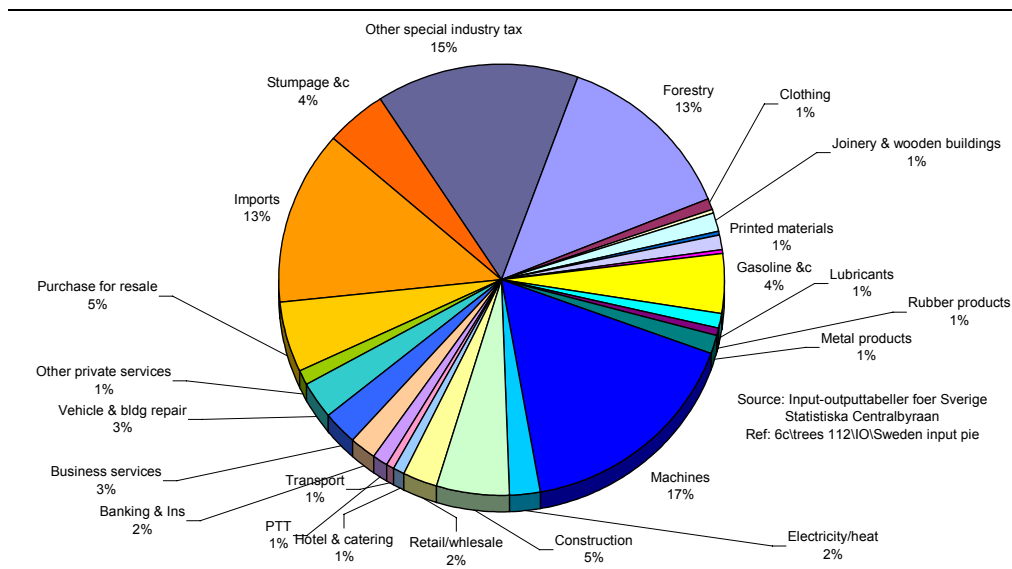
Canada

Figure 3.19   Inputs to the Canadian forestry industry

Source: The input-output structure of the Canadian economy
Statistics Canada System of National Accounts
Ref 6c:\trees 112\IO\Canadian input pie
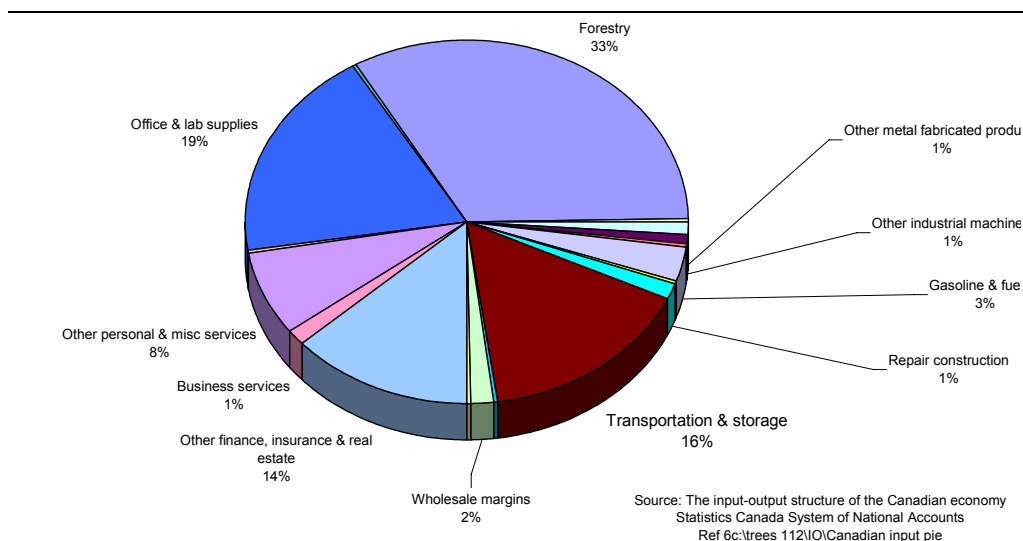
England

3.4.21   The results from the English study are shown for completeness, although they refer not just to forestry but to the end-user industries, and appear to cover both capital and current expenditure. PACEC's estimate of total purchases excluding within-sector purchases and purchases from abroad, Scotland or Wales, £651 mn, appears to be substantially higher than current purchases as recorded in the national accounts.

Figure 3.20   Purchases by the English forestry *and wood processing* sectors

Other services
11%

Transport
11%

Construction
1%

Other materials
25%

Chemicals, fertilisers
10%

Machinery, metal goods
25%

Electricity, gas, water
17%

Source: PACEC survey for the English study
Ref: 6c\trees 112\/O\pacecpie
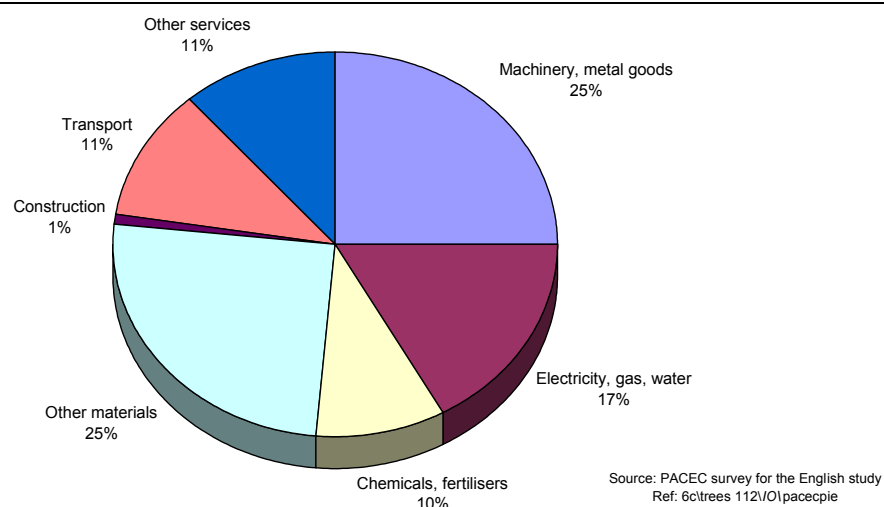
Synthesis

3.4.22   The six sets of figures are clearly very different, with for example purchases of machinery and metal goods varying from less than 1 per cent of sales in the Scottish tables to 15 per cent in PACEC's English figures, and purchases of services from 2 per cent in Sweden to 18 per cent in Scotland. Indeed, purchases as a whole from outwith the industries range from 60 per cent of sales (PACEC) to 10 per cent (Sweden)   The Welsh study gives no comparable detail, but the total is some 55%of sales. A 'typical' return from a harvesting company gave outside purchases, primarily haulage, as 25 per cent of sales. The following chart shows the results of the six earlier studies, together with the set of assumptions used in this study:

Figure 3.21   Purchase costs as a share of Gross Output

Source: various input output tables (see piecharts for details)   Ref 9c:\trees 112\ IO\input%sales(2)
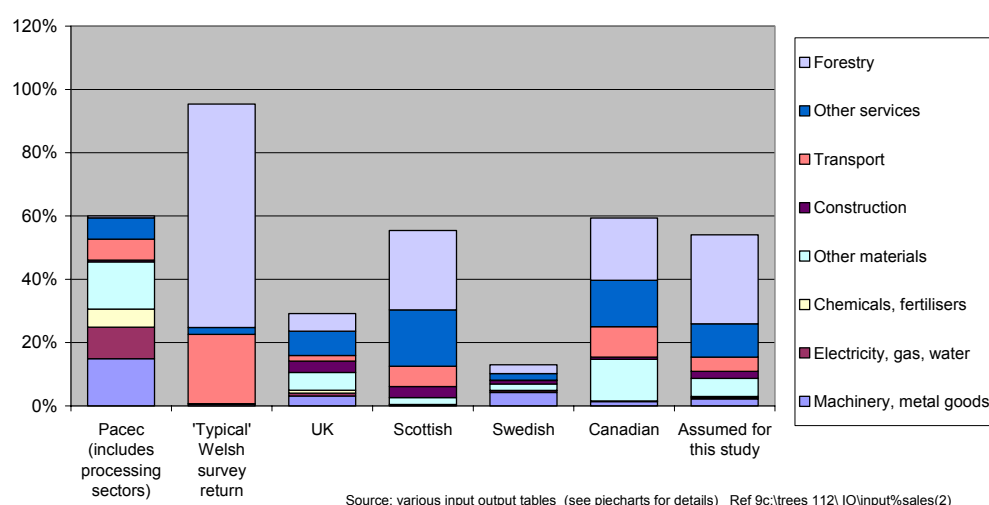
Sectoral split of forestry

3.4.23   Seven key activities were identified in the forest industries:

- Nurseries
- Forest establishment (usually from basic ground preparation through to 'beating up', or replacement of trees that die)
- Forest maintenance
- Construction (mainly roads)
- Other in-forest activities
- Harvesting
- Non-forest activities allocated to the industry

3.4.24   We measure the sales from one segment to another – in part because increasingly specialised companies or contractors are being hired to carry out specific tasks corresponding to a segment.   Our estimates are very much higher than the apparently similar figure quoted in the national accounts. In practice neither affects the overall view of the industry from the outside, because sales from one segment are offset by the matching purchase from the other.   The national accounts figure is therefore in principle lower than ours, because those accounts do not disaggregate the industry into detailed segments, whereas we have broken it up into seven. What we have considered transactions between segments – sales from the 'forest establishment' to the 'forest maintenance' segments, for example – would often not be measured because they would take place within a forest management company or within Forest Enterprise.   There is also a practical reason why they should be underestimated – they are essentially an updated version of the 1990 transactions, and since then the commercial structure of forestry has changed radically.   This suggests that what estimates of inter-industry sales the national accounts do contain are likely nowadays to be too low even by their own standards. They are based on times when there was much less contracting and sub-contracting within the industry.

Finally, where there are more detailed official estimates of inter-industry transactions – the Scottish IO tables estimates of sales from planting to growing stock, and of mature trees from growing stock to felling - these are commensurate with our estimates.   By convention, only two of these sell outside the sector: harvesting/extraction and other non-forest-based.   The sales of the former were adjusted to correspond to the sales of the commodity 'forestry' identified in the input output tables, other than the sales within the industry itself[6].   The sales of the latter correspond to the sales of the forest <u>industry</u> less the sales of forestry – ie the sales identified as off the diagonal in the 'make' matrix summarised in table 1 of the input output balances (ONS 1999).

3.4.25   Approximate values were adduced for the other stages of the process – plants were costed at £200 per thousand, establishment (including beating up) at £1.30 per plant, and maintenance at £75 per hectare.   Each stage was assumed to have as its sole customer the next stage in the process.

3.4.26   The effect of this was greatly to increase the 'within industry' sales, as treating the industry as separate sectors means that sales are counted at each stage of the process.   This does in fact continue a process which was begun with the Scottish tables' division into 'planting' and 'harvesting' – while the consolidated industry according to the UK IO tables sells only £25 mn to itself, the Scottish harvesting industry purchases £54 mn from earlier plantings.

Prices

3.4.27   The fall in timber prices has had a profound effect on the industry, its behaviour, and its wider economic impacts.   In real terms standing timber prices are now only one third the levels they were at in 1988.   The following chart links recent Forestry Commission data to index numbers for earlier years:

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[6] These had first been adjusted to compensate for the omission of sales to the paper industry, which was an error in the tables.

Figure 3.22   Timber prices

Source: Forestry Commission (np)

Ref: 6c:\ trees 112\ np prices\ pricecht
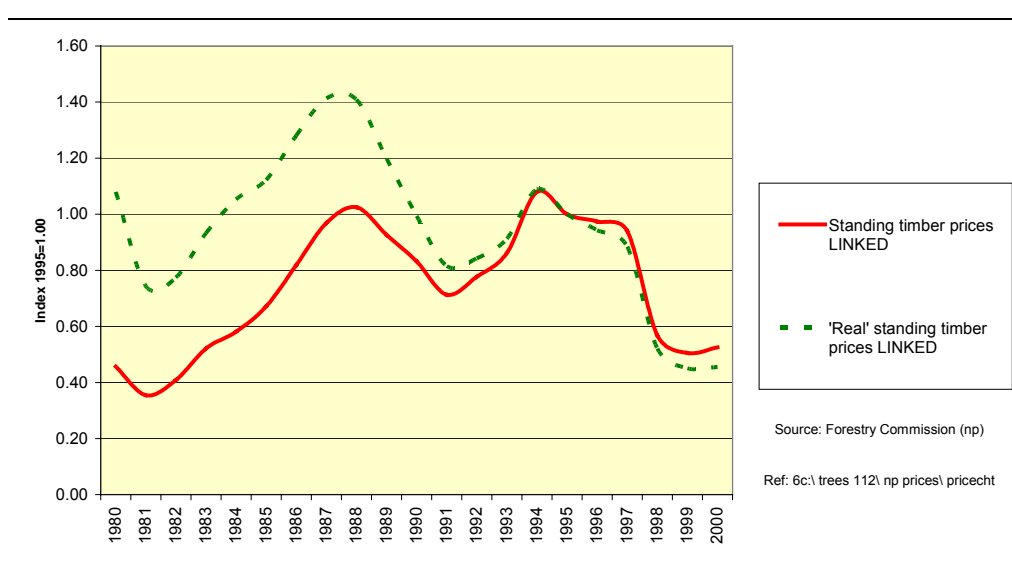
3.4.28   The fall in sawlogs prices over recent years has been slower:

Figure 3.23   Nominal Timber Prices 1994-2001

Source: Forestry Commission
Ref: 6c\trees 112\np prices\chart 2
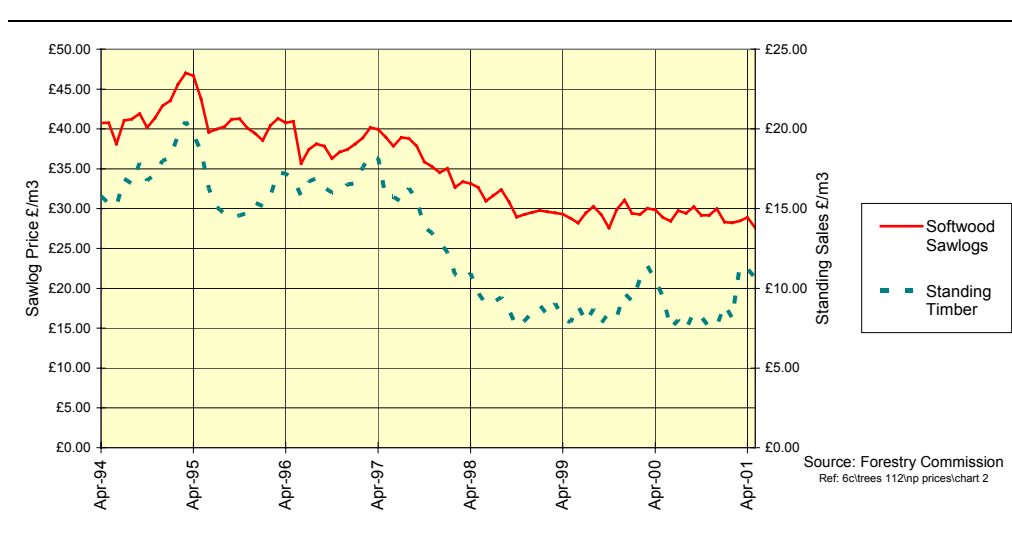
Pulp & paper

3.4.29   The following analysis is based on the UK input output tables, where all the mills come under the same heading, and data from the Forest Industry Yearbooks and the BPBIF Reference Tables.   There are significant elements of estimation and attribution, because there appear to us to be significant inconsistencies in the inputs to the pulp and paper industry in the published UK tables. Firstly there is *no* use shown of British timber. Secondly, the figure shown use of the commodity pulp and paper, which should include all inter-industry sales, imports of products of the industry (including pulp) and recycled products which have not been sold on to other users is lower even than the imports of pulp alone recorded in the trade statistics. Thirdly, purchases from IO industry 84, which includes recycling, seem low compared with the

use of recycled used fibre. In the table below we have preserved the value added from the UK tables, and increased both sales and purchases.

	Integrated mills using British timber	Paper based on Imported Pulp	Paper based on recycled NIE	Total	Integrated share
Sales income	542	1015	2303	3860	14%
of which within forestry					
Purchases					
Machinery, metal goods	16	20	44	79	20%
Electricity, gas, water	39	41	108	187	21%
Chemicals	22	51	118	191	11%
Other materials	49	301	723	1073	5%
Construction	1	2	4	7	15%
Transport	36	29	66	131	27%
Other services	53	65	148	265	20%
Forest products	55			55	100%
Imported/recycled fibre/pulp	12	447	200	659	2%
Total	294	955	1410	2659	11%
Value added	248	60	893	1201	21%
Wages, salaries and self employment	46	162	512	720	6%
Other operating surplus	202	-102	381	481	42%

Direct employment

3.4.30   Estimating direct employment is not a straightforward matter. Official systems such as the Annual Employment Survey do not address the question, for three reasons:

- in the forests, haulage, and elsewhere they report only employees and not the self-employed

- many of the contracting firms may not be classified to a forestry-related code

- the timber-using industries reported in the statistics include mills that do not process British timber

3.4.31   For this reason the Forestry Commission, with the active support of trade associations, has undertaken surveys of employment.

Forestry Commission Surveys

3.4.32   We had available four surveys, one recent report prepared by the Forestry Commission, (Heggie, 2001), one covering 1989 in the form of a detailed paper, Thompson (1990), and the others, covering 1986 and 1993, in summary tables. The figures used in the separate country studies were for 1993. An attempt to update was in our view clearly necessary, not only because of the passage of time and improvement in technology but because the nature of activity had changed between 1993 and 1997. The harvest had risen by 25 per cent in volume terms, but planting had fallen back 15 per cent. New larger sawmills had come into operation and, in processing, wood-based panels had taken a larger share of the timber at the expense of paper.

3.4.33   Examining the four surveys, we found that in the forest sector there had been some remarkable advances in productivity in the three inter-survey gaps. In the processing sector an increase in productivity in the first gap had been reversed in the second and resumed in the third. In the chart below we show the measured productivity from the surveys and our interpolations used in this study. A warning is appropriate: the coverage of the surveys has improved and widened over time, and each survey warns that it is not strictly comparable with the previous ones.

Figure 3.24   Productivity growth
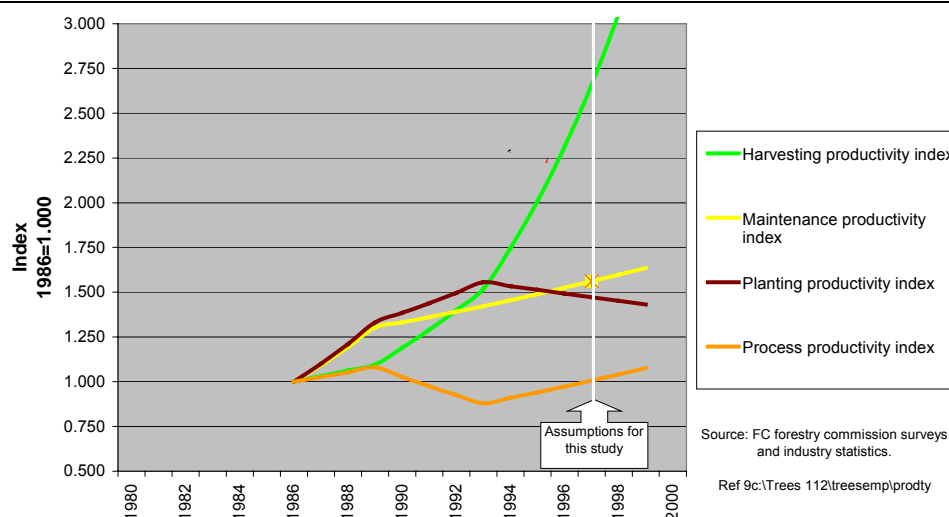
3.4.34   Productivity measures in the various sectors were prepared as follows:

- In planting and nurseries the number of plants per worker, based on 2250 saplings per hectare of planting. The 1997 figure was 21 400 plants per worker.

- In maintenance the number of hectares under forest per employee. In 1997 the GB average was 696

- In harvesting the standing volume over bark removed. In 1997 the GB average was 1183 m^3

- In haulage the removals (svob) per employee. In 1997 the GB average was 8 570 m^3

- In processing we created an index by weighting together the deliveries of wood to different end-uses. We then divided this index by processing employment.

3.4.35   In the graph above these five different productivity measures are all re-based to 1986 = 1.00.

3.4.36   The total number of workers counted in the four surveys and our assumptions can be summarised as follows:

Workers	1986	1989	1993	1997 est	1999	Growth rate 1986/99	Growth rate 1993/99
Planting & nurseries	5330	4865	3350	3190	3153	-4.0%	-1.0%
Maintenance	5000	3970	3725	3480	3364	-3.0%	-1.7%
Harvesting inc road-building & r	13270	14775	11110	7750	6159	-5.9%	-9.8%
Managerial/clerical/other	5305	5905	2790	3910	4568	-1.2%	8.2%
Haulage	1445	1495	985	1070	1061	-2.4%	1.2%
Processing	9040	10040	12860	11350	11227	1.7%	-2.3%
TOTAL	39390	41050	34820	30760	29532	-2.2%	-2.7%
of which in-forest	23600	23610	18185	14430	12676	-4.8%	-6.0%
England	22180	21025	19410	16000	14739	-3.1%	-4.6%
Wales	5940	4780	4750	4230	4099	-2.9%	-2.5%
Scotland	11270	15245	10660	10740	10694	-0.4%	0.1%

Source: FC surveys and CEIFA interpolations   Ref:6c:\trees 112\treesemp\empsurv

3.4.37   The two charts following indicate the development. In the first one we have sketched the pattern over time, on the assumption that productivity movements between the surveys took place steadily (this assumption is probably *not* realistic, but there seems little alternative):

Figure 3.25   Direct employment in forestry, haulage and primary processing

Source:1986, 1989, 1993 and 1999 Forestry Commission Surveys
Other years: cogentsi modelling & interpolation
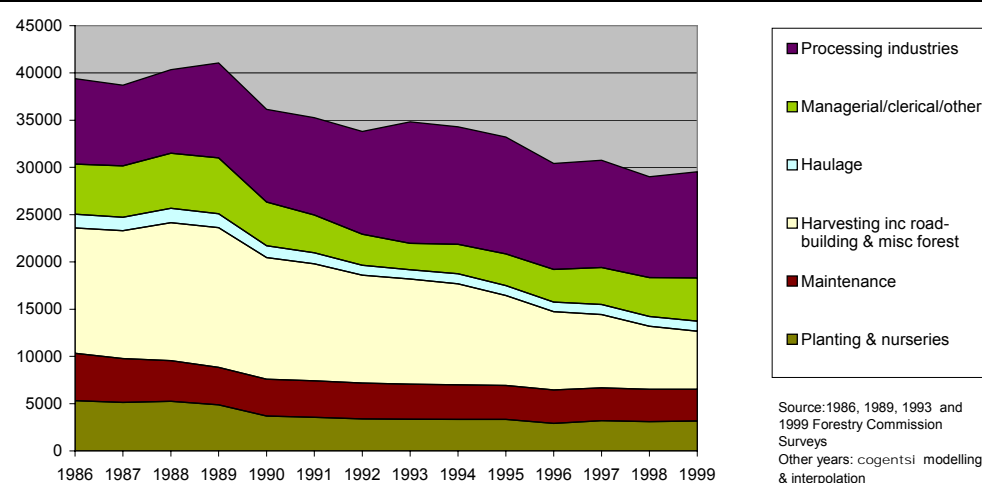
3.4.38   The second chart shows that, in terms of the three countries, then except for 1989-1993, in Scotland, the major reductions in employment occurred in England.

Figure 3.26   Forest employment by country
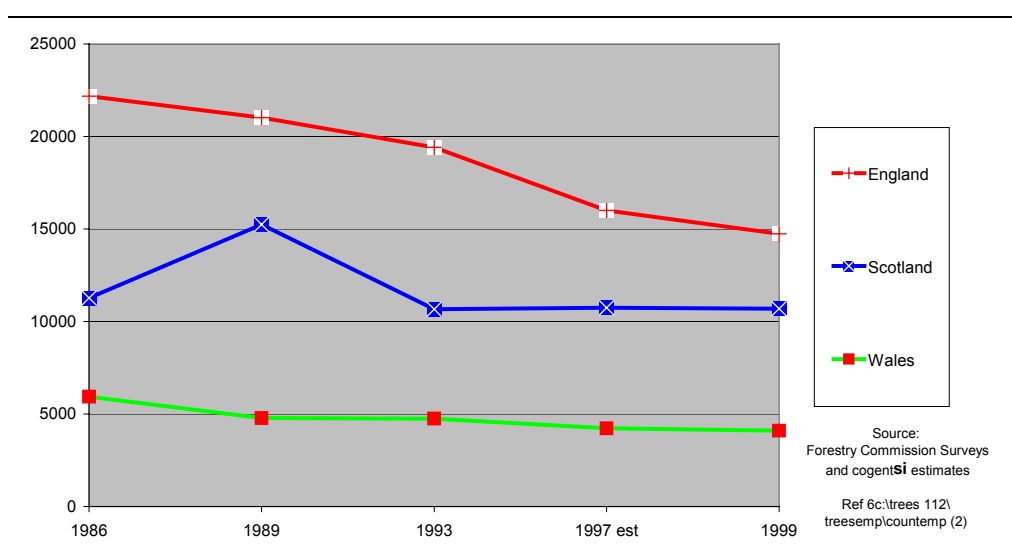
3.4.39   Only one of the national studies attempted to update the 1993 survey. That was the English one, which created a matrix of type of employer and type of activity and extrapolated the trend formed by joining the 1989 and 1993 data points. The extrapolation was essentially conservative: linear if the trend was increasing and exponential if it was decreasing. It took no account of changes in outputs or inputs in the various sectors, and did not refer to forestry employment other than in-forest.

Incomes

Forest workers' incomes

3.4.40   The wage and salary bill identified for forestry in the input-output tables, divided by the employment identified in the ONS database Nomis, show gross wages and salaries per head for forestry employees as £16 860 in 1997. The Welsh survey reports gross wages in private estates at £10 400 per fte and in harvesting and contracting at £19 600 in 1996, with an average of £15 580 in 1996. The other two country reports offer no comparable figures[7]. From the Forest Enterprise annual report we have calculated a figure for its 2500 employees of £19 000. The Nomis figure of £16 860 is close to an updated Welsh figure, and what might be expected for an industry average given that Forest Enterprise can be expected to have a different occupational structure, so it has been used for both employment and self-employment income.

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[7] The Scottish report quotes Scottish I-O tables as giving a total figure of £45.3 mn for employment and self-employment costs, and elsewhere an employment figure of 5990, but the implied earnings per head of less than £7 600 is clearly too low. The total income from employment and self-employment in the Scottish appendix is £47.8 mn, which would give earnings per head of £8 000, still far too low. Even if allowance is made for FC housing (the treatment of which in the input output tables is not transparent to the author) the figures are still too low.

Figure 3.27   Sales, prices and wages trends - forestry

Source: Values: UK Input output balances
Employment: Nomis
Volumes: FC & FICGB
Stdg timber price:FICGB,FC,Cogent

Ref 6c:\trees 112\ Treets\wagetrends
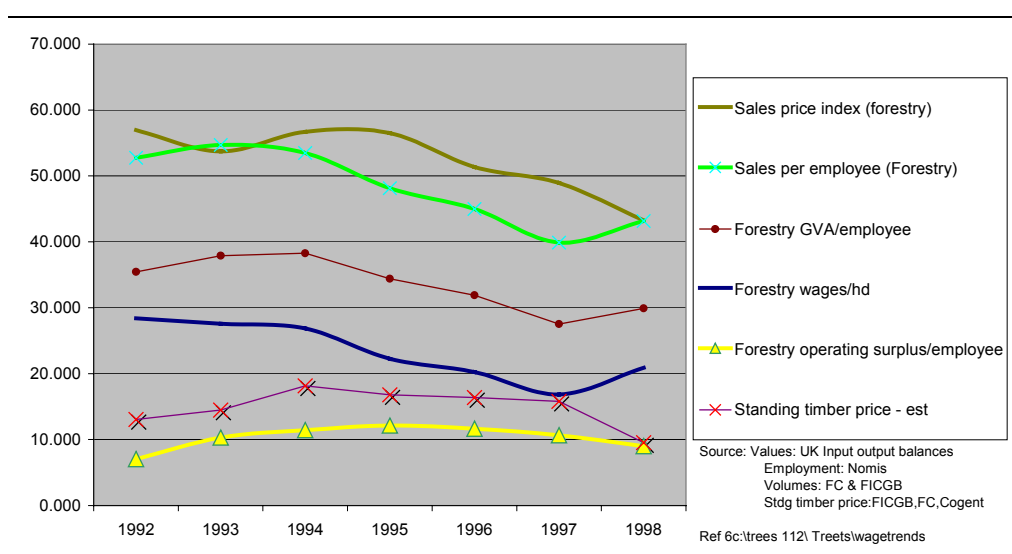
Paper mills workers' incomes

3.4.41   From the input output tables and NOMIS data on employees in employment the average income is £25 100 in the paper and board industry. However, the sales and output per employee are much higher for the domestic-timber-based industry, which is much more capital-intensive than mills based on recycled paper and imported pulp, and almost always operates on a 3-shift system. These factors will almost certainly be reflected in higher earnings. To take account of this and the individual differentials estimated for different types of paper individual estimates were made for the wage bill per head, averaging £28 700 per head. These figures are gross of employer's NI contributions and before tax, so they represent the cost to the mill, and they are averages for all employees in all grades and occupations.

Sawmills and panelboard mills workers' incomes

3.4.42   From the input output tables and NOMIS data on employees in employment, it can be calculated that the average income from employment (before tax and gross of employer's NI contributions) in the wood and wood products sector is £15 150. This figure of course includes builders' joinery and other wood products and mills using foreign timber. The Welsh survey reported wages of £24 400 for panelboard and paper and £13 600 for sawmills at 1996 prices, but no income per head figures are quoted in either of the other studies. The Welsh figures appear compatible with the UK average, and so they were applied. In general wages and salaries are higher in England than the other countries, but this is in part a question of the mix of occupations and in particular the impact of high earnings in London and the South East. We did therefore consider using a higher wage assumption for England, but the pattern of other costs and revenues for the English mills suggested that the average earnings differentials between countries found across industries as a whole was unlikely to apply in full in wood processing. The mills are in many cases quite near the border and so the assumption that they operate in similar labour markets to the Scottish or Welsh ones is reasonable. After inflating to 1997 the relevant figures

were £25 400 for panelboard and £14 100 for sawmills, applied in all three countries. The chart below shows that movements in wages reflect movements in the industry's sales and value added. (Gross operating surplus is profit + depreciation; Gross Value Added is Wages (strictly, gross employment income) + gross operating surplus + taxes on production (mainly VAT)).

Figure 3.28   Sales and wages trends – wood and wood products
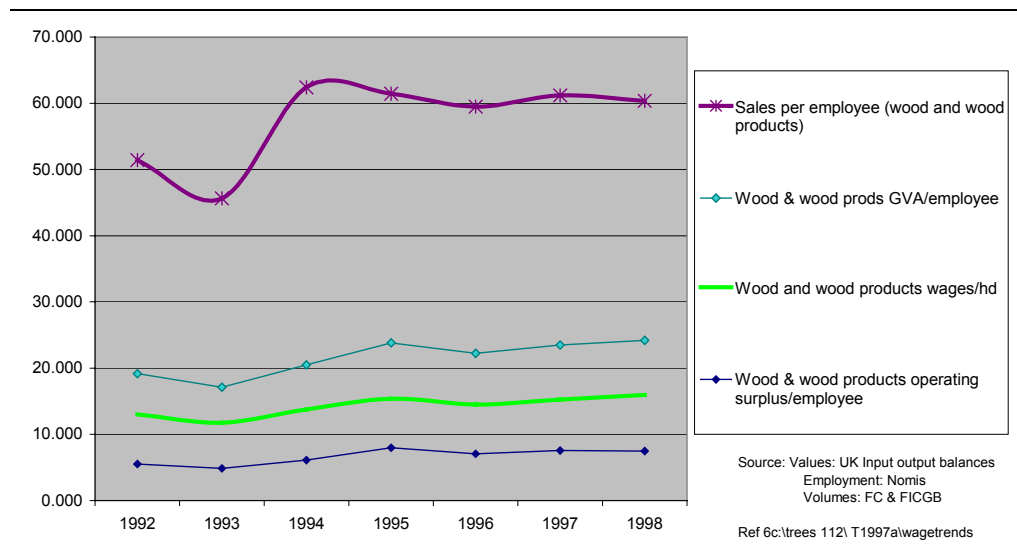
Comparing trends in wage rates and value added

3.4.43   The differences in trends in the figures that can be calculated for government statistics are instructive. They suggest that the burden of falling timber prices has been shared by the companies and the employees in the forestry industry, and that the growth in sales income per employee for sawnwood and board has likewise been shared in the wood-processing industry. The effect has been to bring the two wage rates closer together over the 1990s:

Figure 3.29   Value added and wages trends – forestry and timber processing

Source: Values: UK Input output balances
Employment: Nomis
Volumes: FC & FICGB

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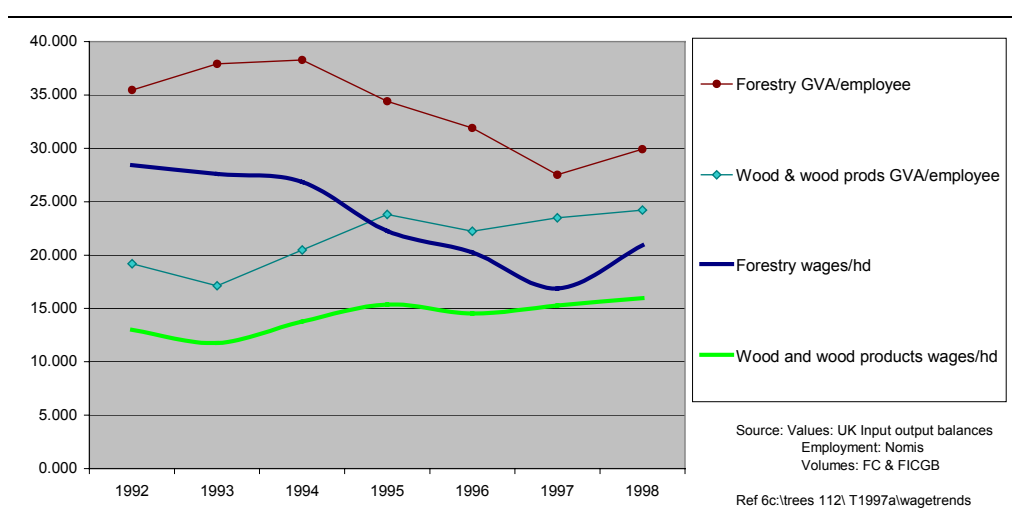
Geography

Timber – geographical balance

3.4.44   The model adds together timber demand from the five sectors separately for each country. In the case of the sawmills then the input assumptions are themselves split by country. The locations of the paper and board mills are known, and in the case of the panelboard mills we have split the different panel types between countries on the basis of assumption and industry intelligence. We have allocated 'other' across countries on the basis of small roundwood removals.

3.4.45   Thus we know in which country wood is demanded. From where will it be supplied? To allocate this demand across the countries we must draw a balance showing where wood is moved from one to the other. In principle we have done this in the form of a matrix as follows:

3.4.46   For timber, most of the inter-country movement that goes on appears to be close to the border. The Welsh report remarked on this, eg on p19, and we encountered it in one of our own interviews, where a major Scottish sawmill in Dumfriesshire said that 'we consider the Forest of Kielder part of our natural catchment area'. As well as the substantial cost of transportation in relation to the cost of timber, there are other considerations. For example, to limit infestation, timber cannot legally be transported into Scotland with its bark on from Wales and from England other than northern England.

3.4.47   Important exceptions to the 'just across the border' rule are Scottish supplies of small roundwood to the newsprint mill at Shotton and to the cartonboard mill at Workington which can move considerable distances, sometimes by sea.

3.4.48   The English study based assumptions on wood imports into England on a study by McGregor and McNicoll (1989). This in turn was based on a theoretical calculation where the output of 'national' industries (including all forest-dependent sectors) was

allocated across regions in fixed proportions (McGregor and McNicoll (1991) and the inputs to industries were based on UK 1984 input-output tables. There are three difficulties with this, two of misinterpretation and one of currency. Firstly McGregor and McNicoll actually quote the direct and indirect impacts of forestry, so the figures are not a timber sourcing estimate at all. Secondly, the model which McGregor and McNicoll uses actually treats forestry as a national (UK) industry, so all timber using industries wherever located are assumed to source evenly from timber across the UK - that is, the English mills would in McGregor and McNicoll draw timber from exactly the same source as a Scottish or Welsh one. And thirdly, since 1984 the supply of domestic softwood (mainly harvested in Scotland and Wales) has increased by 130 per cent, and the use of domestic hardwood (mainly harvested in England) has fallen by 70 per cent. Even if they had been correctly discerned in the first place, it is very unlikely that the import ratios would be similar today.

3.4.49   Having estimated the demand from each country, this requires to be allocated across the supplying countries. In accordance with the philosophy of input-output modelling we have done this in fixed proportions, but in much greater detail than in the old McGregor and McNicoll estimates. Three separate tables are used, one for softwood logs, one for small roundwood, and one for hardwood:

3.4.50   For softwood logs we have based our estimates on actual data collected by the Forestry Commission. The FC Sawmill Survey 1998 reported that the main flows of softwood logs were from Scotland and Wales into England. Using responses from sawmills themselves, it provided an estimate of the flow of softwood logs between countries.

3.4.51   There remain difficulties with these estimates, in addition to those arising from the balancing of deliveries and removals already covered above. As FCSS98 acknowledges, over 14 per cent of log inputs were not accounted for (over 23 per cent in the case of the English sawmills). Nevertheless the estimates are the best available

3.4.52   For small roundwood we started by building a similar table, but adjusted so that the row totals and column totals reflected the supply and demand for srw in 1997. These figures therefore take some account of the different stages of maturity of the different national forests.

3.4.53   When it came to estimating hardwood there was an added difficulty, as no removals figures were available. The production was allocated on the basis of evidence of grant aid to the private sector and the area under timber.

4   Scenario analysis

4.1   Design of simulations

4.1.1   We have created a set of seven simulations that enable the report to address issues raised in the brief for the study. Those issues were:

  1   'Remove' forestry and the '100% dependent' user industries from the UK economy

  2   Double current timber production levels

  3   Double current productivity levels

  4   Add 100 000 hectares of community forest

4.1.2   The approach taken has been to model the removal of each major end-use sector in turn to calculate appropriate all-effect multipliers. This is a straightforward application of the model and we can readily carry it out for any individual end-use. Below we examine

  0   A base case

  1   Removal of the paper and board sector and the forest production activities that serve it

  2   Removal of the panel board sector and the forest production activities that serve it

  3   Removal of the softwood sawmilling sector and the forest production activities that serve it

  4   Removal of the hardwood sawmilling sector and the forest production activities that serve it

  5   Removal of all physical outputs. Because the relationships are essentially linear, within the framework of an input-output model, a doubling of output with the current mix of activity would have almost equal but opposite effects to eliminating the output. (They would only be different because the model is not *exactly* linear). However, we would obtain different results if the mix was varied and section 6 examines this.

4.1.3   The presentation of these simulations is deliberately utilitarian. Two summary tables are followed by a simple summary text following a conventional pattern. This 'bare bones' approach seems appropriate for the present document, but it should be understood that the model offers almost limitless possibilities to explore the detail of each scenario. For example, the different timber and other supply chain needs of the different paper mills could be examined, or the effect of one scenario on a particular country explored. The model could shed light on the impact of some change in the assumptions about Scottish sawmills on timber transport routes, or panelboard profitability, or Welsh service industry employment.

4.1.4   We hope that the model will become sufficiently established as a policy tool at the Commission that many issues are addressed in this way as separate studies.

4.2   The base case

4.2.1   The base case for the simulations corresponds closely, but not quite exactly, to the situation in 1997.   The main difference is that the levels of planting and of maintenance are those appropriate to the level` of harvesting – in other words it s a 'full cycle' or 'sustainable' scenario.   The main assumptions, inputs and outputs for the base scenario are summarised in a single sheet as follows:

Timber product outputs

Paper & Board — tes of paper

Newsprint (Shotton)	439	
Magazine (Irvine)	223	
Paperboard (Workington)	176	*Total*
Fluting (Sudbury)	132	969.5

Panelboards &c — 000 m³

MDF	410	
OSB	200	
PBCB	1920	*Total*
Other	8	2538

Sawn Softwood

England	827	
Wales	333	*Total*
Scotland	823	1983

Other softwood uses

Fuelwood	100	
Fencing	323	*Total*
Other	33	456

Sawn Hardwood

England	133	
Wales	5	*Total*
Scotland	6	144

Other hardwood uses

Fuelwood	150	
Fencing	30	*Total*
Other	25	205

Hectares of forest maintained
(Reqd to sustain removal rate shown) — *(Actual 1997)*

Softwood	2160	1539
Other	891	901
Total	3052	2440

Economics (million)

	Sales	Value added	Income from emp & self-emp	Operating surplus (before subsidies)
Paper & Board	542	193	46	147
Sawmills	445	171	156	15
Panelboard	419	268	50	218
Forestry	644	185	286	-101
Total direct	2050	817	539	278
Indirect	1263	559	339	220
Total	3313	1376	877	499
Induced	1454	697	360	336
Total	4767	2072	1237	835
Type I Multiplier	1.62	1.68	1.63	1.79
Type II Multiplier	2.33	2.54	2.30	3.00

Sourcing (GB)

Softwood srw	3086	*Total*
Softwood logs	3560	6646
Hardwood	821	

Softwood

England	1552	
Wales	1339	*Total*
Scotland	3754	6646

Native	1508	
High forest	4644	*Total*
Farm &c	493	6646

Hardwood

England	516	
Wales	54	*Total*
Scotland	250	821

Land planted for sustainability

Native/tradl	14.4	
Comml/High Frst	13.9	
Farm/Ctty	1.9	*Total*
Hardwood	8.2	38.4

Transport

Notional 000 tonne-miles	715

Labour (jobs) *GREAT BRITAIN*

	Direct	1st round indirect	Later indirect	Induced	Type I Mult-iplier	Type II Mult-iplier
Paper	1600	2811	2720	3672	4.46	6.75
Board	2000	1049	1015	2025	2.03	3.04
Sawmills	7748	970	939	4401	1.25	1.81
Harvesting	6314	1940	1877	4057	1.60	2.25
Mtce for sustainability	4383	1008	975	2172	1.45	1.95
Planting for sustainability	3972	580	562	1732	1.29	1.72
Other	3977	249	241	1742	1.12	1.56
Haulage	928	375	363	847	1.80	2.71
Total	30923	8983	8692	20647	1.57	2.24

Grand total>	69245	48598	Direct & <indirect
	9.27	6.51	< per 000 tonne removal

Jobs by country

	Direct	1st round ind	Later indirect	Total D&I	Ratio
England	11221	5658	7005	23884	2.13
Wales	5083	1031	503	6617	1.30
Scotland	14619	2074	1000	17693	1.21
NI (assmptn)	925	220	184	1330	1.44
Total	31849	8982	8692	49523	1.55

Note: 'indirect' jobs quoted on this sheet do **not** include jobs in the forest industries themselves

4.2.2   The elements of this sheet can be examined separately:

Inputs

4.2.3   The outputs of the product mills are specified in their own units:

Timber product outputs

Paper & Board	tes of paper		
Newsprint	438.5		
Magazine	223.0		
Paperboard	176.0	*Total*	
Fluting	132.0	969.5	

Panelboards &c	000 m^3		
MDF	410		
OSB	200		
PBCB	1920	*Total*	
Other	8	2538	

4.2.4   and the sawmill throughputs and other products in appropriate units

Sawn Softwood			
England	827		
Wales	333	*Total*	
Scotland	823	1983	

Other softwood uses			
Fuelwood	100		
Fencing	323	*Total*	
Other	33	456	

Sawn Hardwood			
England	133		
Wales	5	*Total*	
Scotland	6	144	

Other hardwood uses			
Fuelwood	150		
Fencing	30	*Total*	
Other	25	205	

4.2.5   The model then calculates the requirements for different types of timber from all end uses:

Sourcing (GB)

Softwood srw	3086	*Total*
Softwood logs	3560	6646
Hardwood	821	

4.2.6   and the likely sourcing pattern:

Softwood

		Total
England	1552	
Wales	1339	
Scotland	3754	6646

		Total
Native	1508	
High forest	4644	
Farm &c	493	6646

Hardwood

		Total
England	516	
Wales	54	
Scotland	250	821

4.2.7 As explained in Part III, the sourcing is done on the basis of the average pattern of current sourcing for each main timber use. From the origins and destinations the model calculates the transport requirements based on 'notional' tonne-miles:

Transport

Notional 000 tonne-miles	715

4.2.8 The model then calculates the planting needs to replace this, based on planting densities provided for one of the national studies, and likewise the area of forest needing to be maintained:

Land planted for sustainability

		Total
Native/tradl	14.4	
Comml/High Frst	13.9	
Farm/Ctty	1.9	
Hardwood	8.2	38.4

Hectares of forest maintained
(Reqd to sustain removal rate shown)

		(Actual 1997)
Softwood	2160	1539
Other	891	901
Total	3052	2440

4.2.9 The sales of each component are calculated, and from them the value added and its components, labour income and operating durpluses:

Economics (£ million)

	Sales	Value added	Income from emp & self-emp	Operating surplus (before subsidies)
Paper & Board	542	193	46	147
Sawmills	445	172	156	15
Panelboard	419	268	50	218
Forestry	644	186	286	-100
Total direct	2050	818	539	280

4.2.10 This table can be completed by calculating first of all the purchases, and then the indused income, the income generated when people employed in the system spend their wages and salaries. The output and income multipliers are ratios derived from this table:

Economics (£ million)

	Sales	*Value added*	*Income from emp & self-emp*	*Operating surplus (before subsidies)*
Paper & Board	542	193	46	147
Sawmills	445	172	156	15
Panelboard	419	268	50	218
Forestry	644	186	286	-100
Total direct	2050	818	539	280
Indirect	1261	558	338	220
Total	3311	1376	877	499
Induced	1454	696	360	336
Total	4765	2073	1237	836
Type I Multiplier	1.62	1.68	1.63	1.79
Type II Multiplier	2.32	2.53	2.30	2.99

4.2.11   Employment is calculated for the forest-based industries in proportion to the Forestry Commission survey data, and for other industries based on the average employment per £000 of sales of each of 123 industries identified in the UK input output tables.

Labour (jobs)
GREAT BRITAIN

	Direct	*1st round indirect*	*Later indirect*	*Induced*	*Type I Multiplier*	*Type II Multiplier*
Paper	1600	2811	2720	3672	4.46	6.75
Board	2000	1049	1015	2025	2.03	3.04
Sawmills	7748	970	939	4401	1.25	1.81
Harvesting	6314	1937	1874	4052	1.60	2.25
Mtce for sustainability	4383	1008	975	2172	1.45	1.95
Planting for sustainability	3972	580	562	1732	1.29	1.72
Other	3977	249	241	1742	1.12	1.56
Haulage	928	375	363	847	1.80	2.71
Total	30923	8979	8690	20643	1.57	2.24

4.2.12   The direct and indirect employees can be allocated to countries:

Jobs by country

	Direct	*1st round ind*	*Later indirect*	*Total D&I*	*Ratio*
England	11221	5656	7004	23880	2.13
Wales	5083	1030	503	6616	1.30
Scotland	14619	2073	999	17692	1.21
NI (assmptn)	925	220	184	1329	1.44
Total	31849	8979	8690	49517	1.55

4.2.13   The ratios shown to the right of this table are <u>not</u> multipliers, because the 'indirect' shown for England includes English employees in the supply chains for Scottish and Welsh activities, and does not include Welsh and Scottish employees in the supply chains for English activities – and similarly for other categories. However they do illustrate a potential regional issue, that the employment consequences of activities in the periphery tend to revert towards the centre:

Figure 4.30   The supply chains lead to England
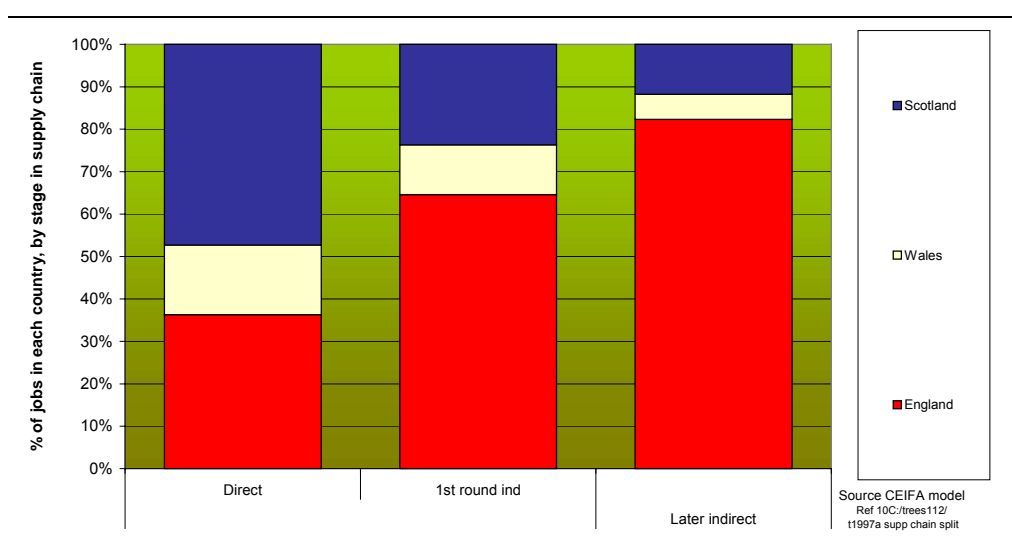
4.2.14   The Northern Irish figure should be taken as no more than an illustrative calculation, designed solely to give a broadly indicative total for the United Kingdom.

4.3   Simulation 1: The impact of the paper mills

4.3.1   In this scenario the outputs of the four paper mills were set to zero. By examining the difference from the base case as follows, we can assess the impact of the integrated paper industry on the economy.

4.3.2   The paper mills themselves employ an estimated 1600 people. Their use of forest industry supplies gives rise to a further 2960 jobs, removing and replacing 940 green tonnes of softwood and 198 green tonnes of hardwood. The supply chain to the integrated paper mills employs 6226 (this is a net effect after taking account of the diversion of sawmill residues to fibreboard mills).

4.3.3   Thus we can see that the four paper mills and the activity to supply them account for £578 million pounds of value added, 32 per cent of the GDP generated directly and indirectly by the forestry sector. They account for 15 per cent of the direct employment, but 35 per cent of indirect employment, bringing the overall impact on supply chain jobs to 23 per cent. They account for 25 per cent of induced jobs

4.3.4   Paper activities absorb 15 per cent of timber harvested, 1138 green tonnes. This amounts to 31 per cent of small roundwood and 26 per cent of hardwood removals. They give rise to approximately 20 per cent of the haulage in the industry. Housing two paper mills, Wales is by far the most paper-dependent economy, with 32 per cent of its forestry-related jobs affected. England and Scotland are roughly equally affected, with 23 and 19 per cent respectively.

4.3.5   The physical parameters for this scenario are as follows:

Paper & Board	Scenario	Base	Absolute difference	% difference
Total forest sector				
Softwood removals				
England	1391	1552	161	10.4%
Wales	1158	1339	181	13.5%
Scotland	3156	3754	598	15.9%
GB	5706	6646	940	14.1%
Hardwood removals				
England	362	516	154	29.8%
Wales	19	54	36	65.6%
Scotland	242	250	8	3.4%
GB	623	821	198	24.1%
Forest Employment	15687	18647	2960	15.9%
Other direct Employment	10498	12276	1778	14.5%
Indirect Employment	11449	17675	6226	35.2%
Total direct & indirect Employment	37635	48598	10964	22.6%
of which England	*18412*	*23884*	*5472*	*22.9%*
Wales	*4517*	*6617*	*2100*	*31.7%*
Scotland	*14426*	*17693*	*3267*	*18.5%*
Induced employment	15576	20647	5071	24.6%
GRAND total employment	52931	68841	15910	23.1%

4.3.6   This leads to the following commercial effects

Paper & Board	Scenario	Base	Absolute difference	% difference
Sales				
Direct	1424	2050	626	30.5%
Indirect	790	1263	473	37.4%
Induced	1097	1454	357	24.6%
Total	3311	4767	1456	30.5%
Value added				
Direct	614	817	203	24.9%
Indirect	353	559	205	36.7%
Induced	525	697	171	24.6%
Total	1493	2072	579	28.0%
Miles haulage	578	715	137	19.2%

4.3.7   The fact that paper production entails the use of a wide range of other inputs significantly increases the multipliers for this industry.

Jobs generated per 000 tons of timber	14.0
of which forestry	*2.6*
other forest industries	*1.6*
supply chain	*5.5*
induced	*4.5*
Value added/000 tonnes	*0.509*
Feed-forward multiplier from forestry	
Type I	3.70
Type II	5.38

4.3.8   Multipliers shown in this table are employment multipliers.

4.4   Simulation 2: The impact of the panelboard mills

4.4.1   In this scenario we set the outputs of the panelboard mills to zero. Panel activities absorb 25 per cent of timber harvested, 1833 green tonnes. This represents 56 per cent of small roundwood and 14 per cent of hardwood removals. They give rise to approximately 23 per cent of the haulage in the industry. Scotland is by far the most panel-dependent economy, with 31 per cent of its forestry-related jobs affected. England and Wales are equally affected, with around 20 per cent.

4.4.2   The board mills themselves employ an estimated 2000 people. Producing the timber to supply them employs a further 4400 people. The remainder of the supply chain to the mills themselves employs 2205 people, and the chains to the supplying forestry activities 1787, making a grand total of 10523 in the mills and all the activities to supply them. A further 4490 jobs are induced as these people spend their incomes.

4.4.3   Thus we can see that the panelboard mills and the activity to supply them account for £552 million pounds of value added, 30 per cent of the GDP generated directly and indirectly by the forestry sector. They account for 23 per cent of the direct employment, but 25 per cent of indirect employment, bringing the overall impact on supply chain jobs to 24 per cent.

4.4.4   The physical parameters are as follows:

Panelboard	Scenario	Base	Absolute difference	% difference
Total forest sector				
Softwood removals				
England	1139	1552	413	26.6%
Wales	1145	1339	195	14.5%
Scotland	2646	3754	1109	29.5%
GB	4930	6646	1716	25.8%
Hardwood removals				
England	468	516	48	9.3%
Wales	53	54	2	3.2%
Scotland	182	250	68	27.3%
GB	703	821	118	14.4%
Forest Employment	14248	18647	4399	23.6%
Other direct Employment	10071	12276	2205	18.0%
Indirect Employment	13755	17675	3920	22.2%
Total direct & indirect Employment	38075	48598	10523	21.7%
of which England	*19498*	*23884*	*4387*	*18.4%*
Wales	*5466*	*6617*	*1151*	*17.4%*
Scotland	*12789*	*17693*	*4904*	*27.7%*
Induced employment	16159	20647	4489	21.7%
GRAND total employment	53911	68841	14930	21.7%

4.4.5   Thus the board mills absorb around a quarter of GB softwood and a seventh of hardwood removals. Their impact on the economics of the industry is as follows:

Panelboard	Scenario	Base	Absolute difference	% difference
Sales				
Direct	1512	2050	538	26.2%
Indirect	992	1263	270	21.4%
Induced	1138	1454	316	21.7%
Total	3643	4767	1124	23.6%
Value added				
Direct	536	817	281	34.4%
Indirect	439	559	120	21.4%
Induced	545	697	151	21.7%
Total	1520	2072	552	26.6%
Miles haulage	557	715	158	22.1%

4.4.6   While only around two thirds the value for paper, the 'feed forward' multipliers are still high:

Jobs generated per 000 tons of timber	8.1	
of which forestry	*2.4*	
other forest industries	*1.2*	
supply chain	*2.1*	
induced	*2.4*	
Value added/000 tonnes	*0.301*	
Feed-forward multiplier from forestry		
Type I	2.39	
Type II	3.39	

4.4.7   Multipliers shown in this table are employment multipliers.

4.5   Simulation 3: The impact of non-integrated softwood timber uses

4.5.1   In this scenario we set the outputs of the softwood sawmills and basic softwood products to zero.

4.5.2   Thus it can be seen that other softwood uses and the activity to supply them account for £592 million pounds of value added, 32 per cent of the GDP generated directly and indirectly by the forestry sector. They account for 47 per cent of the direct employment, but 28 per cent of indirect employment, bringing the overall impact on supply chain jobs to 40 per cent.

4.5.3   Softwood activities other than the integrated product mills absorb over half of softwood and almost a third of timber harvested, 2838 green tonnes.

4.5.4   Faced with the obvious hypothetical question 'what if all softwood sawmills closed' the economic model is left with a fibre deficit for the panelboard and paper mills, which normally use pulp, dust and sometimes bark from the sawmills.. The model has been programmed to resolve this by calling for more small roundwood. The gross effects are 3560 green tonnes less logs, and 722 more srw to replace the residues. The softwood gives rise to approximately 43 per cent of the haulage in the industry. Proportionally, its use plays similar roles in the forest economies of all three countries, around forty per cent.

Softwood	Scenario	Base	Absolute difference	% difference
Total forest sector				
Softwood removals				
England	803	1552	750	48.3%
Wales	779	1339	561	41.9%
Scotland	2227	3754	1527	40.7%
GB	3808	6646	2838	42.7%
Hardwood removals				
England	516	516	0	0.0%
Wales	54	54	0	0.0%
Scotland	250	250	0	0.0%
GB	821	821	0	0.0%
Forest Employment	12234	18647	6412	34.4%
Other direct Employment	5631	12276	6645	54.1%
Indirect Employment	13280	17675	4395	24.9%
Total direct & indirect Employment	31145	48598	17453	35.9%
of which England	*15414*	*23884*	*8471*	*35.5%*
Wales	*4328*	*6617*	*2288*	*34.6%*
Scotland	*11122*	*17693*	*6571*	*37.1%*
Induced employment	13626	20647	7021	34.0%
GRAND total employment	44490	68841	24351	35.4%

4.5.5   The financial consequences are much more moderated than for value-added processing:

Softwood	Scenario	Base	Absolute difference	% difference
Sales				
Direct	1496	2050	554	27.0%
Indirect	958	1263	304	24.1%
Induced	960	1454	494	34.0%
Total	3414	4767	1353	28.4%
Value added				
Direct	598	817	219	26.8%
Indirect	423	559	136	24.3%
Induced	460	697	237	34.0%
Total	1481	2072	592	28.5%
Miles haulage	457	715	258	36.0%

4.5.6   Compared with the integrated uses, the multipliers are relatively low for this sector.

Jobs generated per 000 tons of timber	8.6
of which forestry	*2.3*
other forest industries	*2.3*
supply chain	*1.5*
induced	*2.5*
Value added/000 tonnes	*0.208*
Feed-forward multiplier from forestry	
Type I	2.72
Type II	3.80

4.5.7   Multipliers shown in this table are employment multipliers.

4.6   Simulation 4: The impact of hardwood sawmilling

4.6.1   This is similar to Scenario 3 but with hardwood. Hardwood uses outwith the integrated product mills and the activity to supply them account for £17 million pounds of value added, 5 per cent of the GDP generated directly and indirectly by the forestry sector. They account for 12 per cent of the direct employment, but only 7 per cent of indirect employment, bringing the overall impact on supply chain jobs to 10 per cent.

4.6.2   Hardwood activities other than the integrated product mills absorb 6 per cent of timber harvested, 478 green tonnes.

4.6.3   As with softwood sawmills, if the hardwood mills and forests supplying them closed, the economic model is left with a fibre deficit for the panelboard and paper mills, which normally use pulp, dust and sometimes bark from the sawmills. The extra wood called for is small, however. The gross effects are 504 green tonnes less hardwood, and 26 more srw partially to replace the residues.

Hardwood	Scenario	Base	Absolute difference	% difference
Total forest sector				
Softwood removals				
England	1561	1552	-9	-0.6%
Wales	1341	1339	-2	-0.1%
Scotland	3770	3754	-15	-0.4%
GB	6672	6646	-26	-0.4%
Hardwood removals				
England	202	516	314	60.9%
Wales	37	54	17	31.2%
Scotland	77	250	173	69.3%
GB	316	821	504	61.5%
Forest Employment	16749	18647	1898	10.2%
Other direct Employment	10777	12276	1499	12.2%
Indirect Employment	16598	17675	1077	6.1%
Total direct & indirect Employment	44124	48598	4474	9.2%
of which England	*20426*	*23884*	*3459*	*14.5%*
Wales	*6476*	*6617*	*140*	*2.1%*
Scotland	*16842*	*17693*	*851*	*4.8%*
Induced employment	18748	20647	1899	9.2%
GRAND total employment	62492	68841	6349	9.2%

4.6.4   Hardwood gives rise to 7-8 per cent of the haulage in the industry. Proportionally, it represents almost a sixth of the English forest economy, but only 3 per cent of the Welsh and 5 per cent of the Scottish.

Hardwood	Scenario	Base	Absolute difference	% difference
Sales				
Direct	1912	2050	138	6.7%
Indirect	1188	1263	75	5.9%
Induced	1320	1454	134	9.2%
Total	4421	4767	346	7.3%
Value added				
Direct	800	817	17	2.1%
Indirect	526	559	33	6.0%
Induced	632	697	64	9.2%
Total	1958	2072	114	5.5%
Miles haulage	668	715	47	6.6%

4.6.5   Once again, compared with the integrated uses, the multipliers are relatively low for this sector – as low as softwood.

Jobs generated per 000 tons of timber	13.3
of which forestry	*4.0*
other forest industries	*3.1*
supply chain	*2.3*
induced	*4.0*
Value added/000 tonnes	*0.239*
Feed-forward multiplier from forestry	
Type I	2.36
Type II	3.34

4.6.6   Multipliers shown in this table are employment multipliers.

4.6.7   The 'forward' multiplier for the forestry sector that feeds the sawmills is 3.34 (this does **not** go forward beyond sawmills, as it assumed that joiners will use imported timber). However the hardwood sector itself is so labour-intensive that one thousand tonnes of wood generates 13.3 jobs throughout the economy if used in sawmills.

4.7   The whole sector

Summary	Hardwood	Softwood	Panelboard	Paper	TOTAL
Jobs generated per 000 tons of timber	13.3	8.6	8.1	14.0	9.8
of which forestry	*4.0*	*2.3*	*2.4*	*2.6*	*2.5*
other forest industries	*3.1*	*2.3*	*1.2*	*1.6*	*1.9*
supply chain	*2.3*	*1.5*	*2.1*	*5.5*	*2.5*
induced	*4.0*	*2.5*	*2.4*	*4.5*	*2.9*
Value added/000 tonnes	*0.239*	*0.208*	*0.301*	*0.509*	*0.292*
Feed-forward multiplier from forestry					
Type I	2.36	2.72	2.39	3.70	2.77
Type II	3.34	3.80	3.39	5.38	3.93

4.7.1   Multipliers shown in this table are employment multipliers   .

4.7.2   It is clear that making paper and sawing hardwood are the most effective employment creating activities by far. Paper is the most effective wealth-creating use, with Panelboard a distant second and sawlogs the lowest. However, the benefits of integrated paper manufacture are maximised if it displaces paper imports, rather than displacing mills based on imported pulp or recycled fibres.

4.7.3   While there is a broad correspondence between the impact of forest-related activities on employment and on incomes, it is worth noting that hardwood sawmilling has a relatively high impact on employment, given its economic impact, while panelboard manufacture has a high economic impact, given its effect on employment.

Figure 4.31   Job and wealth creation per green tonne removed
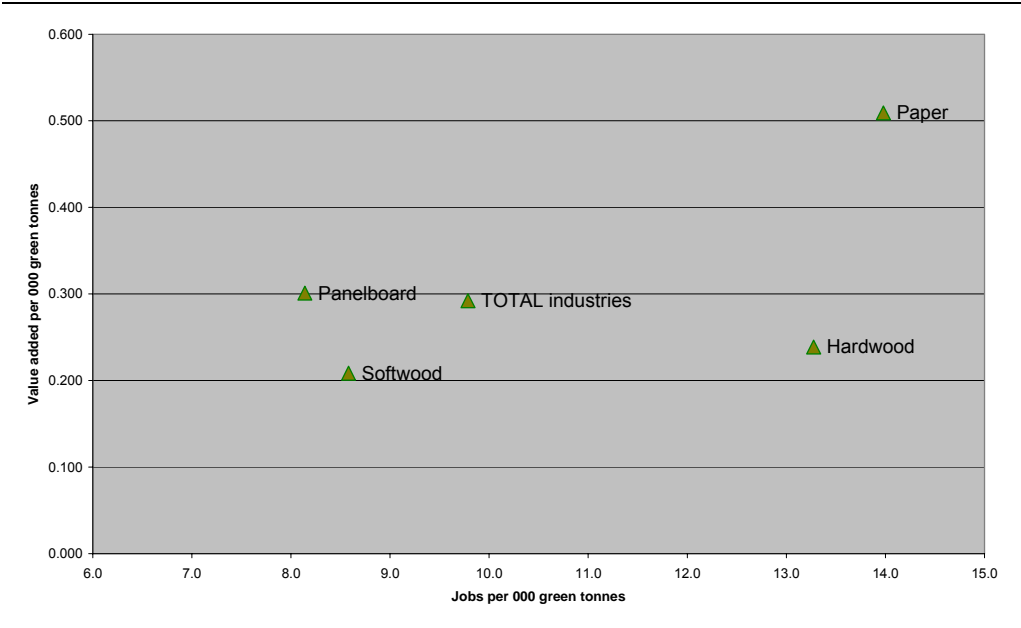
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