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# Tobacco and Jobs

*The impact of reducing  
consumption on  
employment in the UK*

David Buck

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Martin Raw

Matthew Sutton

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**SSA** Society for the Study of Addiction

Centre for Health Economics

THE UNIVERSITY *of York*



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First published in May 1995 by the Society for the Study of Addiction and the  
Centre for Health Economics, University of York.

ISBN 0 9525601 0 0

This report can be ordered from: Publications Office, Centre for Health Economics,  
University of York, York YO1 5DD. Telephone: 01904 433684 Facsimile: 01904 433644  
Price £7.95.

Design and typesetting: Sequel Limited, Banbury, Oxfordshire.

Printed: Seacourt Press Limited, Oxford.

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## **ACKNOWLEDGMENTS**

Material from the Family Expenditure Survey was made available by the Central Statistical Office through the ESRC Data Archive. Material from the General Household Survey, was made available through the Office of Population Censuses and Surveys and the ESRC Data Archive. Both have been used by permission of the Controller of Her Majesty's Stationery Office, to whom we are extremely grateful. We thank the Health Education Authority for providing financial support for the project. The Publications Sub-Committee of the Society for the Study of Addiction, chaired by Professor Griffith Edwards, have given their keen support throughout. An early draft of this report was completed against the clock in the peace and calm of Wayside Cottage, Buckden, North Yorkshire and the authors are very grateful to Dr David Charley for use of the cottage. At the Health Education Authority we received and greatly appreciated the calm and efficient support of our project officer Anne Robbins. We would also like to pay especial tribute to the tremendous support and bristling competence of Katie Aston, who yet again has overseen a complex project through a tight schedule with aplomb and gusto. Neither those who provided the data, nor any other people or organisations bear any responsibility for the analysis or interpretation of the data recorded here. That responsibility belongs to the authors alone.

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May 1995

## PREFACE

Opiates, stimulants, benzodiazepines, alcohol, nicotine. These are all drugs and use of all of them has resulted in problems - personal, medical, social and indeed political. Some of them are legal, some are not, and some have been both legal and illegal within the last hundred years. All of them act powerfully on the human central nervous system. All have, in varying degrees, the potential to cause harm, and all are in varying degrees dependence producing. On the 25th April 1884, at a luncheon at the rooms of the Medical Society of London, the Society for the Study and Cure of Inebriety was established to study these matters. It is the oldest British society concerned with the subject. It later became the Society for the Study of Addiction, and the fact that this society is flourishing 111 years later is testimony to the fact that addiction is becoming a greater and not a lesser problem. The society, as its name suggests, is dedicated to the study of addiction: to studying it, understanding it better, disseminating this knowledge, and informing the process of making policy to reduce the damage done by it.

Until recently the main vehicle through which the Society disseminated such knowledge was its international scientific journal *Addiction*. But in recent years the Society has started new publishing projects and new ventures. This report is part of an initiative to bring a wider audience the results of research which informs important policy areas. Nicotine is in some ways the most dangerous drug of all. Certainly the sheer number of people who have and will be killed through its use is unprecedented and will probably never be touched by any other drug. Through historical accident however it is legal and its use is promoted by wealthy multi-national corporations, which can afford the best advertising and public relations. Many arguments have been advanced to defend the manufacture and marketing of this drug - one of them being it provides jobs. To many this may not seem a reasonable justification for pushing a dangerous drug, but public health policy makers need facts to support their actions, not just rhetoric.

I am therefore pleased on behalf of the Society to present this important study, from a highly respected team of health economists at York. It is our hope and my belief that this research will make a significant contribution to an extremely important area of the tobacco control field - that of the impact of falling consumption on employment. We hope that policy makers everywhere will take note of the implications of this work.

Professor Ray Hodgson  
President  
Society for the Study of Addiction

## SUMMARY

This report assesses the economic significance, in terms of employment, of the tobacco industry to the UK economy. Government figures show that from 1970 to 1991 the number of people employed in tobacco manufacturing has fallen from about 40,000 to 12,000 (about 0.05% of total jobs). Industry sponsored studies suggest that far greater numbers are involved in supplying goods and services to the tobacco industry and distributing and selling tobacco products. However if tobacco consumption continues to fall these jobs will not all be lost. The reason is that when consumers spend less on tobacco they tend to spend the money on other products instead. The money is not lost to the economy. Given that the industries that make these other products will require other industries to supply them, and that these products also will have to be distributed and sold, jobs in alternative industries will be created. Since tobacco manufacturing is now so capital intensive, a higher total number of jobs may result. This is what we have investigated in this study.

This study takes data from 1990, the base year for the government's *Health of the Nation* target for a 40% reduction in smoking, and looks at what would happen to employment if consumption was reduced by 40%. The study uses data on spending patterns to look at different ways in which smokers who stop might re-allocate their released tobacco expenditure. It also simulates two possible government reactions to reduced tobacco tax revenue. Most of these simulations show that a reduction in spending on tobacco would result in a net overall increase in jobs in the UK. Under the assumptions we believe are most reasonable there would be an overall increase of about 150,000 jobs.

These results suggest that current policies aimed at reducing smoking related disease and deaths may also benefit the economy by creating more jobs. Whilst employment is naturally not a primary focus of *The Health of the Nation*, it is fortunate and reassuring to discover that government health policies are also good for employment.



## 1 INTRODUCTION

This report assesses the economic significance, in terms of employment, of the tobacco industry to the UK economy. The tobacco industry, as an employer, is naturally keen to emphasize its role in providing jobs (as well as profits, revenue and other benefits) to the UK economy. However it tends to consider only those jobs directly associated with producing and selling its own products. But what if consumers chose not to spend their money on tobacco (£8,500 million in 1990) and spent it instead on other goods and services (for example because they were responding to government policy and giving up smoking)? Would jobs necessarily be lost, or might there even be more jobs in the economy? Our study attempts to answer this question.

A detailed examination of the impact of reducing tobacco consumption on employment suggests that policies to improve health by reducing tobacco consumption are also likely to be good for employment. Balancing the health and economic effects of government policy is important and such calculations are crucial when considering products, like tobacco, which are addictive and dangerous, and for which government policy is to reduce consumption.

This study compares the actual level of employment in the UK economy with the predicted level of employment when tobacco expenditure is reduced by 40%. This figure of 40% was chosen because it is a *Health of the Nation*<sup>1</sup> target for smoking reduction. The analysis was conducted for the year 1990, which is the baseline for the *Health of the Nation* targets and the latest year for which all data needed for the study were available. In this study smokers who stop are assumed to re-allocate their tobacco expenditure to other goods and services. Falling employment dependent on tobacco will thus be offset by increases in employment dependent on consumption of other goods and services. The overall effect on the level of employment will depend on whether this new spending is on industries which are more or less labour intensive than tobacco related industries. This study is innovative in exploring how ex-smok-

ers might spend released tobacco expenditure.

The remainder of this chapter describes the *Health of the Nation* targets for smoking reduction and the likely health and economic consequences of reduced tobacco expenditure.

### Tobacco and health

Cigarette smoking remains the leading cause of avoidable mortality in the UK, responsible for over 111,000 premature deaths per year.<sup>2</sup> Smokers also have poorer health than non-smokers. Passive smoking causes increased risks for a range of diseases and can affect workmates and more significantly, children in smoking households.<sup>3</sup> If the targets set by the government for improving health are to be met, smoking must be reduced. For England, the *Health of the Nation* targets relate not only to reducing the numbers of people who smoke but also to overall levels of consumption.

The targets (the first two based on 1990 and the last on a 1988 baseline) are:

- to reduce the prevalence of cigarette smoking to no more than 20% by the year 2000 in men and women
- to reduce consumption of cigarettes by at least 40% by the year 2000
- in addition to the overall reduction in prevalence, at least 30% of women smokers to stop smoking at the start of their pregnancy by the year 2000
- to reduce the smoking prevalence of 11-15 year olds by at least 33% by 1994 (to less than 6%)

### The economic impact of falling consumption

Falling tobacco consumption could have a number of economic consequences - on trade, on government revenue, on payment of welfare benefits, and on health care expenditure - as well as on employment, the main concern of this study. Ideally, some overall analysis of all the costs and benefits of different levels of tobacco expendi-

ture should be undertaken. The World Bank have looked at the global effects of tobacco production by comparing the benefits of consumption - in terms of the amount spent on tobacco and profits generated by the industry - with the costs, calculated as direct health care costs and the indirect costs of the premature loss of life and productivity from smoking related illness. In their study<sup>3</sup> the costs outweighed the benefits by a ratio of 11:1. Although our report focuses on employment and does not include a full cost-benefit analysis, some of the potential economic effects of falling tobacco consumption are considered below.

### **Jobs**

The tobacco trade have suggested that falling consumption causes job losses in tobacco manufacturing and in support services, including retailing. For example factories need power and machinery, the goods produced have to be distributed throughout the country, and labour is needed to sell them to the public. Jobs in the tobacco manufacturing industry alone will not therefore provide a good guide to overall tobacco related employment. If spending on tobacco is reduced, it is clear there could be a reduction in the numbers of people employed directly in the tobacco industry. However, if people spend less on tobacco products they will spend more on other goods and services, even if some expenditure is delayed through saving (although this is itself an industry employing people). This means there are likely to be increases in employment in other industries. The effect on the retailing and distribution trade will depend on the relative numbers of people required to sell different goods and services.

### **Health care expenditure**

A 40% reduction in tobacco consumption would result in a large health gain for the population over a long period. However, achieving these targets will require major changes in behaviour and these changes would have economic consequences. Reductions in smoking across the

whole population are likely to reduce sickness absences and save health care resources.<sup>4</sup> However, the full consequences to the health service are difficult to estimate because reducing smoking will increase the numbers surviving into old age. No UK estimates exist of these effects but one American study suggests that smokers incur higher lifetime medical care expenditure than never smokers<sup>5</sup> although there is still some debate about this.<sup>6</sup> Health care expenditures are not addressed in this study.

### **Tax revenue and government finance**

Although strictly speaking tax revenue is a transfer between different groups in the population and therefore not an economic cost, from the government's perspective tobacco tax revenue is a significant and useful source of finance. Tobacco taxation yielded £6,518 million in the 1993/94 financial year, about 10% of total Customs and Excise revenue and 3% of total government indirect and direct (eg income tax) revenue. Any reduction in this revenue would eventually need to be replaced from other sources. In this study we simulate the impact of this replacement for employment.

The effects of falling tobacco consumption on health, life expectancy and the level of employment could in the long run have a number of consequences for government tax revenue and welfare expenditure. For example more jobs could lead to more income and company tax revenue, lower social security payments, but higher pension payments. These long term effects are not addressed in this study.

### **Trade balance**

Raw leaf tobacco and a small number of manufactured cigarettes are imported into the UK. However the industry has an overall net trade surplus with other countries because of its substantial exports of manufactured cigarettes. The consequences of a fall in UK tobacco consumption for the trade balance in tobacco goods are not clear. If the industry's economic viability were damaged

then the ability to export might be damaged. However it has been argued that a declining home market can lead to a focus on exports,<sup>7</sup> and during the 1980s when domestic consumption was falling exports were increasing.<sup>8</sup> If people who stop smoking spend the freed income on other goods and services, an assumption of our methodology, there will be consequences for the amount of general goods imported into the home market. We deal with this possibility later in the report.

### **Structure of the report**

The remainder of the report is divided into four chapters. In chapter two we discuss previous studies which assessed the employment consequences of tobacco and of switching tobacco expenditure to other goods and services. Chapter three describes our methodology, and chapter four presents the results. Chapter five discusses the results and considers some of their implications for policy.

## 2 PREVIOUS STUDIES

There have been several studies of tobacco industry related employment in the UK and abroad and these studies are reviewed below. However each has used slightly different definitions of employment. It is therefore important to be clear what is meant by the term. We define employment in the following way: **direct employment** is employment in the tobacco manufacturing industry and among retailers and distributors of tobacco; **indirect employment** is employment among suppliers of goods and services to the tobacco industry.

### Tobacco dependent employment

#### Manufacturing employment

Employment in the UK tobacco industry has fallen considerably in the last 20 years (Figure 1). The latest government estimates suggest that total employment was just over 12,000 in 1991.<sup>9</sup> Studies which have examined these job losses suggest that the main reason for job losses over the last few decades is new technology and the consequent improvements in productivity. For example, one study applied the rate of decline in employment in

all manufacturing jobs to the tobacco industry and found that of 19,400 jobs lost between 1963 and 1985, 16,000 (82%) could be attributed to general factors like productivity improvements.<sup>10</sup> This study also showed that most tobacco job losses have been in the employment of women, whose numbers fell by 70% between 1971 and 1985. A more recent study, which examined changes in employment between 1980 and 1990, suggested that improvements in productivity in the tobacco manufacturing industry far outstripped those in manufacturing as a whole, and that this was the major reason for job losses.<sup>8</sup>

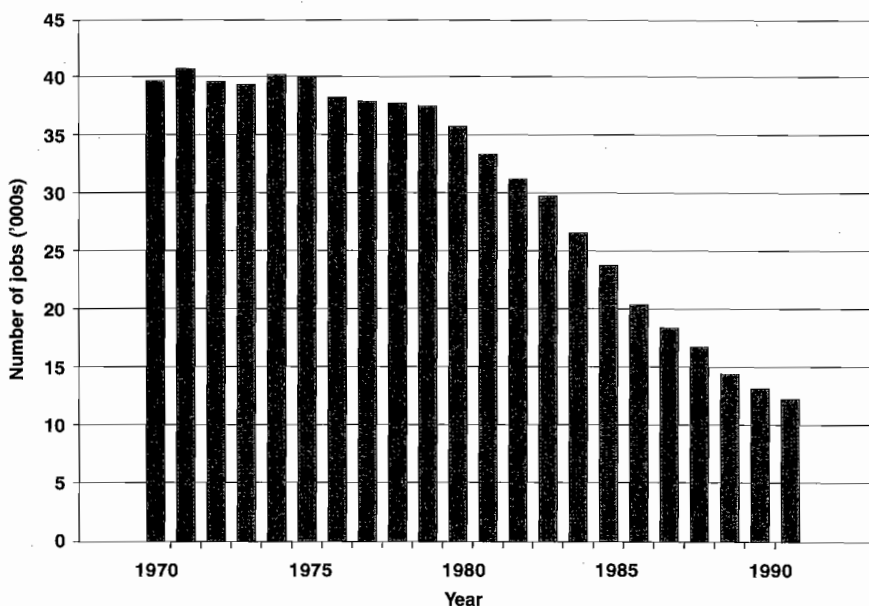
#### The Pieda study<sup>8</sup>

Other direct jobs, as well as those in manufacturing, result from the distribution and retailing of tobacco. However, these jobs are more difficult to identify because, with the exception of a relatively small number of specialist tobacconists, few firms sell tobacco alone. Most tobacco is sold through outlets such as supermarkets, off-licences, newsagents and confectioners which also sell other goods. Estimation is therefore required to calculate the dependence of retail jobs on tobacco sales.

Industry-sponsored studies suggest that the numbers of workers dependent on tobacco for employment are far greater than those employed just in manufacturing. A study commissioned by the tobacco industry from *Pieda*, an economic consultancy, estimated that 112,195 jobs were directly dependent on tobacco retailing in 1990, more than 1 in 8 of all jobs amongst those stores which sold any tobacco. Converted to full time equivalent posts these numbers fall to 43,092 jobs.

The tobacco industry also requires a range of different goods and services in order to manufacture cigarettes and other tobacco products. Tobacco manufacture not only creates retailing jobs but also creates indirect employment in supplying industries. *Pieda* estimated that 26,888 full-time equivalent jobs were indirectly dependent on tobacco in the UK through suppliers of goods and services to the industry in 1990.

**Figure 1** *Employment in tobacco manufacturing in the UK 1970-1991*



Overall then *Pieda* estimated that in the UK 153,000 people in manufacture, retailing and supply were dependent on tobacco for employment, equivalent to 84,000 full-time equivalent jobs in 1990.

### **Net effects on employment of switching from tobacco expenditure**

Estimates of tobacco dependent jobs are not useful however when asking how a change in tobacco expenditure will affect total employment. The *Pieda* study only addresses one side of the equation. It shows how tobacco expenditure supports jobs, but if that expenditure stopped it would not disappear from the economy. For example, a smoker who smoked 20 cigarettes per day at a pack price of £2.50 would have an extra £900 per year to spend. It is extremely unlikely that this will not be spent in a way that generates some jobs. Two previous studies have investigated these wider effects.

#### **A study in Scotland**

McNicoll and Boyle<sup>11</sup> estimated the impact on the Scottish economy of a reduction in spending on cigarettes in Glasgow in 1989. The money that would have been spent on tobacco was assumed to be spent on other goods and services according to consumers' existing expenditure patterns. Therefore any lost tobacco employment would be replaced, at least to some extent, by new jobs created by the different use of tobacco money. They based their estimates on specific Scottish input-output tables. Input-output tables describe interdependencies between all industries in the economy. They can be used to calculate how changes in one industry affect the level of output in other industries, that is, how much these other industries need to produce. Input-output analysis can therefore be used as part of the link between changes in consumption patterns and changes in production and thus in how many people the producing industries need to employ (see Appendix 2 for more details). Their overall results suggested that if everyone in Glasgow stopped smoking there would be a loss of 836 direct and indirect tobacco

jobs from reduced tobacco expenditure, but a gain of 8,705 jobs from switching that expenditure to other goods and services. Their result suggested that employment in Scotland would increase, with the creation of almost 8,000 full time jobs. However, in this study tax revenue changes were assumed not to affect the Scottish economy and therefore extrapolation of these results to the UK as a whole would over-estimate the positive employment effects of a switch in tobacco expenditure.

#### **A study in Michigan**

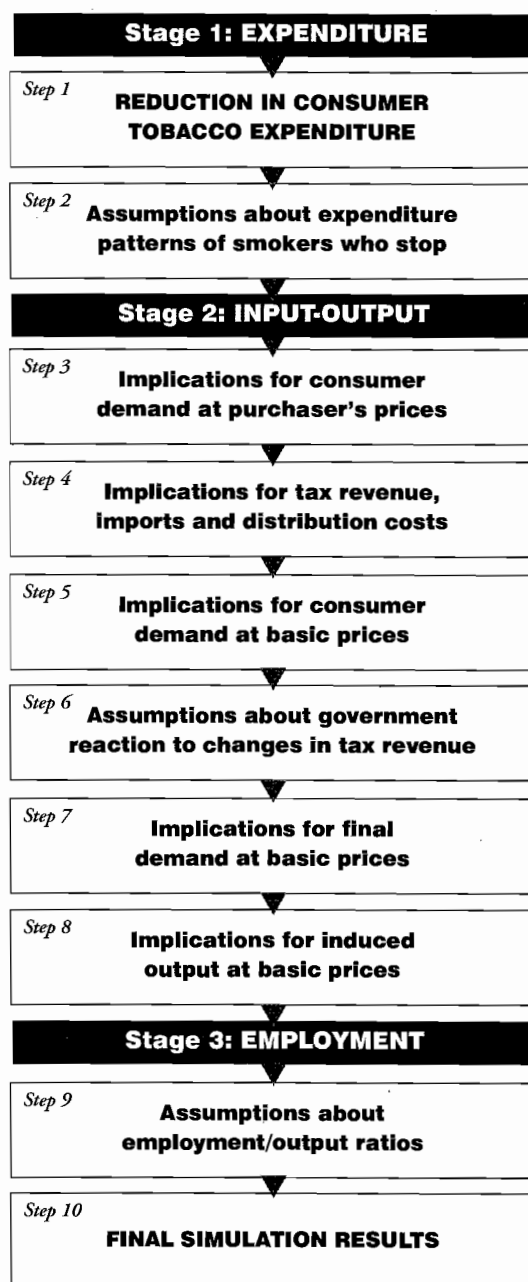
McNicholl and Boyle<sup>11</sup> looked at employment consequences by comparing two alternative situations in a given base year, a 'static' approach. An alternative method is to build a model which allows for the adjustment of the economy to falling tobacco expenditure to occur over a number of years. Such dynamic models have the advantage of being able to simulate the full impact of other important influences on the economy, for example predictions of general economic growth and population changes. However, such analyses depend on the accuracy of the models used, which are based on a series of assumptions about how different parts of the economy interact with one another over time.

Warner and Fulton<sup>12</sup> had access to a well founded dynamic model for the US state of Michigan, which has no tobacco manufacturing employment. The authors used this model to look at two possible cases: a complete and sudden end to tobacco consumption, and a reduction in consumption at double the rate of decline over the previous ten years. This study also assumed that the freed tobacco spending would be redistributed according to average consumers' existing spending patterns. In contrast to the Scottish study it also dealt with the consequences of falling tax revenue by assuming offsetting increases in other taxes or reductions in government spending. Job losses were predicted to occur in the retail and wholesale trades, and in state and local government. However, the predicted losses were outweighed by an increase in jobs in all other industries.

### 3 OUR STUDY

Our study draws on aspects of both the McNicholl and Boyle<sup>11</sup> study and that of Warner and Fulton.<sup>12</sup> It was

**Figure 2** *The basic model*



not possible to use a dynamic approach in our study because of the lack of a suitable model in the UK. Available dynamic models of the UK economy are based on broad industrial and consumption groupings which are of insufficient detail to simulate the effects of changes in tobacco expenditure. Hence our model is based on a comparison of what the economy would look like, at a particular point in time, if 40% of tobacco spending was switched to other forms of spending. It does not predict how the economy reacts to this over the long-term. Although this has some disadvantages, it is similar to the way in which the previous UK studies have estimated the consequences of reducing tobacco expenditure and is therefore more comparable.

The model we use has a number of steps each with its own assumptions. The basic model is shown in Figure 2 and is explained in more detail in Appendix 1. The model has three stages and ten steps which link changes in consumer expenditure to the final simulation results. The first stage requires that assumptions are made about the way consumers would spend freed tobacco spending (steps 1-2). Stage 2 makes use of input-output tables for 1990 (the most recent available) which are then used to predict the impact on the output of UK industry of consumers switching expenditure away from tobacco to other goods and services (steps 3-8). Input-output tables are used because they can trace the interdependence between the different industries in the economy (see Appendix 2 for more detail on input-output theory). Step 6 takes account of government reaction to a tax loss due to losing tobacco revenue. The third and final stage involves translating output changes in industry to the employment consequences by using known output-employment ratios.

Our approach contains an innovation not found in other studies to date. In stage 1 we make what we believe are more realistic assumptions about how people would spend the money they were previously spending on tobacco. This stage is important because it drives the final employment results. McNicoll and

Boyle<sup>11</sup> and Warner and Fulton<sup>12</sup> assumed that smokers who stopped would spend freed money according to existing average consumer expenditure patterns (ie all smokers and non-smokers). Put simply this means that smokers who stop would buy the same things with the freed money that average consumers buy.

We have tested this assumption in our study using data from the *Family Expenditure Survey* (FES). This is an annual government survey of expenditure patterns in which households complete diaries detailing all spending over a two week period. Data on tobacco expenditure indicate whether households contain current smokers. As in other FES tobacco expenditure studies we analyse spending patterns at the household level.<sup>13 14</sup> The FES contains information on the individuals' expenditure within the household, but in many households particular individuals will purchase the majority of goods and services for other members of the household. For example, the household supply of cigarettes may be bought by one individual during a supermarket shopping trip. Thus the way in which freed tobacco money will be spent will be heavily influenced by the characteristics of the household.

There are two principal reasons why smokers who stop will not spend their extra money like average consumers. Firstly, smokers are different from non-smokers. Different rates of stopping smoking according to age, sex, and socio-economic group mean that current smoking households are not representative of the population as a whole. Since many of the characteristics on which smoking and non-smoking households differ will affect household spending patterns, current smoking households' spending also will not be the same as that of average households. Secondly, extra money may not be spent the same way current 'normal' money is spent. When smokers stop, money is released, which is equivalent to a marginal increase in income. Whilst surveys of expenditure patterns offer information on the ways in which households allocate their total

expenditure across commodity groups, there is no information on how household expenditure patterns change following receipt of extra income. It is likely that, at least in the short term, expenditure on essential items such as housing will change little, whilst expenditure on luxury items such as recreational goods and services will change.

In addition we have also used the *General Household Survey* to try and identify households which are most likely to be similar to the households which reduce their tobacco expenditure. Using this survey we have constructed two comparison groups additional to 'average consumers' and 'non-smokers': 'former smokers' or former smoking households (households which contain no current smokers and at least one former smoker); and 'recent stopper' (households which contain no current smokers and at least one ex-smoker who has stopped in the last five years). We feel this last group will have expenditure patterns most similar to those contributing to the 40% reduction in tobacco expenditure.

Thus we investigated four possible patterns of changed consumer spending as a result of reduced tobacco expenditure.

The four patterns are - that the freed money will be spent according to the expenditure patterns of:

- 1 average consumers (the standard assumption);
- 2 all non-smokers (never- and ex-smokers);
- 3 all former smokers (excluding never-smokers);
- 4 recent stoppers (probably the most realistic assumption).

These feed into Stage 1 of the model in Figure 2. Stage 2 translates these consumer expenditure changes into implications for industry output, imports and expenditure tax revenue. Because tobacco is so highly taxed relative to other consumer goods any significant fall in sales will lead to a net loss in overall expenditure tax revenue even taking into account increased taxes from increased sales of other goods and services. A realistic assumption

is that the Exchequer would react to this revenue loss. Under most circumstances this would mean either an increase in other taxes to make up the shortfall or a reduction in government spending. Each will have different, but always negative, employment consequences.

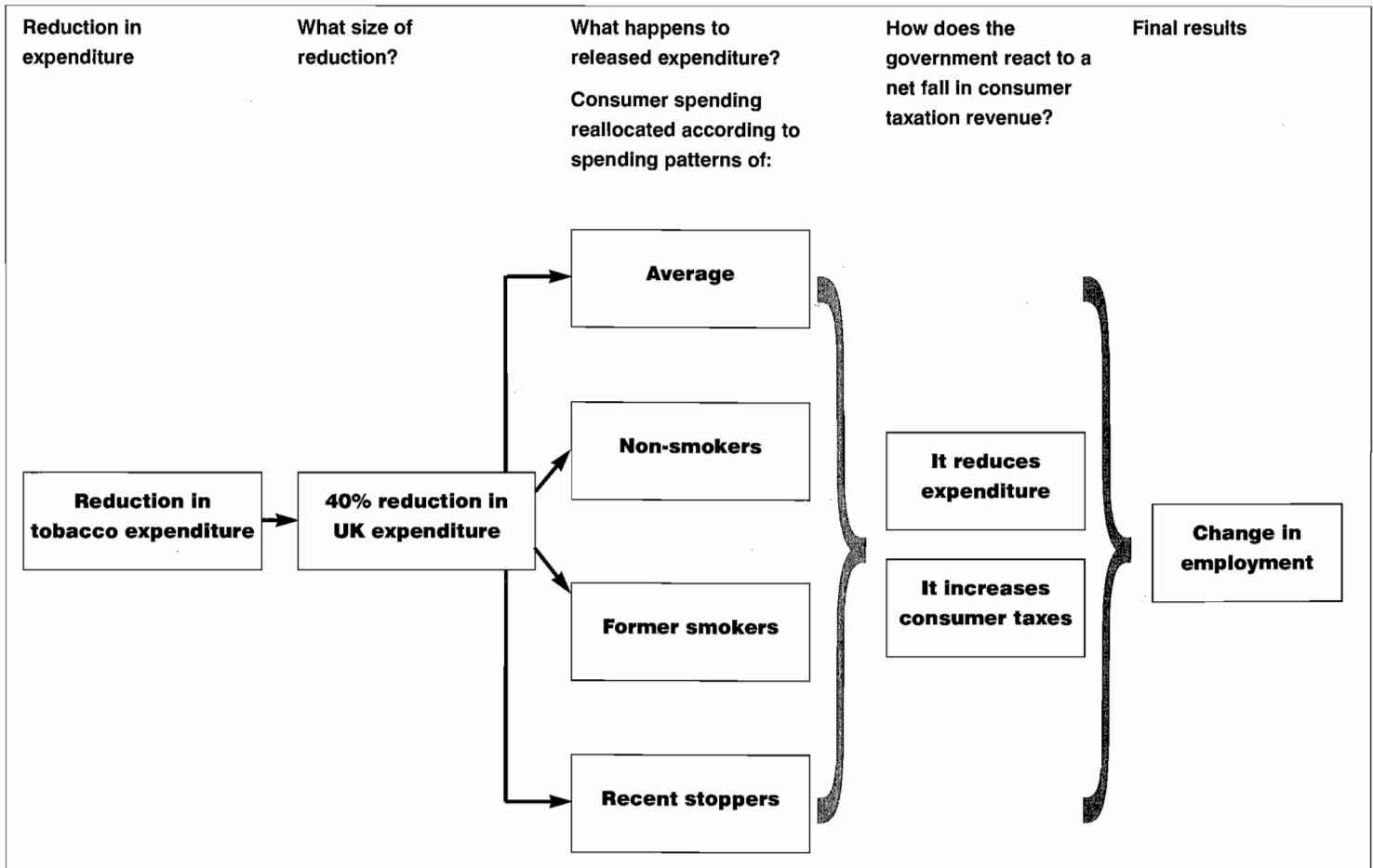
We therefore investigated the effects of two assumptions, that the government would:

- 1 reduce expenditure in line with the overall reduction in revenue;
- 2 increase other consumer taxes to replace lost revenue.

We believe the likeliest of these is the last, recovery of the lost revenue through taxes on other products and services. Despite pronouncements to the contrary governments have found it very difficult to cut the overall level of government expenditure in practice.

Thus we have built our simulations on four assumptions about how spending patterns might change and two about how the government might react to lost revenue - eight combinations. The structure of the study is shown in Figure 3. Appendices 1 to 4 contain further details of the methodology and the simplifying assumptions used. We present the results of these analyses in the next chapter.

**Figure 3** *The structure of the study*





## 4 RESULTS

### Predicted changes in spending patterns

Table 1 shows the spending patterns of four types of household: smokers, non-smokers, former smokers, and recent stoppers. Non-smoking households spend a significantly smaller proportion of money on food and alcohol than smoking households, and a larger proportion on housing and recreation, entertainment and education. The expenditure patterns of former-smoking households also differ significantly from smoking households. Former smoking households spend a significantly smaller proportion on alcoholic drink, clothing and footwear, and fuel and power. On the other hand, like non-smoking households, they spend more on housing and recreation, entertainment and education than smoking households.

The expenditure patterns of recent stopper house-

holds are different from those of non-smoking and former-smoking households. Households containing recent stoppers spend a lower proportion on housing than smoking households, and also a lower proportion on food. In contrast, they spend a higher proportion on clothing and footwear, transport and communication, other goods and services, and recreation, entertainment and education. Since these households are most likely to have similar characteristics to those stopping smoking in the near future, and have relatively recently adjusted their spending in response to released tobacco expenditure, their spending pattern is probably the best available approximation to the spending of smokers most likely to stop. This is especially important given that we are simulating a 40% reduction in consumption and therefore need to identify those most likely to stop.

**Table 1** Spending patterns of smoking, non-smoking, former-smoking, and recent stopper households

Functional category <sup>1</sup>	Percentage of net household expenditure (excluding tobacco and miscellaneous)			
	Smokers <sup>9</sup>	Non-smokers <sup>10</sup>	Former smokers <sup>11</sup>	Recent stoppers <sup>12</sup>
Food	21.1	20.3*	21.0	18.6*
Alcoholic drink <sup>2</sup>	6.2	3.5*	3.7*	4.3*
Clothing and footwear	6.7	6.3	6.1*	7.8*
Housing <sup>3</sup>	22.0	25.6*	25.1*	19.1*
Fuel and power <sup>4</sup>	7.4	7.2	6.9*	5.3*
Household goods and services <sup>5</sup>	5.7	5.7	5.8	6.5
Transport and communication <sup>6</sup>	12.4	11.9	11.8	14.8*
Recreation, entertainment and education <sup>7</sup>	9.4	10.0*	10.3*	12.5*
Other goods and services <sup>8</sup>	9.3	9.5	9.2	11.1*
Number of households	3003	4043	1580	359

Source: derived from the 1990 Family Expenditure Survey.

**Footnotes to Table 1\*** Indicates that the percentage of total expenditure spent on this functional category is significantly different from the percentage spent by smoking households at the 95% level; **1** Based on Blue Book categorisation; **2** Includes alcohol consumed both 'on' and 'off' licensed premises; **3** Includes: rent; rates; water charges; maintenance, repair and improvement costs; and do-it-yourself goods; **4** Refers to electricity, gas, coal and coke, and other fuels; **5** Includes: furniture; carpets; major appliances, such as cookers and refrigerators; textiles and soft furnishings; hardware; cleaning materials; and household and domestic services, such as laundry, hire and repair of household goods, and house contents insurance; **6** Refers to: cars and other vehicles; petrol and oil; vehicle running costs; rail, bus and air travel; postal services; and telecommunications; **7** Includes: televisions and other durable goods; sports goods and toys; records, tapes and photographic films; pets and pet food; betting and gaming; admission charges to the cinema and other entertainments; books and newspapers; and educational tuition fees; **8** Includes: medicines and spectacles; NHS charges; toilet articles; hairdressing and beauty care; jewellery, watches and clocks; catering (meals and accommodation); life insurance; bank charges etc; **9** Refers to households which contain at least one adult who currently smokes; **10** Refers to households which do not contain any adult smokers; **11** Refers to households not containing a current smoker, but predicted to contain at least one former smoker; **12** Refers to households not containing a current smoker, but predicted to contain at least one former smoker who has stopped in the last five years.

### Economic consequences of assumptions about predicted spending patterns

In this study we have used four assumptions about how ex-smokers may allocate their freed tobacco expenditure across other goods and services: 1) in the same way as all consumers; 2) in the same way as all non-smokers; 3) in the same way as former smokers; 4) in the same way as recent (in the last five years) stoppers.

The expenditure patterns which we adopt are important for jobs for several reasons. Different goods and services are provided by different industries with different levels of labour-intensiveness (ie. different output/employment ratios). Furthermore, different goods and services are taxed at different levels and, whilst no commodities are taxed as highly as tobacco, re-allocated expenditure will bring in some tax revenue to replace lost tobacco tax revenue. In addition some consumer expenditure will flow out of the country on imports and will thus reduce employment within the UK. Finally, the majority of tobacco-related employment has been found to be in distribution industries, and different goods and services will require different levels of input from this sector.

The taxation, imports and distribution industry impacts of each of the four different spending assumptions are shown in Table 2. Although in some simulations, a small proportion of lost tax revenue (which for a

40% fall in consumption is about £2,600 million) will be replaced by increased tax revenue from the switching of this expenditure to other goods and services, in others this will not be the case. Because non-smoking households, including recent stoppers, spend *less* than smokers on alcohol, another highly taxed commodity, some cases (expenditure allocated in the same way as non-smokers or former-smokers) will result in even greater loss of tax revenue than just that from tobacco expenditure. The first column of Table 2 shows this by showing the *overall* loss of expenditure tax revenue from a 40% reduction in consumption. This highlights the need to take into account potential government reactions to changes in tax revenue, when simulating the employment consequences of falling tobacco consumption.

If ex-smokers are assumed to spend their money in the same way as all non-smokers or former smokers there are net reductions in the amount spent on distribution industries and on goods and services imported from abroad. If ex-smokers are assumed to spend in an average way there is a substantial increase in the demand for distribution industries. On the other hand, if ex-smokers spend in the same way as recent stoppers, there will be a sizeable increase in imports.

### Employment consequences of re-allocation of tobacco expenditure

The estimated effects of a 40% reduction in tobacco expenditure on total employment in the UK are shown in Table 3. Results are shown for eight combinations of assumptions about how ex-smokers would spend the released money, and how the government would react to the net losses in tax revenue on consumers expenditure shown in Table 2.

Table 3 shows predicted employment changes if the government reacted to a loss of revenue by reducing its expenditure (**Reduction in expenditure** column). Three of the assumptions about changed spending patterns produce job increases, from 10,000 (standard assumption) to 165,000 (ex-smokers spend like recent

**Table 2** *Economic consequences of different expenditure patterns (£m)*

Assumptions about how released tobacco expenditure is spent	Overall change in expenditure tax revenue	Change in amount spent on imports <sup>1</sup>	Change in amount spent on distribution industries <sup>2</sup>
According to existing patterns	-2,400	+330	+370
As non-smokers	-3,000	-82	-560
As former smokers	-3,000	-110	-530
As recent stoppers	-2,500	+700	+210

<sup>1</sup> At basic prices (see Appendix 1); <sup>2</sup> At basic prices. Distribution industries includes: wholesale distribution; retail distribution; maintenance and repair of motor vehicles, filling stations and other goods; and hotels, catering, public houses etc.

stoppers). Only one produces job losses: if ex-smokers spend like all non-smokers.

Smaller job gains come from the case which we consider the most likely government reaction, namely that the government reacts to a loss of revenue by increasing other taxes (**Increase in other consumer taxes** column). Again only one of the assumptions about changed spending patterns predicts job losses. If ex-smokers spend freed money like recent stoppers there would a net increase of 155,000 jobs.

#### Full and part time workers

The results in Table 3 relate to total employment. However, the disaggregated figures hide substantial differences in employment changes for men and women, and between full- and part-time jobs. In the employment figures used for the simulations, part-time is defined as less than 30 hours a week. For comparability with previous work, full-time equivalent results are shown in Table 4. Details of the conversion technique can be found in Appendix 3.

The predicted increases in the number of total jobs are reduced when considered in terms of full-time equivalents. For example, the projection based on recent stoppers' spending patterns and replacement of tobacco tax revenue with other expenditure taxes yields 115,000 full-time equivalents (Table 4) compared to 155,000 new jobs in total (Table 3). In the case where ex-smokers are assumed to allocate freed spending in the same way as all former smokers, and the government compensates for lost revenue by increasing other taxes, the increase in total jobs becomes a decrease in full-time equivalent terms. This implies that, in this case, the jobs created by new spending on non-tobacco products are more likely to be part-time than the jobs lost. Nevertheless, most of the simulations still produce job gains and this remains the key finding of this research.

**Table 3** *Predicted total employment changes if Health of the Nation Targets were met*

Assumptions about how released tobacco expenditure spent	GOVERNMENT REACTION TO LOST REVENUE	
	Reduction in expenditure	Increase in other consumer taxes
According to existing patterns	10,386	4,932
As non-smokers	-14,431	-21,931
As all former smokers	9,394	1,597
As recent stoppers	165,369	155,542

#### The impact of saving

What if people save the money they were spending on tobacco? In assessing the economic importance of the tobacco industry in the UK, Pleda<sup>8</sup> suggested that projecting re-allocation of freed tobacco expenditure would be misleading, since ex-smokers might save the money. There is some evidence from the *Family Expenditure Survey* that non-smoking households tend to save a greater proportion of their income than smoking households, but it is not credible that smokers will save all the money previously spent on cigarettes. In the short-term some saving could lead to lower expenditure and therefore fewer jobs. However, in the long-term accumulated savings may be spent on expensive items, such as cars and consumer durables. It should also be remembered that even saved money has not disappeared from the system and may create jobs in financial industries. Savings, will also eventually generate investment which in turn generates employment. It is too complex to model such long-term effects here however.

Warner and Fulton<sup>12</sup> allowed for a potential increase in savings by ex-smokers by assuming that 5% of the freed money would be saved. This figure is slightly higher than the historical average of the proportion of

**Table 4** *Predicted changes in full-time equivalent jobs if Health of the Nation targets were met*

Assumptions about how released tobacco expenditure spent	GOVERNMENT REACTION TO LOST REVENUE	
	Reduction in expenditure	Increase in other consumer taxes
According to existing patterns	6,382	889
As non-smokers	-14,834	-22,133
As all former smokers	3,742	-3,771
As recent stoppers	124,705	115,688

total consumers' income saved in Michigan. It is thus an average savings rate. However, the proportion of a small increase in disposable income which is saved (the marginal savings rate) may be higher than the proportion of total income saved, at least in the short-term. We therefore undertook two further analyses to assess the possible short-term impact of saving, using marginal savings rates of 10% and 25%. These analyses were based on the case where the government reacts to the loss of tax revenue by increasing taxes on all consumers expenditure, and ex-smoking households allocate freed money like recent stoppers. If stopping smokers save 10% of released tobacco expenditure, 17% fewer jobs are created than if all released expenditure is spent. If 25% of freed expenditure is saved, 44% fewer jobs are created.

#### Implications for different industries

The results presented in Tables 3 and 4 are aggregated across all industry sectors. In Table 5 we present the employment changes for a range of industries on the

**Table 5** *More detailed employment predictions*

INDUSTRIAL GROUP (SIC(80))	EMPLOYMENT CATEGORY					
	Male FT	Male PT	Female FT	Female PT	Total	Total fte
Agriculture, forestry & fishing	-2794	-564	-823	-465	-4646	-4152
Energy & water extraction	-9653	-22	-1828	-465	-11968	-11733
Extraction of minerals etc	-1476	-14	-514	-104	-2108	-2051
Metal goods, engineering etc	-3208	-39	-1000	-211	-4458	-4337
Other manufacturing	-6768	-155	-5182	-1487	-13592	-12799
Construction	-1799	-28	-170	-177	-2114	-2044
Distribution, hotels & catering	9555	879	4397	4484	19315	16728
Transport & communications	-2202	-66	-363	-72	-2603	-2537
Banking & finance etc	-39	63	-1112	-213	-1301	-1228
Other services	41747	11463	56069	69738	179017	139841
<b>TOTAL</b>	<b>23363</b>	<b>11517</b>	<b>49574</b>	<b>71088</b>	<b>155542</b>	<b>115688</b>

These predicted job losses and gains are based on the case in which ex-smokers spend freed money like recent stoppers and the government replaces lost revenue by increasing consumer taxes, the assumptions we have considered most reasonable.

basis that ex-smokers spend like recent stoppers and the government increases other taxes. As can be seen the pattern of employment is variable. Although many jobs are created overall, both in terms of total jobs and full-time equivalents, there are job losses in many industry sectors. However, it should be noted that these are themselves aggregates and that for some industries within these groups there would be gains. The main findings are a substantial increase in jobs in the **Other services** sector, a considerable gain in the **Distribution, hotels and catering** sector, and larger total job gains for women than for men (120,000 against 35,000).

### **Key findings**

- 1** Smokers who stop are likely to spend a larger proportion of their freed expenditure on recreation, entertainment and education.
- 2** Most of the employment simulations show that a reduction in spending on tobacco would result in more jobs.
- 3** The assumptions we believe to be the most reasonable yield 155,000 more jobs (115,000 full time equivalents).

## 5 DISCUSSION

### The key results

The results for the first three of the four expenditure patterns in Tables 3 and 4 suggest that the net changes in employment which would result from a 40% reduction in tobacco consumption are fairly small. The changes range from an increase of 10,400 jobs to a loss of 21,900 jobs in terms of total employment. Converted to full time equivalent jobs the range falls to 6,400 job gains to 22,100 job losses. However, if smokers spend their released money in the same way as recent stoppers, which we have argued is intuitively more likely, the changes - and in this case increases - in jobs are more marked. Reducing tobacco expenditure by 40% of its 1990 level (the *Health of the Nation* target) would create 155,000 to 165,000 total jobs or 115,000 to 125,000 full time equivalent jobs, depending on whether the government increased other taxes to compensate for lost revenue, or reduced expenditure.

Understanding why this is possible depends on an understanding of spending patterns (of smokers and other non-smoking groups) and the relationship between output and employment, these being the main determinants of these results. Recent stoppers spend a much higher proportion of their income on other goods and services, transport and communication, and recreation, entertainment and education than non-smokers or all former smokers. This feeds through to employment in related industries via the input-output analysis. The industry group 'other services' is where the majority of this increased expenditure goes. It is also the industry group which has by far the largest output-employment ratio, that is, it is very labour-intensive. In fact it is more than nine times as labour-intensive as tobacco manufacture, one of the least labour-intensive industries. Put simply, recent stoppers spend their newly available money on goods and services which employ more people (considerably more) than does the tobacco industry. (Some details of the goods and services included in these groups can be found in the notes accompanying Table 1 and in Appendix 1, Table A1.3).

### How these results compare with other studies

At first sight our figures appear larger than those from the few previous studies in this area. There are two main reasons for this. Firstly, we present a larger range of results, or more correctly simulations, based on a wide range of assumptions about expenditure patterns and government reaction. In effect we are casting our net more widely than previous studies like McNicoll and Boyle's.<sup>11</sup> Secondly, the three UK studies use an input-output approach which generates results for a base year only. These studies should be capable of generating comparable results if similar assumptions are used. However Warner and Fulton<sup>12</sup> use a dynamic model which generates results year by year and consequently only their base year results may be compared to the other studies.

Table 6 shows the main differences in methodology between the studies, and it is these methodological differences which have the greatest impact on results. Given these different approaches it is not surprising that estimates vary widely. However, looking at comparable situations reveals that the real differences in the estimates are not great. Two sets of such simulations are shown in Table 7, one where released tobacco expenditure is spent and the other where it is not. In the latter case we ran our model on this assumption to compare the number of jobs dependent on tobacco with the Peda estimate of just under 84,000. As can be seen, we arrive at only 50,000 tobacco dependent jobs (far right column). The first set of simulations looks at the case where smokers who stop are assumed to spend the released money like average consumers. We chose this assumption because it is the assumption made by McNicholl and Boyle<sup>11</sup> and Warner and Fulton<sup>12</sup>, in order to allow comparison with our results. The table shows the raw results from these other studies multiplied pro rata to an economy the size of the UK's. As can be seen from both the cases where the government reduces spending, and increases tax (to replace lost revenue), our estimates of job increases turn out to be the most conservative in all but one instance.

**Table 6** *Major differences in methodology of studies*

Defining characteristics	MODEL			
Question asked	Pieda (1990)	McNicoll & Boyle (1992)	Warner & Fulton (1994)	Our study
Question asked	What is significance of UK tobacco industry to the economy?	What would happen if Glasgow residents stopped smoking?	What would happen if Michigan residents stopped or cut back smoking?	What would happen if UK residents stopped or cut back smoking?
How is it answered?	Estimate of UK employment dependent on tobacco	Estimate of net change in Scottish employment from reducing expenditure on tobacco and spending released expenditure on other goods	Estimate of net change in Michigan employment from reducing expenditure on tobacco and spending released expenditure on other goods	Estimate of net change in UK employment from reducing expenditure on tobacco and spending released expenditure on other goods
Basic methodology	1. Input-output 2. Ad hoc	Input-output	REMI model - dynamic regional forecasting model	Input-output
Link between output and employment	1. Output-employment ratios 2. Value-added-salary ratios	Output-employment ratios	Cobb-Douglas production function	Output-employment ratios
Base year for simulation	1990	1989	1992	1990
Static or dynamic	Static	Static	Dynamic	Static
Area/region	UK	Glasgow/Scotland	Michigan	UK
Level of consumption cut	N/A	Total	1. Total 2. Double rate of decline	1. Total 2. HoN targets (40%)
How is redistributed tobacco expenditure spent?	N/A	According to average consumer expenditure patterns	According to average consumer expenditure patterns	According to expenditure patterns: 1. of average consumers 2. all non-smokers 3. all former smokers 4. recent quitters
How does the government react to lost tobacco tax revenue?	N/A	No reaction	1. Increase in personal taxes/decrease in expenditure 2. Increase in personal taxes 3. Decrease in expenditure	1. No reaction 2. Increase in consumer taxes 3. Decrease in expenditure

## Discussion

A number of points are brought out by our study. Firstly, and this is sometimes over-looked in discussions of employment and the tobacco industry, tobacco manufacturing in the UK provides relatively few jobs. There are many more jobs not directly related to manufacturing - in industries supplying goods and services needed by the manufacturers, and in those involved in

retailing tobacco products. These jobs would not all disappear if tobacco consumption continued to decline. Secondly, industry studies which simply estimate the total numbers of people dependent on tobacco for employment are not a useful guide to the employment consequences of falling tobacco consumption. They take no account of what would happen to the released tobacco expenditure, in effect assuming

**Table 7** *Employment consequences: comparable results from studies*

	Study	Employment consequences of released expenditure spent according to average expenditure patterns			Tobacco dependent employment
		Total jobs		FTEs	
		▼ Taxes	▲ Government spending	No reaction	
Results grossed to UK equivalent	Our study	4,932 <sup>1</sup>	10,386	85,830 <sup>2</sup>	50,302 <sup>3</sup>
	Warner & Fulton (1994) <sup>4</sup>	18,146 <sup>5</sup>	8,249	n.a.	n.a.
	McNicoll & Boyle (1992) <sup>6</sup>	n.a.	n.a.	220,969	n.a.
	Pieda (1991)	n.a.	n.a.	n.a.	83,594

Notes: 1. Increase in expenditure taxes, other than tobacco, sufficient to replace net lost revenue. 2. A run of our model assuming no government reaction, in order to produce results comparable to those of McNicoll and Boyle<sup>11</sup>. 3. A run of our model assuming that reduced tobacco expenditure is 'lost' to the economy, in order to produce results comparable to analysis of Pieda<sup>12</sup>. 4. Grossing factor is total jobs in Michigan relative to total jobs in the UK. 5. Increase in personal (income) taxes sufficient to replace lost tobacco tax revenue. 6. Grossing factor is McNicoll and Boyle's<sup>11</sup> calculation that each £1mn reduction in tobacco expenditure will lead to 64.4 fte jobs, applied to UK tobacco expenditure.

that it disappears. Our analysis suggests that this assumption is unreasonable.

By testing a range of assumptions about changing spending patterns and government reactions to lost revenue, we have produced some simulations that show job losses. It should be noted firstly that these losses are relatively small, smaller in fact than the jobs lost in tobacco manufacturing over the last 20 or so years (mainly because of improved productivity). It should then be remembered that only two out of eight simulations do produce overall job losses, and that these are not the simulations based on what we believe to be the most reasonable assumptions about how smokers would spend their freed money.

It is also worth remembering that tobacco consumption in the UK is falling and that this is govern-

ment policy. Obviously in any change of this sort there will be transitional problems as employment decreases in some industries and increases in others. But this is something happening in many industries, not only in the UK but throughout the world. It is perhaps a matter for governments to consider in what ways they might ease these problems. There are examples of development funds being made available to ease such transition in industry, many in the European Union. A similar point applies to the loss of tobacco tax revenue which would occur if *Health of the Nation* targets were met. The government would need to respond to a loss of revenue in some way. We have simulated a sudden decrease in tobacco consumption. The advantage of what is happening in reality, a gradual decline in prevalence and consumption, is that government has time to plan a strategy.

**Conclusion**

Policies to improve health through reducing tobacco consumption are likely to benefit the economy by creating jobs. Our study suggests that when changing spending patterns, and different government reactions to revenue loss are taken into account, falling tobacco consumption affects employment in a complex way. Nevertheless, under most assumptions, *reducing tobacco consumption leads to net gains in employment*. Finally, should not arguments about the employment and tax implications of falling tobacco consumption remain secondary to the purpose of the government's *Health of the Nation* targets: improving the nation's health? It is government policy to reduce tobacco consumption, because of its impact on morbidity and premature mortality. That this policy will likely increase employment might be seen as a fortunate consequence of a positive health policy. As it turns out, the health of the nation is good for the employment of the nation.



## REFERENCES

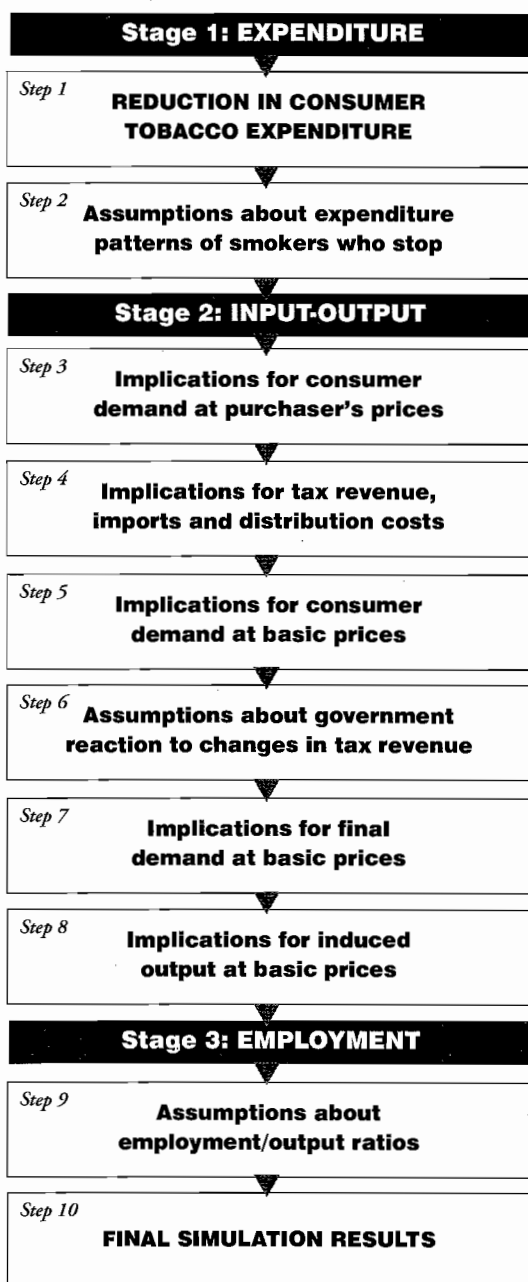
- 1 Department of Health (1992) *The Health of the Nation. A strategy for health in England*. London, HMSO.
- 2 Godfrey C, Raw M, Sutton M, Edwards H (1993) *The smoking epidemic. A prescription for change*. London, Health Education Authority.
- 3 Barnum H (1994) The economic burden of tobacco - a World Bank Analysis (summary of presentation in BASP newsletter). *Smoking Prevention, Newsletter* 26, December 1994. Brussels, European Bureau for Action on Smoking Prevention.
- 4 Buck D, Godfrey C (1994) *Helping smokers give up. Guidance for purchasers on cost-effectiveness*. London, Health Education Authority.
- 5 Hodgson TA (1992) *Cigarette smoking and lifetime medical expenditures*. *The Millbank Quarterly* 70 81-125
- 6 Pekurinen M (1992) *Economic aspects of smoking: is there a case for government intervention?* Helsinki, National Agency for Welfare and Health.
- 7 Cooper RA, Hartley K, Harvey CRM (1971) *Export performance and the pressure of demand*. London, George Allen and Unwin.
- 8 Peda (1991) *The Economic Significance of the UK Tobacco Industry*. Manchester, Edinburgh & Reading, Peda.
- 9 Central Statistical Office (1993) *Report on the Census of Production. Summary volume*. London, HMSO.
- 10 Godfrey C, Hartley K (1990) Employment. In Maynard A, Tether P (1990) *Preventing Alcohol and Tobacco Problems, Volume 1*. Aldershot, Avebury Gower.
- 11 McNicoll I, Boyle S (1992) Regional economic impact of a reduction of resident expenditure on cigarettes: a case study of Glasgow. *Applied Economics* 24 291-296
- 12 Warner KE, Fulton GA (1994) The economic implications of tobacco product sales in a nontobacco state. *Journal of the American Medical Association* 271 771-776
- 13 Atkinson A, Gomulka J, Stern N (1984) *Household expenditure on tobacco 1970-80: evidence from the Family Expenditure Survey*. Economic and Social Research Programme; taxation, incentives and the distribution of income, No.57. London, London School of Economics.
- 14 Fry V, Pashardes P (1988) *Changing patterns of smoking: are there economic causes?* Report Series No.30. London, Institute for Fiscal Studies.

## APPENDICES

### Appendix 1 Description of Methodology

As described in the text the basic model has 10 steps which trace the implications of a reduction in consumer

**Figure A1.1** *The basic model*



expenditure on tobacco at one end to the final predicted effects on UK employment at the other. These are represented as a simple flowchart in Figure A1.1.

The methodology is essentially simple to outline. Smokers who stop, or reduce their consumption, will release their tobacco expenditure for other uses. How smokers spend this released expenditure will have an important influence on the employment consequences of their giving up. In this study we have looked at four alternate spending patterns: that smokers will spend the released expenditure across industries in the same proportion as the average consumer; that they will have expenditure patterns similar to non-smokers; that they will have expenditure patterns similar to former smokers who have now given up; and finally that they will have expenditure patterns similar to smokers who have stopped in the last five years (see step 2 below).

Obviously different assumptions about ex-smokers' expenditure patterns will have different effects on consumer demand at purchaser prices (the price that is paid by the final consumer of a product) and therefore implications for government tax revenue, imports of goods and distribution costs. The input-output tables (see Appendix 2) are used to predict the full consequences of a change in consumer expenditure for UK industry output. However, in order to use the input-output tables consumer demand needs to be valued at basic prices, that is purchaser prices minus taxes and distribution costs plus subsidies.

Given that tobacco is highly taxed relative to other consumer goods and services the net result on tax revenues of a switch from tobacco to other products is likely to be negative. Therefore the government's reaction to an overall fall in expenditure tax revenues needs to be simulated. We examine two likely possibilities: that the government reduces its expenditure by an equivalent amount to the net tax loss; or that it raises other consumer taxes to finance the deficit. Again, which assumption is made will have different consequences for jobs.

Given these steps the consequences for final demand can be simulated. By using the input-output tables the intermediate output needed to satisfy this final demand can also be determined. The final step is to link the change in intermediate output and final demand to its employment consequences. We have used employment data from the *Census of Employment* and calculated static output-employment ratios based on 1990's original final demand and intermediate output figures. Assuming these ratios are constant allows a prediction of the employment consequences of different demand and output combinations. There are therefore eight possible combinations of spending patterns and government reaction as a result of a reduction in tobacco expenditure

as Figure A1.2 shows. The 10 steps are more precisely documented in the remainder of this appendix.

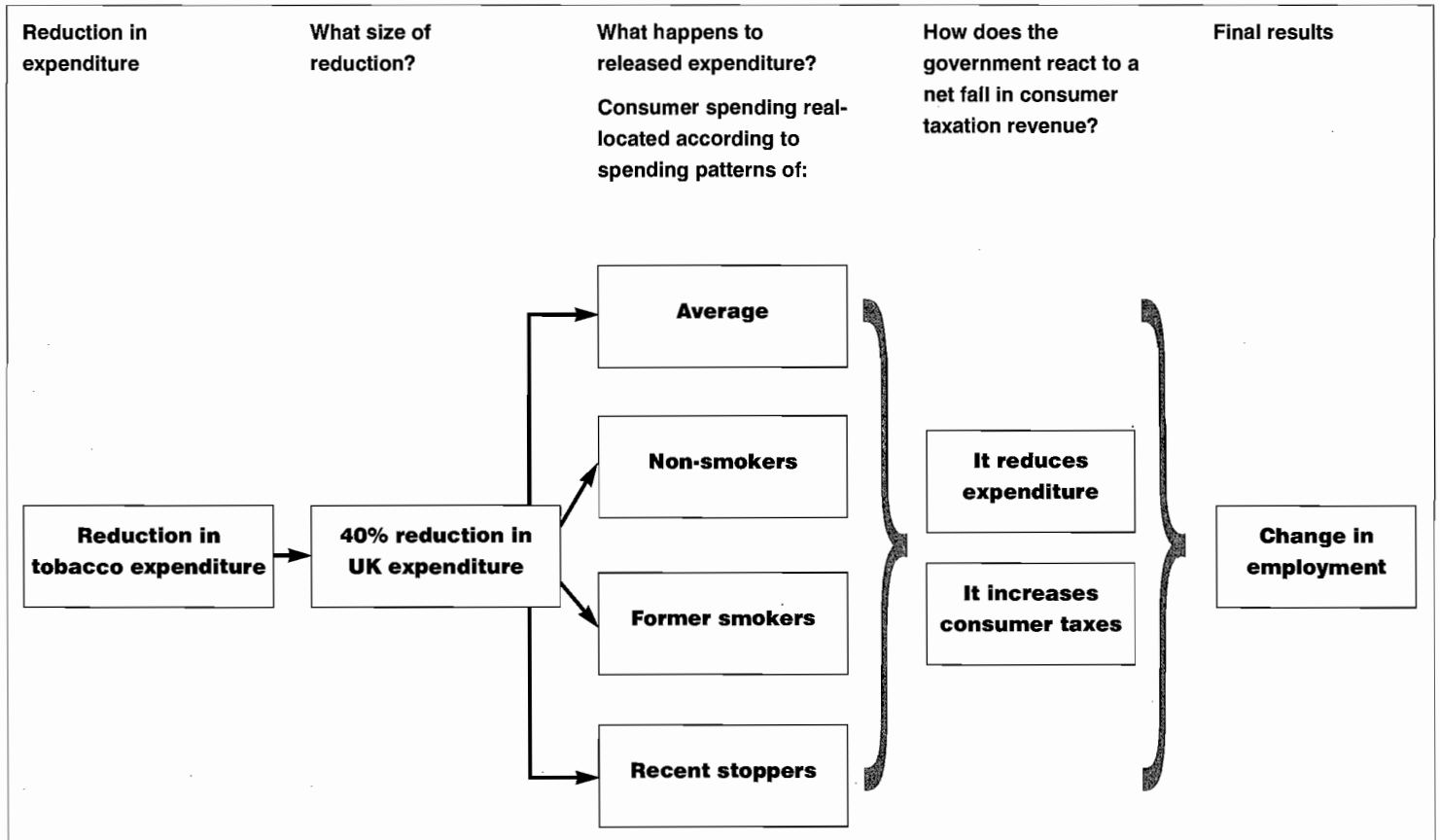
**Step 1: Reduction in consumer expenditure**

In 1990 UK consumer expenditure on tobacco was £8,578mn or 2.5% of total consumer expenditure. The simulations in the text are based on the scenario where there is a 40% reduction in tobacco consumption in line with Health of the Nation targets.

**Step 2: Assumptions about expenditure patterns of smokers who cease**

The way in which individuals who stop smoking change their expenditure patterns is crucially important for determining the employment consequences of reduc-

**Figure A1.2** *The structure of the study*



tions in tobacco expenditure. Expenditure on different types of goods or services will involve different consequences for tax revenue, the volume of imports, and demand for goods from input industries. Moreover, different industries will vary in terms of the labour-intensiveness of their output.

Previous studies of the employment implications of re-allocation of tobacco expenditure have assumed that the released expenditure will be allocated across expenditure groups in the same proportions as total consumer expenditure. However, the following analysis shows that there are major differences in spending patterns between smokers and non-smokers. Therefore, in this study, employment consequences have been estimated based on four assumptions about the expenditure patterns of those who stop smoking:

- 1 freed expenditure will be spent on goods and services in the same proportions as total consumers expenditure;
- 2 smokers who stop will have the same expenditure patterns as existing non-smokers;
- 3 smokers who stop will have the same expenditure patterns as the subset of non-smokers who are former regular smokers;
- 4 smokers who stop will have the same expenditure patterns as the subset of former smokers who have stopped smoking in the last five years.

There are no known specific surveys of the ways in which former smokers re-allocate their expenditure across different commodity groups once they stop smoking. The *Family Expenditure Survey* (FES) contains information on the expenditure patterns of a nationally representative sample of private households each year, and one of the categories of expenditure considered is tobacco. However, since respondents are not asked about their current and former smoking status, it is only feasible to divide households into "smoking households" (households with non-zero tobacco expenditure) and

"non-smoking households" (households with zero tobacco expenditure).

To construct groups of households which contain no current smokers but at least one former smoker ("former smoking households") or former smokers who have stopped in the last five years ("recently stopped households"), it is necessary to turn to an alternative information source. The *General Household Survey* (GHS), a national survey of a representative sample of private households, asks questions about smoking status biennially. As well as collecting smoking behaviour information from individuals, a wide range of demographic, socio-economic and household characteristics are considered which include many of the variables collected in the FES. The GHS can be aggregated to household level so that it is comparable to the FES, and the smoking behaviours of the individuals within each household unit recorded. Therefore, the GHS can be used to predict which households in the FES contain former and recently-stopped smokers.

The identification of households in the FES which are predicted to belong to former-smoking or recently-stopped household groups is a two-stage process. In the first instance, the influences of a range of household characteristics on the probability of membership of each of the groups are estimated using GHS data. Secondly, these estimates are applied to the households in the FES sample, and the groups are assembled using GHS estimates of the size of the groups and including the FES households with the highest probabilities.

## 2.1 Constructing a former-smoking household group

Following this approach, the households in the 1990 GHS sample which contained at least one current smoker were removed from the sample. Of the remaining non-smoking households, 39% contained at least one ex-regular cigarette, pipe or cigar smoker. A probit analysis was undertaken to identify those household characteristics which would predict the likelihood that a currently non-

**Table A1.1** *Regression results used to construct comparison groups*

Variable	Coefficient in probit equation (t-ratio)	Coefficient in grouped data regression (t-ratio)
<b>CONSTANT</b>	-1.47 (-21.9)	9.88 (14.2)
<b>No. male children, under 2 years</b>	0.03 (0.3)	-1.80 (-2.0)
<b>No. male children, 2 - 4 years</b>	0.12 (1.5)	1.11 (1.5)
<b>No. male children, 5 - 17 years</b>	0.12 (3.3)	1.57 (4.8)
<b>No. adult males, under 45 years</b>	0.20 (5.4)	-1.39 (-3.7)
<b>No. adult males, 45 - 59 years</b>	0.67 (12.2)	1.41 (2.8)
<b>No. adult males, 60 - 64 years</b>	0.78 (9.8)	0.69 (1.0)
<b>No. adult males, 65 - 69 years</b>	0.73 (8.9)	1.71 (2.5)
<b>No. adult males, 70 years or more</b>	0.84 (13.3)	2.01 (3.5)
<b>No. female children, under 2 years</b>	0.12 (1.3)	-2.10 (-2.5)
<b>No. female children, 2 - 4 years</b>	0.05 (0.6)	0.20 (0.3)
<b>No. female children, 5 - 17 years</b>	0.08 (2.3)	0.82 (2.3)
<b>No. adult females, under 45 years</b>	0.12 (2.9)	-1.75 (-4.1)
<b>No. adult females, 45 - 59 years</b>	0.21 (3.8)	0.09 (0.2)
<b>No. adult females, 60 - 64 years</b>	0.19 (2.4)	1.59 (2.3)
<b>No. adult females, 65 - 69 years</b>	0.29 (3.8)	0.37 (0.6)
<b>No. adult females, 70 years or more</b>	0.06 (1.1)	1.71 (3.1)
<b>Unemployed head of household</b>	0.55 (7.0)	-1.27 (-2.0)
<b>Retired head of household</b>	0.85 (16.0)	1.41 (2.7)
<b>Disposable income per adult</b>	0.43 (16.4)	0.13 (0.5)
<b>(Disposable income per adult) squared</b>	-0.03 (-8.25)	-0.00 (-0.0)
<b>Head of household, employer or manager</b>	0.10 (1.8)	0.08 (0.2)
<b>Head of household, professional</b>	-0.00 (-0.1)	0.73 (1.0)
<b>Head of household, non-manual</b>	0.03 (0.6)	-0.64 (-1.3)
<b>Head of household, skilled manual</b>	0.12 (2.2)	0.14 (0.3)
<b>Head of household, own account non-manual</b>	0.45 (5.7)	-0.59 (-0.9)
<b>Head of household, farmer or agricultural</b>	-0.07 (-0.6)	2.60 (2.0)
<b>Sample size</b>	6689	2480
<b>Log-likelihood</b>	-3821.1	-2976.5
<b>Pseudo-R<sup>2</sup></b>	0.29	-
<b>Proportion of predictions correct</b>	71.4%	-
<b>RESET statistic, Prob(coefficient = 0)</b>	0.96	0.01

smoking household contained at least one former smoker. The independent variables included in the regression equation were those which were also available in the FES. The regression results are presented in Table A1.1.

The probit equation results in Table A1.1 are broadly in-line with expectations, have reasonable predictive accuracy and pass a RESET-type specification test. The most significant predictors of the probability that the household will contain a former smoker are those relating to the number of adults. Males and individuals in older age groups tend to have a greater impact on the probability that the household will contain an ex-regular smoker. Households with unemployed or retired heads are significantly more likely to be classified as 'former smoking households' than households with currently employed heads of household. The level of weekly disposable income per adult in the household has a significant positive impact on the probability of former smoking. The socio-economic group of the head of household has little impact, however.

These coefficients have been applied to the sample of non-smoking households in the FES to estimate the probability that each of these households contains at least one former smoker. Using the GHS, it was estimated that 39% of currently non-smoking households would contain a former smoker. This proportion of non-smoking households was selected in the FES by choosing those with the highest calculated probability of containing a former smoker. This sub-sample of 1580 households are classified as the 'former smoking group'.

## **2.2 Constructing a recently-stopped household group**

In the 1990 GHS, households which contain a former smoker who has stopped in the last five years constitute 23% of all former-smoking households. To estimate the demographic and socio-economic factors which might predict membership of this recently-stopped group, a grouped data regression was undertaken based on how long ago the most recently stopped smoker in a household gave up smoking. A grouped data regression

approach was used since the information on time since stopping smoking is collected in six categories: less than 6 months ago; between 6 months and 1 year ago; between 1 and 2 years ago; between 5 and 10 years ago; more than 10 years ago.

The same independent variables were used in this regression model as for the probit analysis of former smoking. Since there was some evidence of misspecification based on a RESET-type test for the linear version of the grouped data regression approach, other models were tried. These included log-linear grouped data regression models, and probit analysis, defining those who have recently stopped as either those who gave up in the last five years, or those who gave up in the last ten years. There was more evidence of misspecification in all of these alternative models and, therefore, the linear model was used. The regression results are shown in table A1.1.

The regression coefficients on the household demographic characteristics variables are broadly what might be expected. The numbers of very young children and adults aged under 45 years are negatively related to time since stopping, implying that households containing recently-stopped smokers are likely to be those with young children or adults. Households with unemployed heads of household are also more likely to contain individuals who have recently stopped, whereas retired heads of household are associated with stopping longer ago. Few of the other variables have been found to have a significant impact.

Once again, these parameter estimates have been applied to the FES data to construct likelihoods that each household will contain a recently-stopped smoker. Based on the GHS figures, 359 (23%) predicted former smoking households with the highest predicted probability of containing a recently-stopped smoker are classified into the 'recently-stopped' group.

## **2.3 Characteristics of the four household groups**

Some characteristics of the smoking, non-smoking, former-smoking and recently-stopped household groups

are shown in Table A1.2. The households in the recently-stopped group tend to be larger than those in the non-smoking and former-smoking group. All groups have fewer children than the smoking household group. In the recently-stopped group, there is a high percentage of unemployed heads of household. The heads of household in this group also have a high probability of being in the employer/manager socio-economic group.

#### 2.4 The expenditure patterns of different household groups

The expenditure patterns of the different household groups have been compared in terms of the proportion of total expenditure allocated to different goods and services. Proportions of total expenditure have been analysed since these data are less skewed than expenditure figures and are therefore less sensitive to outlying observations.

Table A1.3 shows the proportions of total non-tobacco expenditure reported to be spent across 27 commodity groups by different household groups within the 1990 FES. The 27 commodity groups considered are

those used by the Central Statistical Office (CSO) in the collation of consumers' expenditure figures and the production of input-output tables. The expenditure figures reported in the FES have been re-classified according to CSO descriptions (see Appendix 3). Expenditure on miscellaneous items has not been considered, since a clear description of the items to be included is not available.

In the first column of Table A1.3 the percentages of total expenditure by current smokers are shown. In the subsequent columns, the expenditure patterns of other household groups are shown. Statistically significant differences between the proportions spent by smoking households and other comparison groups are indicated.

The data indicate that non-smoking households spend a smaller proportion of their expenditure on food, alcohol, major appliances, cleaning materials, cars and petrol, travel, 'other recreational goods', and toilet articles. On the other hand, these figures show higher proportional expenditure on items such as housing, household and domestic services, post and telecommu-

**Table A1.2** Characteristics of different household groups

Characteristic	Smoking	Non-smoking	Former-smoking	Recently-stopped
<i>Number in household:</i>				
Children	0.78	0.53*	0.38*	0.61*
Female adults (<60 years)	0.82	0.60*	0.51*	1.09*
Male adults (<60 years)	0.78	0.54*	0.50*	0.99*
Female adults (60 years plus)	0.18	0.34*	0.44*	0.09*
Male adults (60 years plus)	0.20	0.25*	0.58*	0.29*
<i>Percentage with head of household:</i>				
Unemployed	20.5	11.2*	13.9*	46.2*
Retired	16.8	33.9*	48.7*	1.9*
Employer/manager	12.5	14.7*	14.4	21.7*
Professional	3.8	5.8*	5.3	3.9
Non-manual	9.3	8.5	2.8*	5.8
Skilled manual	19.0	10.6*	7.1*	11.7*

\* Indicates that this characteristic is significantly different from smoking households at the 99% confidence level.

nications, recreational and entertainment services, books and newspapers, and hair and beauty.

The finding that non-smoking households spend significantly less on some items relative to smoking households may seem counter-intuitive, given that the main topic of interest is estimation of how quitting smokers re-allocated their 'freed' expenditure. However,

the figures in Table A1.3 relate to proportions of total expenditure. If 'freed' expenditure is not re-allocated equally across commodity groups, expenditure on some classes will increase at a greater rate than others. Higher marginal expenditure elasticities for some commodities, therefore, may result in lower proportional expenditure, but higher or equal absolute expenditure, on some items.

**Table A1.3** *Proportions of total household expenditure (excluding tobacco and miscellaneous) allocated to different goods and services*

CSO category	Smoking	Non-smoking	Former-smoking	Recently-stopped
Food	21.1	20.3*	21.0	18.6*
Alcohol	6.2	3.5*	3.7*	4.3*
Clothing & footwear	6.7	6.3	6.1	7.8
Housing	22.0	25.6*	25.1*	19.1*
Fuel and power	7.4	7.2	6.9*	5.3*
Furniture & pictures	0.9	0.9	0.9	1.4
Carpets and other	0.4	0.4	0.4	0.5
Major appliances	1.5	1.1*	1.0*	1.1
Textiles and other	0.5	0.5	0.5	0.6
Hardware	0.8	0.8	0.8	0.9
Cleaning materials	1.0	0.9*	0.8*	0.8*
Household and domestic services	0.7	1.2*	1.4*	1.2
Cars and petrol	6.8	6.1*	6.1	8.6*
Other vehicle running costs	1.1	1.4	1.6*	2.2*
Travel	2.3	1.7*	1.6*	1.9
Post and telecommunications	2.2	2.7*	2.5*	2.2
Durables (eg.TVs)	1.3	1.3	1.2	1.6
Sports etc. goods	0.7	0.6	0.5	0.6
Recreational goods	2.2	1.9*	1.9	2.1
Recreation and entertainment	2.6	3.2*	3.4*	4.5*
Books and news	1.9	2.1*	2.3*	1.9
Education	0.9	1.0	1.1	1.7*
Medicines	1.3	1.5	1.6	1.6
Toilet articles	1.6	1.5*	1.3*	1.5
Hair and beauty	0.8	1.0*	0.9*	0.9
Other goods	1.5	1.6	1.6	2.1*
Catering	4.2	4.0	3.8*	5.0*

\* Indicates significantly different from smoking households at the 99% significance level.



Former-smoking households have similar spending patterns to all non-smoking households. However, in contrast to all non-smoking households, former smoking households do not spend a significantly smaller proportion than smoking households on food, cars and petrol or recreational goods. They do, however, spend a significantly smaller proportion on fuel and power and catering and a significantly larger proportion on 'other vehicle running costs'.

There are fewer instances of significantly different proportions being spent by smoking and recently-stopped households. The differences which set this group apart from non-smoking and former-smoking households are that this group spend a significantly smaller proportion on food and housing, and a significantly larger proportion on cars and petrol, entertainment services, education and catering than smoking households.

This analysis demonstrates that expenditure patterns vary widely between different groups of non-smoking households and between smoking and non-smoking households. In this study, four assumptions about how spending patterns will change are used to demonstrate the potential range of economic consequences. Nevertheless, recently-stopped households are most likely to have similar characteristics to those households which will contribute to the simulated 40% reduction in tobacco expenditure. Furthermore, these households have relatively recently been in a position to re-allocate their income in reaction to released tobacco expenditure. Therefore, it is likely that the spending patterns of recently-stopped households will be the most appropriate for simulating the economic consequences of a 40% reduction in expenditure on tobacco.

### Step 3: implications for consumer demand

The four new expenditure patterns have implications for consumer demand at purchaser prices. However, because the expenditure patterns of former and non-smokers are available only from the FES some link

between the FES and the input-output tables is needed. Expenditure according to FES categories were reassigned to the National Accounts expenditure categories in Table 4 of Hayes and Hughes (1993). These themselves derive from the definitions in CSO (1985). This allowed a reallocation of consumer expenditure among the 123 industries of the input-output tables according to the expenditure patterns from the FES. However, inevitably there are inaccuracies and these are discussed further in Appendix 3.

### Step 4: implications for tax revenue, imports and distribution costs

The new expenditure patterns will obviously have implications for government tax revenue. Because tobacco is such a highly taxed good there is a net tax loss even after the increased tax returns on products that consumers switch their expenditure to. It is important to take this into account in step 6 below. However, adjustments have to be made also for different import patterns and changes in distribution costs because the Leontief Inverse is based on expenditure at basic prices. The difference between purchaser and basic prices can be huge. In 1990 consumer expenditure on tobacco at purchaser prices was £8,578mn, expenditure at basic prices was £820mn. Basic prices are defined as purchaser prices minus taxes on production and expenditure and distributor trading margins plus subsidies. The import component of UK tobacco expenditure also has to be taken into account. More formally:

$$C_{\text{basic}} = C_{\text{purch}} - (\text{imports} + \text{taxes} + \text{distributors trading margins}) + \text{subsidies}$$

which implies;

$$C_{\text{purch}} - C_{\text{basic}} = \text{imports} + \text{net taxes} + \text{distributors trading margins}$$

It is therefore essential to remove these elements before further analysis is carried out. The input-output tables contains details of imports at basic prices so these figures were removed first. This leaves two unknowns, net taxes and distributors' margins. The input-output

tables do give information on distribution industries output at basic and purchase prices. Therefore we can assume that:

$$C_{\text{distpurch}} - C_{\text{distbasic}} = \text{net taxes} + \text{other industries distribution costs}$$

In order to arrive at some meaningful conclusion assumptions need to be made about taxation rates so that the distribution costs of other industries can be solved for and removed from expenditure at purchaser prices. For several industries, including tobacco and alcohol which are subject to specific expenditure taxes, information on tax rates were derived from the national accounts. The remaining difference between  $C_{\text{purch}}$  and  $C_{\text{basic}}$  was defined as distribution costs. This allowed the remaining distribution costs unaccounted for to be reallocated to the other goods industries according to the proportionate gap in  $C_{\text{purch}}$  and  $C_{\text{basic}}$ . Service industries were not allocated distributors margins since in most cases  $C_{\text{purch}} - C_{\text{basic}}$  was negligible, as final services tend to be distributed by the industries concerned themselves. Having dealt with distribution costs satisfactorily the remaining gap between  $C_{\text{purch}}$  and  $C_{\text{basic}}$  was defined as net taxation. Thus taxation and distribution can also be removed from  $C_{\text{purch}}$  to finally arrive at  $C_{\text{basic}}$ . Finally, distribution costs were allocated to the distribution industries (wholesale, retail, hotels and catering and vehicle distribution).

#### **Step 5: Implications for consumer demand at basic prices**

This process leads to four estimates of consumer demand at basic prices. Assumptions about government reaction are discussed below.

#### **Step 6: Assumptions about government reaction to changes in tax revenue**

In the short-run the government will inevitably receive a net fall in revenue as a result of reductions in consumer spending on tobacco. This shortfall can be financed in one of two ways. First, the government could react by attempting to balance its tax loss by reducing expendi-

ture on goods and services. In this scenario we assume that it reduces expenditure on each industry in proportion to existing expenditures across industries. Alternatively it could react by increasing consumer taxation on other goods and services in proportion to existing expenditures, this being reflected in decreased consumer spending.

#### **Step 7: Implications for final demand at basic prices**

The culmination of steps 1 through 6 are 8 different scenarios where final demand vectors at basic prices is different from the known actual final demand vector for 1990.

#### **Step 8: Implications for induced output at basic prices**

Each vector of final demand was multiplied by the domestic-use Leontief Inverse supplied by the CSO in order to solve for final output at basic prices (see Appendix 2). This change in output is what drives the employment simulations in step 9.

#### **Step 9: Assumptions about output-employment ratios**

In order to simulate the employment consequences of changing output in response to a reduction in consumer expenditure on tobacco certain assumptions needed to be made. Comprehensive UK data on employment, exists from the Census of Employment for 1989 (Department of Employment 1991) and 1991 (Department of Employment 1993) but not 1990. Linear interpolation was used to construct 1990 figures. The Census of Employment data, based on the Standard Industrial Classification 1980 (SIC(80)) was regrouped into the 123 input-output industry definitions according to the reconciliation provided in Table 8 of Millard (1994). Static output-employment ratios were constructed on the basis of this known employment in 1990 and the original results for induced output from the Leontief equation. These were simply used as coeffi-

cients of multiplication for the 8 new scenarios. See Appendix 3 for a discussion of the validity of these assumptions.

### Step 10: Final simulation results

Thus 8 simulation results under reasonable assumptions were produced. Because of the detailed structure of the input-output tables each simulation produced results for 123 different industries. These are cumbersome to present and difficult to interpret. The results have therefore been collapsed for the 10 main industry groupings of SIC(80). One of these tables are reproduced and discussed in the main text. The remainder are presented in Appendix 5 for reference.

## Appendix 2 The theory of input-output tables

Input-output tables describe the flow of goods and services in the economy in matrix form (Millard (1994) provides a more detailed description of the use of input-output tables). They illustrate the relationship between producers and consumers and the interdependence among the different industries. This allows important economic questions to be answered such as: what will be the direct and indirect effect on the output of different commodities given a change in demand? More specifically, it is possible to ask the question of what will be the full economic consequences of a change in UK consumer's expenditure on tobacco.

Input-output tables were first developed in the 1930s by Wassily Leontief and applied to the US economy. The most recent tables for the UK were published for the year 1990 (Millard 1994) and this is one reason why the analysis in the text is based in 1990. Millard (1994) presents a simplified version of the framework of input-output theory which is reproduced opposite.

In a simple economy with no taxes, foreign trade and no distinction between commodities and industries, which produce only one unique product, the relationship in Table A2.1 is relatively simple to understand. Final demand ( $f$ ) represents expenditure on finished

**Table A2.1** *Input-output framework*

	PRODUCTION SECTORS	FINAL DEMAND	TOTALS
PRODUCTION SECTORS	$W$	$f$	$q$
PRIMARY INPUTS	$y$		
TOTALS	$q$		

goods and services by final end-users such as consumers and government. However, in order to satisfy this final demand industry needs to make the products demanded. This involves buying goods and services from other industries and these in turn will have to buy goods and services. This is represented by  $W$  in the table. During this stage employees are also paid and profits are made, these are known as primary inputs ( $y$ ) to the production process. For example, when someone buys a CD from a shop they are increasing final demand for that product ( $f$ ) but this also implies an increase in expenditure in industries further down the chain ( $W$ ). This in turn generates employment and profits ( $y$ ).

More formally, matrix  $W$  records the value of transactions between the production sectors of the economy and is known as a 'use matrix'. Entry  $w_{ij}$  shows the amount bought by sector  $j$  of sector  $i$ 's output. Commodity output is  $q$ . For the economy the output of each production sector can be defined in terms of the amounts purchased by other production sectors (the  $w_{ij}$ s or intermediate demand) and amounts sold to final consumers such as government or individuals (final demand or  $f$ ). In total:

$$q_1 = w_{11} + w_{12} + \dots + w_{1n} + f_1$$

$$q_2 = w_{21} + w_{22} + \dots + w_{2n} + f_2$$

.

.

.

$$q_n = w_{n1} + w_{n2} + \dots + w_{nn} + f_n$$

This simply states that total output for each sector ( $q$ ), or industry, is the sum of its output which goes to other intermediate industries ( $w$ ) plus final demand for its finished products ( $f$ ). It is useful to convert the use matrix into coefficient form. This measures not the value of every transaction, as does the use matrix, but the amount of each commodity produced per unit of output of the purchasing sector. Each column of the use matrix,  $W$ , is divided by the total gross output of the purchasing sector. The typical cell of the coefficient matrix  $A$ , is  $a_{ij}$ , the amount of commodity  $i$  used in the production of a unit of commodity  $j$ , or in matrix notation (where  $qmat$  is the diagonal matrix form of  $q$ ):

$$w_{ij} = a_{ij} qmat_j \text{ or } A = W qmat^{-1}$$

This yields a more useful set of equations:

$$q_1 = a_{11}q_1 + a_{12}q_2 + \dots + a_{1n}q_n + f_1$$

$$q_2 = a_{21}q_1 + a_{22}q_2 + \dots + a_{2n}q_n + f_2$$

.

.

.

$$q_n = a_{n1}q_1 + a_{n2}q_2 + \dots + a_{nn}q_n + f_n$$

Again these can be written for convenience in matrix form as:

$$q = Aq + f$$

This set of equations can be solved for  $q$  assuming that the level of final demand is known (where  $(I-A)^{-1}$  is the Leontief inverse):

$$q = (I-A)^{-1}f$$

More importantly for analysis, changes in  $f$  can be solved for the resultant implications for  $q$ , given that the input-output relationships hold. The basic methodology in appendix 1 makes use of this relationship to simulate changes in consumer expenditure as a result of reductions in tobacco purchases, how this feeds through to final demand, and to induced output for intermediate goods and services in the economy.

The UK input-output tables for 1990 were used in this analysis. They are constructed on a basic 123 x 123 matrix of industry relationships plus various final demand vectors. The balance and derived tables can be received directly from the CSO on disk or found in Hayes and Hughes (1993) and Millard (1994) respectively.

### Appendix 3 Details of the assumptions used in the study

In any counter-factual simulation work it is necessary to make simplifying assumptions. This appendix outlines the most important simplifying assumptions which have been made in the study and discusses the implications for the results obtained.

#### Analysis of expenditure patterns

The assumption that all released expenditure on domestic tobacco is actually spent rather than saved may be unrealistic. In particular the industry argues that smokers may simply save their released expenditure (Pieda 1991). While this is an over-statement there is some evidence that former smokers do save more than average. The main text discusses this in more depth and presents the results of various simulations where some of the released expenditure on tobacco is saved.

#### The input-output analysis

Any input-output analysis work makes certain assumptions about industry structure and the workings of the economy. In particular these are that supply can adapt to final demand and that input-output coefficients remain static in response to changing demand. The first necessitates an actual or potential pool of unused or under-utilised factors of production. If this pool is not available then output may not reach predicted levels or greater than predicted imports may be induced. However, in the current economic climate it is not difficult to imagine a sufficient pool of factors of production. The second assumption implies that modes of production will not

change as demand changes. Fortunately, there is evidence to suggest that technical coefficients are fairly static in the short-run (McNicoll and Boyle 1992).

Additionally, the Leontief Inverse matrix is based on commodity or product output. This means that it shows how demand for other products changes in response to a change in final demand for products. However, we are interested in changes in industry employment. Using the published matrix therefore induces some inaccuracies since industries often produce other products as well as their principle product. Ideally, a modified Leontief Inverse based on changes in industrial output would have been used but this was not considered feasible for this project.

### **The FES and the input-output tables**

In order to link the likely expenditure patterns of smokers who reduce their consumption with the consequences for industry, expenditure by FES function and CSO function had to be reconciled. Whilst for some types of expenditure this is straightforward there will obviously be some induced inaccuracies since disaggregation of both classifications is not sufficient to be totally precise.

### **Output-employment ratios**

It has been assumed that employment-output coefficients are static in response to different final demand vectors. This may not be valid if, for example, industries react to what they see as temporary demand changes by changing part-time employment and to permanent changes by changing full-time employment.

### **Conversion of employment figures to full-time equivalents**

The conversion of part-time and full-time employment to full-time equivalent figures requires several assumptions. The 1990 New Earnings Survey (HMSO 1990) provides information on the average hours worked of part-time and full-time female employees and full-time male employees according to whether they were in manual or non-manual professions. The Employment

Gazette (Department of Employment 1990) provides details of the split between manual and non-manual occupations for the manufacturing industries. Assuming that male part-timers are the same proportion of total male employment as women are of total female employment and that the relationship between manufacturing manual and non-manual employment is reflected across all industries a conversion to full-time employment is possible. This results in dividing male and female part-time employment by 1.91 and 1.94 respectively to convert to full-time equivalents.

## **Appendix 4: Data sources**

### **Central Statistical Office**

Spreadsheet files containing all tables from Hayes and Hughes (1993) and Millard (1994) were obtained from the CSO. These include all input-output table data and information on consumer demand, final demand, government demand, imports and the Leontief Inverse used for deriving induced demand for 123 industries.

### **Census of Employment**

Basic data on male and female full-time and part-time employment in the UK were obtained from Department of Employment (1991) and Department of Employment (1993). These figures were reclassified into the input-output table classification of industries.

### **Family Expenditure Survey**

The FES 1990 (OPCS 1992a) was analysed to provide information on the expenditure and other characteristics of the household population, smoking households and predicted non-smoking households, households with former smokers and households with recent former smokers.

### **General Household Survey**

The GHS 1990 (OPCS 1992b) was analysed to predict the likelihood of a household containing former smokers and recent stoppers based on background variables common to the FES 1990.

**United Kingdom National Accounts**

Used to provide information on consumer taxation on certain expenditure functions.

**Appendix 5: Results**

The detailed results for the employment implications of a cut of 40% in tobacco expenditure during 1990 are shown below under the 8 different combinations of assumptions about expenditure patterns and government reaction. Male and female full-time and part-time employment changes are reported. For our purposes part-time employment is defined as anyone employed for less than 30 hours per week in line with the Census of Employment.

Industry groups in the tables are defined according to the following:

Industry group	Definition
0	Agriculture, forestry and fishing
1	Energy and water extraction
2	Extraction of minerals etc
3	Metal goods and engineering etc
4	Other manufacturing
5	Construction
6	Distribution, hotels and catering
7	Transport and communications
8	Banking and finance etc
9	Other services

**Tables**

**1. Released tobacco expenditure reallocated according to average consumer expenditure**

**Table 1.1** *Government reacts by decreasing expenditure*

Indgroup SIC(80)	Employment category				
	Male FT	Male PT	Female FT	Female PT	Total
0	1212	249	361	204	2027
1	1455	3	280	66	1804
2	-153	-1	-146	-20	-319
3	-771	-9	-163	-27	-970
4	2240	122	1295	780	4437
5	-367	-6	-35	-24	-431
6	8660	2264	5926	8958	25808
7	2502	116	492	182	3293
8	4125	107	2938	759	7928
9	-16194	-893	-11581	-4522	-33190
<b>Total</b>	2710	1953	-632	6356	10386

**Table 1.2** *Government reacts by increasing taxes on other consumer spending*

Indgroup SIC(80)	Employment category				Total
	Male FT	Male PT	Female FT	Female PT	
0	-348	-64	-97	-55	-564
1	185	1	52	17	255
2	-832	-8	-330	-65	-1235
3	-3283	-34	-948	-183	-4448
4	-7098	-142	-6414	-1104	-14758
5	254	4	24	16	298
6	5285	933	3774	4948	14940
7	474	32	79	49	634
8	636	22	417	105	1180
9	1771	494	2950	3415	8630
<b>Total</b>	-2956	1238	-493	7143	4932

## 2 Released tobacco expenditure reallocated according to non-smokers

**Table 2.1** *Government reacts by decreasing expenditure*

Indgroup SIC(80)	Employment category				Total
	Male FT	Male PT	Female FT	Female PT	
0	367	72	106	60	605
1	2518	8	506	105	3137
2	81	1	-214	-39	-171
3	-2097	-20	-474	-87	-2678
4	286	91	96	372	845
5	2730	43	258	177	3208
6	-5076	-1899	-4533	-7508	-19016
7	-1789	-7	-274	17	-2053
8	7194	50	4046	937	12227
9	-12613	1309	-6378	7147	-10535
<b>Total</b>	-8399	-352	-6861	1181	-14431

**Table 2.2** *Government reacts by increasing taxes on other consumer spending*

Indgroup SIC(80)	Employment category				Total
	Male FT	Male PT	Female FT	Female PT	
0	-1571	-317	-463	-261	-2612
1	875	5	209	42	1131
2	-790	-9	-452	-97	-1348
3	-5186	-51	-1436	-279	-6952
4	-11044	-243	-9400	-1986	-22673
5	3415	53	322	222	4012
6	-9318	-3565	-7236	-12537	-32656
7	-4260	-112	-779	-149	-5300
8	2689	-57	837	106	3575
9	9698	2971	11556	16667	40892
<b>Total</b>	<b>-15492</b>	<b>-1325</b>	<b>-6842</b>	<b>1728</b>	<b>-21931</b>

3 Released expenditure allocated according to former smokers

**Table 3.1** *Government reacts by reducing expenditure*

Indgroup SIC(80)	Employment category				Total
	Male FT	Male PT	Female FT	Female PT	
0	1282	260	379	214	2135
1	1084	5	231	37	1357
2	-55	-2	-325	-65	-447
3	-2297	-23	-528	-96	-2944
4	2271	162	838	813	4084
5	2266	35	214	147	2662
6	-4240	-1897	-4320	-7473	-17930
7	-2409	-39	-351	-29	-2828
8	6465	84	3989	968	11506
9	-7328	2736	517	15874	11799
<b>Total</b>	<b>-2961</b>	<b>1321</b>	<b>644</b>	<b>10390</b>	<b>9394</b>



**Table 3.2** *Government reacts by increasing taxes on other consumer spending*

Indgroup SIC(80)	Employment category				Total
	Male FT	Male PT	Female FT	Female PT	
0	-687	-136	-199	-113	-1135
1	-521	1	-59	-25	-604
2	-915	-11	-554	-120	-1600
3	-5358	-53	-1480	-286	-7177
4	-9094	-172	-8606	-1546	-19418
5	2962	46	280	192	3480
6	-8482	-3551	-7011	-12466	-31510
7	-4860	-143	-852	-193	-6048
8	1991	-23	789	138	2895
9	14850	4368	18290	25206	62714
<b>Total</b>	-10114	326	598	10787	1597

## 4 Released expenditure allocated according to smokers who have recently stopped

**Table 4.1** *Government reacts by decreasing expenditure*

Indgroup SIC(80)	Employment category				Total
	Male FT	Male PT	Female FT	Female PT	
0	-1209	-246	-358	-202	-2015
1	-8473	-20	-1615	-422	-10530
2	-758	-7	-317	-57	-1139
3	-370	-11	-141	-42	-564
4	3122	135	3277	560	7094
5	-2486	-39	-235	-161	-2921
6	13312	2342	6774	8895	31323
7	-87	22	171	68	31497
8	3687	155	1546	480	6042
9	23508	10210	41728	62633	143947
<b>Total</b>	30246	12541	50830	71752	165369

**Table 4.2** *Government reacts by increasing taxes on consumer spending*

Indgroup SIC(80)	Employment category				
	Male FT	Male PT	Female FT	Female PT	Total
0	-2794	-564	-823	-465	-4646
1	-9653	-22	-1828	-465	-11968
2	-1476	-14	-514	-104	-2108
3	-3208	-39	-1000	-211	-4458
4	-6768	-155	-5182	-1487	-13592
5	-1799	-28	-170	-117	-2114
6	9555	879	4397	4484	19315
7	-2202	-66	-263	-72	-2603
8	-39	63	-1112	-213	-1301
9	41747	11463	56069	69738	179017
<b>Total</b>	23363	11517	49574	71088	155542

## REFERENCES FOR APPENDICES

- Central Statistical Office (1985) *United Kingdom national accounts: sources and methods. Studies in official statistics no.37*. London: HMSO.
- Department of Employment (1990b) *Employment Gazette*, December.
- Department of Employment (1991) 1989 Census of Employment: Results for the United Kingdom. *Employment Gazette* April pp.209-25.
- Department of Employment (1993) 1991 Census of Employment: Results for Great Britain and the United Kingdom. *Employment Gazette* April pp.117-33.
- Hayes, K. and Hughes, D. (1993) Input-output balance for the United Kingdom 1990. *Economic Trends* 480 pp.90-120.
- McNicoll, I. and Boyle, S. (1992) Regional economic impact of a reduction in resident expenditure on cigarettes: a case study of Glasgow. *Applied Economics* 24 pp.291-296.
- Millard, D. (1994) *Input-output tables for the United Kingdom 1990*. London: Central Statistical Office.
- Office of Population Censuses and Surveys (1992a) Family Expenditure Survey 1990. London: HMSO.
- Office of Population Censuses and Surveys (1992b) General Household Survey 1990. London: HMSO.
- Pieda PLC (1991) *The economic significance of the UK tobacco industry*. London: Pieda.