International Review of the Health and Economic Impact of the Regulation of Smoking in Public Places

Summary report 2005

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1 Introduction

1.1 In 2004, the Scottish Executive published its *Tobacco Control Action Plan*, which included as an action point the intention to 'sponsor a major public debate on actions to minimise the impact of second hand smoke'. A public consultation relating to smoking in public places was launched in June 2004. A number of specific studies were also commissioned to support the consultation and this report contains a summary of the results of a review of evidence about the impacts of smoking bans and restrictions.

1.2 The aims of the review as stated in the brief were:

- to determine the health impact of smoking bans and smoking restrictions in public places
- to determine the economic impact of smoking bans and smoking restrictions in public places.

2 Methods

2.1 The study has combined a literature review with a modelling exercise to place the likely impacts of restrictions on smoking in public places in a Scottish context. The literature review has had to cover a number of distinct areas: health impacts of exposure to environmental tobacco smoke (ETS) or passive smoking; impact of restrictions on exposure levels; impact of restrictions on tobacco use behaviour; economic impacts of restrictions on the hospitality sector; costs of workplace smoking; and the costs of smoking-related diseases.

2.2 Existing high quality reviews of evidence were sought first and primary studies were only reviewed where such studies were lacking or did not provide sufficient information for the nature and quality of the evidence to be judged. Quality assessment of reviews and primary literature was carried out with respect to the study methods and whether or not peer review had taken place.

2.3 The model for Scotland has been estimated to show the impact of moving from the present situation, under the existing voluntary code, to a possible legislative restriction. The model has been estimated on the basis of the best available evidence and using expert judgement where evidence does not exist. The model has been estimated to show the impact of a complete ban on smoking in public places as there is no evidence base available to estimate the differential effect of lesser restrictions, such as smoke-free areas and improved ventilation, but the weight of evidence relating to health effects suggests that such interventions reduce but do not remove the harmful effects of ETS.

3 Health impacts of ETS

Lung cancer

3.1 More than 50 epidemiological studies have examined the relationship between passive smoking and lung cancer. The excess risk amongst never-smoking females, who have self-reported exposure to passive smoking in the home from their husbands who are smokers, appears to be about 25%. A dose–response relationship between excess risk of lung cancer and number of cigarettes smoked by husbands is indicated. Although most of the reviews restrict analysis to females only, the most recent meta-analysis found no difference between the relative risk values for men and women. It is generally agreed that exposure in one place acts in similar ways to exposure in others and therefore exposure in public places would elevate the risk of lung cancer. The most recent meta-analysis of studies of workplace exposure reports levels of excess risk that are consistent with those for domestic exposure.

Coronary heart disease (CHD)

3.2 More than 20 epidemiological studies have assessed the relationship between CHD (also referred to as ischaemic heart disease, IHD) and exposure to ETS. The excess risk associated with ever exposure to ETS amongst never-smoking women who have a spouse that smokes appears to be in the region of 25%. The risks associated with exposure in the home range from 1.22 to 1.51. Where risks from workplace exposure are pooled, the estimates are similar, 1.11 to 1.32. There appears to be some evidence of a dose–response relationship in terms of the intensity of ETS to which the individual is exposed.

Stroke

3.3 Only seven studies that look at the association between risk of stroke and exposure to ETS were found and no meta-analysis of the studies has been conducted. Most of the studies were fairly small and whilst most found an excess risk of stroke related to exposure to ETS, the size of the effect varied considerably and the confidence intervals around the estimates were large. Only two of the reported results were statistically significant. The studies also used different endpoints associated with ETS exposure and this makes it unlikely that formal meta-analysis of all the studies could be carried out. Nevertheless, the pattern of association is clear. The relationship between active smoking and stroke is similar to active smoking and CHD. It is plausible that the relationship also holds for passive smoking but this has not been clearly demonstrated because of a lack of studies of sufficient size.

Respiratory disorders

3.4 Few studies have been conducted in this area (with the exception of lung function). The risks that are presented appear to indicate that a relationship exists between exposure to ETS and poor respiratory health. However, the degree to which passive smoking affects the respiratory system is not clear, as many of the confidence intervals are wide and the risk estimates vary considerably between studies and different health effects. Comparisons between studies are difficult to make due to differences in study design and quality.

3.5 In 1992, the US Environmental Protection Agency (EPA) compared the risks of exposure to ETS to those gained from light active smoking (i.e. less than 10 cigarettes/day). In 1997, the Californian Environmental Protection Agency (CEPA) stated that epidemiological evidence published since the US EPA report had further strengthened the association between the risk of respiratory disorders and exposure to ETS. A more recent review argued that although further research is required, the evidence presented so far indicates that exposure to ETS adversely affects the respiratory system.

Pregnancy

3.6 A number of studies have indicated that exposure to ETS amongst pregnant women may affect the foetal growth and birth weight of the child. In 1997, CEPA published a comprehensive review of the evidence regarding passive smoking and health risks to the foetus/child with both perinatal and postnatal manifestations. They concluded that small decrements in mean birth weight (25–50 grams) are associated with ETS exposure. Studies that looked at passive smoking in pregnancy and low birth weight (less than 2500 grams) or small for gestational age found an excess risk of 20–40%. Although few studies examined other health effects, there was some evidence that exposure to ETS may be associated with increased risk of neonatal mortality, spontaneous abortion and congenital malformation. There was no or little evidence linking ETS exposure with stillbirth, sudden infant death syndrome or cognitive and behavioural problems. More recent reviews have generally supported the conclusions made in the CEPA report.

Quality and relevance of the evidence

3.7 The literature relating to lung cancer and CHD is substantial and there are a number of good quality meta-analyses of primary studies. The design of the studies that have been carried out, cohort studies and case–control studies, makes them vulnerable to the possibility of the results being affected by confounding variables and there are other sources of potential bias. However, some of the meta-analyses have taken these factors into account and have adjusted results accordingly. These studies show that there may be an effect on the size of the relative risk for exposure to ETS but adjusting for these factors does not eliminate the excess risk. Some of the potential sources of bias act in opposite directions.

4 Exposure to ETS and associated health risks in hospitality settings

4.1 Several studies have measured exposure levels in hospitality settings. The data indicated that exposure levels in hospitality settings where smoking occurred were higher than in areas where smoking was not permitted. Nicotine concentration levels and cotinine levels related to exposure in hospitality settings appeared to be higher than exposure levels related to exposure at home or other workplaces. High levels of exposure to ETS clearly have implications for the health of hospitality workers.

4.2 A study comparing the exposure of non-smoking hospitality workers to workers in smoke-free employment found the mean post-shift salivary cotinine concentrations for workers in bars and restaurants was 3.38 ng/ml compared to 0.08 ng/ml amongst those in smoke-free employments. Other studies of exposure amongst hospitality workers report similar levels of exposure. Studies have reported elevated risks of lung cancer and increased respiratory symptoms amongst hospitality workers.

Quality and relevance of the evidence

4.3 Most studies have been conducted in the US and some studies have taken measurements in only one location. Exposure levels may not accurately reflect wider workplace characteristics and smoking habits/behaviours in the UK. Measurements associated with exposure levels in the 1980s and 1990s may not be representative of current exposure levels as smoking rates change and smoking behaviours in public places become less socially acceptable. Very few studies have assessed the health effects of exposure to ETS amongst hospitality workers.

5 Impact of smoking bans and restrictions on exposure to ETS

5.1 A number of studies have been conducted that have considered the effectiveness of smoking bans and restrictions on exposure to ETS and these have been the subject of a review for the US Task Force on Community Preventive Services (TFCPS). Ten studies were assessed to be of sufficient quality to include in the review: four evaluated restrictions; four evaluated bans and two considered both. Seven studies evaluated particular worksites and three studies were population-based surveys. Four studies measured air quality and six were based on self-reported exposure to ETS. Smoking bans were generally associated with greater reductions in exposure to ETS.

5.2 Some recent studies relating to the hospitality sector showed a 90% reduction in the level of respirable suspended particles (RSPs) and a reduction in self-reported exposure to ETS following the introduction of a smoking ban. An observational study found that designated 'no smoking' areas in licensed gaming clubs typically produced about 50% reduction in exposure to ETS.

Quality and relevance of the evidence

5.3 The TFCPS review was conducted to a high standard and individual studies were assessed for quality, including the robustness of the design. The studies of specific work settings encompassed the health care sector, government and other public sector workplaces and a university. Whilst this may not be a totally representative sample of workplaces, this is unlikely to bias the measurement or reporting of exposure to ETS.

6 Impact of smoking bans and restrictions on smoking behaviour

6.1 Four reviews have been published relating to the impact of smoking bans and restrictions on smoking behaviour. The literature reviewed included individual workplace studies, population-based studies of workplaces and studies of the impact of public laws on smoking behaviour.

Cigarette consumption

6.2 Most of the studies reported reductions in cigarette consumption. The TFCPS review reported a median reduction of 1.2 cigarettes per day (range no change to –4.3 cigarettes per day). A more recent meta-analysis, which included a larger number of studies, gave a pooled estimate of –3.1 cigarettes per day. The third review reported reductions of 10–20% in the quantity smoked from workplace studies. Population-based studies have also shown lower consumption by smokers in workplaces with restrictions compared with those without.

6.3 Clean air laws are also effective in reducing cigarette consumption, although these results are based on per capita consumption and will combine reductions in consumption per smoker and reduced smoking prevalence. Clean air laws appear to be more effective than workplace bans in reducing cigarette consumption per capita.

Effect on smoking cessation or quit attempts

6.4 In three studies with 12–18 month follow up there were more quitters with a ban than with other workplace restrictions or no restrictions. Results for quit rates are not consistent in prospective cohort studies but they show little initial effect with greater increases over time. Population-based studies have shown higher rates of quit attempts and quitting (10–15%) by workers in workplaces with bans. States with clean air laws have higher quit rates than states without such laws.

Smoking prevalence

6.5 There were fewer studies that reported the effect of smoking bans and restrictions on smoking prevalence and those included in the TFCPS review gave inconsistent results. Prospective cohort studies reported reductions in smoking prevalence of 7–20% and population-based studies comparing workplaces with and without restrictions showed 15–20% lower prevalence. Partial restrictions had little or no effect. A recent meta-analysis reported a 3.8% reduction in absolute prevalence (pooled effect) associated with smoke-free workplaces.

6.6 The effect of clean air laws on smoking prevalence has only been included in a few studies. Prevalence rates were lower in states with extensive restrictions. In one study, the impact was greatest in the 25–44 age group. Some studies have examined youth smoking but with variable results. Smoking restrictions in schools appear to be effective and a broader range of smoking restrictions may reduce the quantity smoked by young people and inhibit the progression to regular smoking.

Quality and relevance of the evidence

6.7 Unlike the studies of impact on exposure to ETS, population studies of smoking behaviour may be affected by selection bias and the specific worksites studied may not be representative of the wider effects of restrictions. Some studies have attempted to control for these problems. One study estimated a 20% reduction in per capita consumption of cigarettes with clean air laws compared with 4–8% without clean air laws, after controlling for smoking sentiment. By contrast, the impact of worksite laws became insignificant when social attitudes were taken into account.

6.8 The smoking prevalence studies provided a wide range of estimates. Given the uncertainty around the precise estimate, the benefit of reduced smoking prevalence has been estimated using conservative estimates of the effect, with a range of 1–3%.

7 Economic impacts of restrictions on smoking in public places

General effects on all workplaces

7.1 A small number of studies have been carried out on the costs of workplace smoking. These studies included a range of costs, some of which can be avoided by restrictions on workplace smoking. Other costs, such as absence due to ill health of smokers will only be saved to the extent that smokers reduce or quit smoking.

Productivity loss caused by workplace smoking

7.2 Individual studies of the costs of smoking breaks have produced a wide range of estimates based on alternative assumptions about frequency of smoking breaks and differences in length of smoking breaks. These included a study in Scotland that estimated a gain in productivity from workplaces going smoke-free of between £289 million and £605 million (1998 prices); an estimated annual loss of £740 million (Great Britain) based only on the productivity losses when any form of smoking policy is introduced to a previously unrestricted workplace; an estimated gain for the Republic of Ireland of €271 million (2002 prices).

Absenteeism due to passive smoking

7.3 The Health and Safety Executive have estimated costs for sickness absence relating to exposure to ETS for those with asthma and chronic bronchitis to be £83 million to £166 million per year in Great Britain.

Fire hazards

7.4 The cost of fire damage relating to smoking on business premises has been estimated as £4.5 million for Scotland (1998 prices) and £52 million for Great Britain (1998/9 prices).

Cleaning and redecoration costs

7.5 None of the published studies has estimated the effect of workplace smoking restrictions on cleaning and redecoration costs, although it is recognised that there will be an effect. A US survey estimated a saving of £300 per smoker per year on cleaning and maintenance costs.

Specific effects on the hospitality sector

7.6 Two comprehensive reviews of studies assessing the economic impact of smoke-free policies were identified. The reviews included journal publications and grey literature. In addition, the TFCPS review considered six studies that showed no adverse impact of smoking ordinances on businesses or tourism. The reporting of individual studies within the reviews was considered to be limited, in terms of methods, results and conclusions, and provided insufficient information to carry forward to the modelling study. It was therefore decided to examine the available peer-reviewed studies that used objective data.

Restaurants

7.7 A total of 11 studies have been conducted relating to the impact of smoking restrictions in restaurants. Ten of the studies were carried out in the USA and one in Australia. The US studies covered restrictions in New York (State and City), California and Colorado, Massachusetts, Flagstaff, Arizona and West Lake Hills, Texas. Most of the study results were not statistically significant and most of the effects, whether positive or negative, were small. Results from one study were used in the estimation of impacts for Scotland. The results were reported in terms of an impact on the growth of restaurant revenues of +0.25% (95% CI: –1.32% to +1.81%).

Bars

7.8 One study of the effects of restrictions in California has been conducted. The pooled results for bars showed the impact on bar sales as a fraction of total retail sales was positive but not significant. This was the only study available to model results for Scotland. The effect of the smoke-free ordinance on bar sales as a fraction of retail sales was reported as +0.5% (95% CI: –0.284% to +1.284%).

Hotels and tourism

7.9 Four studies have considered the effect of smoking restrictions on hotel business, as a proxy for tourism, or on tourist numbers directly. Most of the results were not significant. One study showed a positive and significant effect on sales. One location within one study reported a significant negative impact on hotel room revenues. The effect on tourist numbers was either not significant or positive. One study has been used to estimate results for Scotland. The pooled results for hotel room revenues as a fraction of retail sales were used and these showed an overall effect of –0.054% (95% CI: –0.128% to +0.02%).

Quality and relevance of the literature

7.10 Three papers have provided a commentary on the quality of the literature relating to the hospitality sector. There are a number of valid criticisms relating to the studies carried out in this area and these reflect the difficulties of conducting research into policy impacts. The problems include: the inadequacy of sales tax data to capture all the effects; the timing of the intervention in relation to the data periods; limitations to the smoking restrictions; compliance with the smoking restrictions; selection bias; and the transferability of the results to other settings.

7.11 The failure to find any significant impact on revenues in the sectors analysed does not rule out the possibility of a small negative effect on business but it does weigh against a large negative impact being experienced. If such large effects were experienced and were widespread then it seems unlikely in the extreme that no objective data have been produced to substantiate these effects. However, it is also the case that there has been no analysis of impacts within sectors and no analysis based on measures such as sales volume or profits was reported in the reviews.

8 Model of the impact of a smoking ban in public places in Scotland

Introduction

8.1 Evidence from the review of health and economic impacts has been applied to Scotland, as a way of providing a context. The model has been based on a ban on smoking in public places, which include workplaces and the leisure and hospitality sector. A ban has been modelled, rather than lesser restrictions, because it was unclear what the health effects of a partial restriction would be. In order to provide as complete an overview of the impacts of smoking restrictions as possible, some impacts have been modelled on the basis of only limited information. Therefore, to reflect this uncertainty, a range of estimates has been produced; central, low and high.

Health effects of exposure to ETS

Mortality

8.2 The figures in **Table 8.1** form the basis for estimating the impact of a ban on smoking in public places in Scotland on deaths attributable to exposure to ETS. The figures show the number of deaths that are projected to occur in 2024 as a result of exposure to ETS in public places occurring today. These deaths would be avoided by eliminating such exposure. The basis of the three estimates is explained overleaf.

Central estimate: This is based only on the **219** deaths per year averted from lung cancer and CHD. These diseases have the greatest amount of evidence available for the attribution of risk and, hence, the least uncertainty regarding the estimates. This is still likely to underestimate the impact of reduced exposure to ETS.

Low estimate: The estimates for lung cancer and CHD deaths are reduced by 15% to demonstrate the possible impact of a reduced intensity of active smoking. This gives a lower intensity of exposure to ETS and there is some evidence of a dose–response effect for these diseases. The reduced estimate is **186** deaths per year.

High estimate: This includes estimates for all four major causes of death where strong evidence is available and the increased estimate is **406** deaths per year averted.

Table 8.1 Estimated deaths attributable to exposure to ETS in 2024

Cause of death	ETS all sources			ETS in public places		
	Male	Female	Total	Male	Female	Total
Lung cancer	21	24	**45**	11	10	**21**
Coronary heart disease	195	219	**414**	105	93	**198**
Stroke	102	214	**316**	55	91	**146**
Respiratory disease	34	54	**88**	18	23	**41**
Total deaths from four causes	**352**	**511**	**863**	**189**	**217**	**406**

8.3 Applying a range of value of life estimates to the estimated number of lives saved from reduced exposure to ETS produces the following values for the three main scenarios:

Central estimate: £91,350,000

Low estimate: £16,757,000

High estimate: £176,685,000

In all cases, it may take between 10 and 30 years to realise the full benefit of action taken now.

Morbidity

8.4 The evidence that has been reviewed suggests that the impact on morbidity is similar to the impact on mortality. On this basis, the reduction in morbidity from reduced exposure to ETS has been assumed to be proportional to the reduction in deaths. This approach has been applied to NHS treatment costs, productivity losses due to sickness absence and the human costs of ill health. Note that no estimate has been made for any benefits associated with reduced exposure to ETS for pregnant women because specific data on change in exposure following bans or restrictions were not available.

NHS treatment costs

8.5 NHS treatment costs (**Table 8.2**) have been derived either from UK-based costing studies applied to Scottish disease incidence data or by aggregating Scottish activity and cost data for inpatient care, GP contacts and prescribing. Although this is not entirely comprehensive, the breakdown of costs from published costing studies shows that these are the three main components. It may take between 10 and 30 years to realise the full benefit.

Table 8.2 Summary of NHS treatment cost savings (£, 2003 prices)

	Central estimate	Low estimate	High estimate
Lung cancer	202,000	171,700	202,000
Coronary heart disease	5,116,000	4,346,800	5,116,000
Stroke			4,885,000
Respiratory disease			1,322,000
Total	**5,318,000**	**4,518,500**	**11,525,000**

Productivity losses due to sickness absence

8.6 Data have only been identified to estimate this for CHD and for asthma. For heart disease, the estimated loss is **£4,126,000**. This figure has been included in the central estimate and high estimate. For the low estimate, the figure has been reduced by 15% (to £3,507,000) in line with the estimates for mortality. The figure for asthma was estimated as **£1,039,000**. This figure has only been included in the high estimate (to give a total for the high estimate of **£5,165,000**). It has been assumed that it may take between 10 and 30 years to realise the full benefit.

Human costs of ill health

8.7 A range of values has been applied to the incidence of lung cancer (4,500), CHD (21,766), stroke (14,067) and respiratory disease (asthma only 64,000) to allow for pain and suffering associated with ill health. The avoided cost was again assumed to be the same proportion as avoided mortality. The central estimate has been based on lung cancer and CHD only. This has been reduced by 15% for the low estimate. The high estimate included all four diseases.

Central estimate: **£12,816,000**

Low estimate: **£10,894,000**

High estimate: **£36,040,000**

Health effects of reduced active smoking

8.8 The precise impact of a smoking ban on smoking cessation is difficult to estimate because smoking bans may be accompanied by other smoking cessation activities. In line with the cautious approach adopted to estimating benefits, the central estimate used is a 2% reduction in active smoking with a low estimate of 1% and a high estimate of 3%.

8.9 Deaths caused by smoking in Scotland have been estimated to be 13,000 per year. On this basis, the central estimate of future deaths avoided would be 260 with a range of 130 to 390. The financial value of the lives saved has been estimated using an average of the values applied to the lives saved through reduced passive smoking. No additional value has been attributed to avoided morbidity. The results are shown in the first line of **Table 8.3**.

8.10 The total cost to the NHS of smoking related diseases has been estimated as £140 million. On this basis, the central estimate of future saving to the NHS would be £2.8 million, with a range of £1.4 million to £4.2 million. The low estimate has been further reduced by 15% (to £1.2 million) to demonstrate the possible impact of a reduced intensity of active smoking. The total future saving to the NHS from both active and passive smoking is calculated by adding these amounts to the estimates shown in **Table 8.2**. The central estimate is £8.1 million (range: +£5.7m to +£15.7m).

8.11 Total costs relating to additional sickness absence for smokers have been estimated as £40 million. This provides a central estimate of £0.8 million with a range of £0.4 million to £1.2 million. The low estimate has been further reduced by 15% (to £0.34) to demonstrate the possible impact of a reduced intensity of active smoking. The total future saving on sickness absence from both active and passive smoking is calculated by adding these amounts to the estimates shown above. The central estimate is £4.9 million (range: +£3.8m to +£6.4m).

Table 8.3 Summary of benefits relating to reductions in active smoking (£, 2003 prices)

	Central estimate	Low estimate	High estimate
Value of deaths avoided	108,452,000	11,714,000	169,722,000
Saving on NHS costs	2,800,000	1,200,000	4,200,000
Saving on sickness absence	800,000	340,000	1,200,000
Total	**112,052,000**	**13,254,000**	**175,122,000**

Economic impacts for workplaces

Reduction in fire risk

8.12 This estimate has been based on a previous cost of smoking study in Scotland, uplifted for inflation, giving an estimate of **£4,958,000** (**Table 8.4**). This figure has been used in the central estimate and high estimate and has been reduced by 20% in the low estimate to allow for the possibility of continued fire risk from illicit smoking.

Reduction in cleaning costs

8.13 There is relatively little information on the effect of smoking on cleaning and redecoration costs. A US study found the extra costs were £300 per smoker per year where unrestricted smoking was allowed. Applying these costs to estimated numbers of Scottish smokers in workplaces with no restrictions gives a cleaning cost estimate of **£11,686,000**. This cost has been used in all estimates.

Smoking breaks

8.14 There are few satisfactory data on the effect of smoking restrictions on the cost of employee smoking breaks at work. Previous estimates have covered a wide range. The estimate used here has been based on a previous cost of smoking study in Scotland but the estimate has been reduced to take account of research that indicates that most of the cigarettes smoked at work are smoked during normal breaks. Allowing for this factor gives a figure of **£73,707,000**. This figure has been included in the central estimate and in the high estimate but given the size and the uncertainty relating to this figure it has been excluded from the low estimate completely.

Table 8.4 Summary of economic impacts in workplaces (£, 2003 prices)

	Central estimate	Low estimate	High estimate
Fire damage	4,958,000	3,966,400	4,958,000
Cleaning and redecoration	11,686,000	11,686,000	11,686,000
Smoking breaks	73,707,000	0	73,707,000
Total	**90,351,000**	**15,652,400**	**90,351,000**

Economic impacts for the hospitality sector

8.15 The evidence from studies of the introduction of smoking restrictions affecting the hospitality sector shows that overall there is a positive effect that does not significantly differ from zero. The results available in the studies are not perfectly suited to estimating a shift in demand (positive or negative) following the introduction of smoking ordinances and the consequential economic impact. However, in order to put the results into context for Scotland, results from some of the studies that provided 95% confidence intervals have been applied to estimate a range of possible economic impacts for the central, low and high estimates. Estimates of impact on the hotel, restaurant and bar sectors are presented in **Table 8.5**. This shows that the annual effect on the hospitality sector in Scotland is estimated to lie in the range –£104 million to +£299 million with a central estimate of +£97 million. Most of the uncertainty relates to the estimated impact on bars.

Table 8.5 Range of estimates for economic impact in the hospitality sector (£m, 2003 prices)

	Central estimate	Low estimate	High estimate
Hotels	–10	–26	5
Restaurants	4	–21	28
Bars	104	–58	265
Total*	**97**	**–104**	**299**

*Totals vary due to rounding.

8.16 It should be noted that the data are drawn from North American studies of smoking restrictions and bans. The response to smoking restrictions may be different outwith this context. Results from Ireland should be considered carefully when these become available.

8.17 The net effect on the Scottish economy of any impact on the hospitality sector will be reduced as any change in spending is redistributed to or from other sectors of the economy. Expenditure that is diverted from or gained by the hospitality sector will be taken up in or lost from other sectors; however, net losses or gains may occur if the proportion of expenditure on imported goods changes, if the income generated by exports varies or if sectors have different multiplier effects (that is, they create more or less additional economic activity as a consequence of the direct expenditure in the sector). It was outwith the scope of this study to provide a full macroeconomic model of the net economic effects. However, **Table 8.6** shows a range of net economic effects and it is these figures that are carried forward to the summary of health and economic impacts. For the total estimates of impact, the central and high estimates have been based on 20% net economic effect and the low estimate has been based on 40% net economic effect.

Table 8.6 Estimates of the net economic effect of changes in turnover in the hospitality sector (£m, 2003 prices)

'Net economic effect'	Central estimate	Low estimate	High estimate
20%	**19**	–21	**60**
30%	29	–31	90
40%	39	**–42**	120

Highlighted figures are those used in the summary of health and economic impacts.

8.18 The other specific sector of interest is the leisure sector. The only sizeable part of this sub-sector where public demand for services might be affected is gambling and betting activities. The only relevant study related to charitable gaming activities and showed no effect due to smoke-free ordinances.

Estimated total economic impact

8.19 The value of the health and economic impacts has been estimated over the 30-year period required for the full effect of health impacts to be realised. It is assumed that health-related benefits accumulate in a straight line over a 20-year period, i.e. the benefit in year 1 is the full benefit divided by 20. Alternative estimates using a 10-year and 30-year period have also been estimated to test the sensitivity of the results. To take account of the different timing, resource savings and health benefits are discounted at the Treasury recommended rate of 3.5%. In the sensitivity analysis a lower discount rate for health benefits of 1.5% is used.

8.20 The central estimates for the annual net benefit of a ban on smoking in public places are shown in **Table 8.7**. All of the health and economic impacts are positive. Of the total value of the benefits from year 20, almost two-thirds relate to the value of the health gains, almost one-third comes from resource savings and around 6% from the net effect of the increase in trade for the hospitality sector. When future values are discounted, the total falls to between one-half and one-third of the undiscounted value. Health benefits still account for more than half of the total from year 20. The net present value (NPV), which is the sum of the discounted values of the health and economic impacts over 30 years, is £4,620 million.

Table 8.7 Summary of annual health and economic impacts — central estimates (£000, 2003 prices)

	Years post ban					
	5	10	15	20	25	30
Undiscounted						
Increase in hospitality sector turnover — net effect	19,400	19,400	19,400	19,400	19,400	19,400
Resource and productivity savings	93,612	96,873	100,134	103,395	103,395	103,395
Value of health benefits	53,155	106,309	159,464	212,618	212,618	212,618
Total*	**166,167**	**222,582**	**278,998**	**335,413**	**335,413**	**335,413**
Discounted						
Increase in hospitality sector turnover — net effect	16,906	14,234	11,985	10,091	8,496	7,154
Resource and productivity savings	81,557	71,079	61,861	53,782	45,283	38,127
Value of health benefits	46,321	78,002	98,514	110,594	93,118	78,403
Total*	**144,805**	**163,315**	**172,360**	**174,467**	**146,897**	**123,683**

*Totals may vary due to rounding.

8.21 Figures for the low estimate are summarised in **Table 8.8**. These are based on negative estimates of the impact of a smoking ban on the hospitality sector and the least favourable estimates of resource savings and health benefits. The net economic effect from the reduction in turnover of the hospitality sector is assumed to be 40% of the estimated total reduction in turnover for these figures. There is a net cost resulting from a ban on smoking in public places for the first 10 years but this becomes a positive benefit as the health benefits accumulate in later years. From year 20 onwards, this very low estimate of health benefits is almost equal to the estimated net effect of the reduction in hospitality sector turnover; when combined with resource and productivity savings the net benefit is **£23 million**. The NPV of the health and economic impacts over the 30-year period is **£55 million**.

8.22 The figures for the high estimate are presented in **Table 8.9**. These are based on the most positive estimates of impact on the hospitality sector and a favourable view of the health benefits and resource savings. All of the health and economic impacts are positive. From year 20, the value of the health benefits is 69% of the total benefit. Resource and productivity savings account for 20% of the benefit. The net effect of increased turnover in the hospitality sector contributes 11% of the total. The NPV for the 30 year period is **£7,395 million**, which is more than 50% higher than the central estimates.

8.23 In summary, the central estimate is that the full annual effect would be **+£335 million** (undiscounted: range +£23 million to +£555 million); which is equivalent to **+£124 million** when discounted to take account of the timing of effects (range +£8 million to +£205 million), with a net present value over 30 years of **+£4,620 million** (range: +£55 million to +£7,395 million). The main areas of uncertainty relate to the possible productivity gains from smoking breaks and the estimated impact on the hospitality sector.

Table 8.8 Summary of annual health and economic impacts — low estimates (£000, 2003 prices)

	Years post ban					
	5	10	15	20	25	30
Undiscounted						
Reduction in hospitality sector turnover — net effect	–41,600	–41,600	–41,600	–41,600	–41,600	–41,600
Resource and productivity savings	18,042	20,431	22,820	25,210	25,210	25,210
Value of health benefits	9,841	19,682	29,522	39,363	39,363	39,363
Total*	**–13,718**	**–1,487**	**10,743**	**22,973**	**22,973**	**22,973**
Discounted						
Increase in hospitality sector turnover — net effect	–36,252	–30,523	–25,700	–21,639	–18,219	–15,340
Resource and productivity savings	15,722	14,991	14,098	13,113	11,041	9,296
Value of health benefits	8,576	14,441	18,238	20,475	17,239	14,515
Total*	**–11,954**	**–1,091**	**6,637**	**11,949**	**10,061**	**8,471**

*Totals may vary due to rounding.

Table 8.9 Summary of annual health and economic impacts — high estimates (£000, 2003 prices)

	Years post ban					
	5	10	15	20	25	30
Undiscounted						
Increase in hospitality sector turnover — net effect	59,800	59,800	59,800	59,800	59,800	59,800
Resource and productivity savings	95,874	101,396	106,919	112,441	112,441	112,441
Value of health benefits	95,612	191,224	286,835	382,447	382,447	382,447
Total*	**251,285**	**352,420**	**453,554**	**554,688**	**554,688**	**554,688**
Discounted						
Increase in hospitality sector turnover — net effect	52,112	43,877	36,943	31,105	26,190	22,051
Resource and productivity savings	83,548	74,397	66,052	58,487	49,244	41,462
Value of health benefits	83,320	140,307	177,202	198,932	167,495	141,027
Total*	**218,981**	**258,581**	**280,197**	**288,524**	**242,930**	**204,540**

*Totals may vary due to rounding.

9 Sensitivity analysis

9.1 The range of estimates produced in the summary already incorporates the effects of alternative assumptions relating to the estimates of individual effects. Further sensitivity analysis has been carried out to test some of the modelling assumptions, concentrating on the central and low estimates only. These are of the most interest, as in all cases the estimates will remain higher than the central estimates, all of which are positive. The sensitivity analysis has concentrated on factors affecting the health gain estimates, as these are a large component of the total figures, and on the hospitality sector impact, as these are uncertain. The effect of applying a lower discount rate to health gains has also been tested.

9.2 The central estimates are fairly robust to the alternative modelling assumptions and the NPV never falls below £3 billion. The low estimates are sensitive to a number of factors including the time period over which benefits accrue, the inclusion or exclusion of benefits from reduced active smoking and the discount rate for health gains. If two or three of these are set to the most disadvantageous level then it is possible to obtain negative values for the NPV of the low estimates. Given that all of the individual estimates have also been set to maximum disadvantage, these negative values require the most unlikely combination of circumstances. Under reasonable assumptions the NPV will be positive.

10 Recommendations for further research

10.1 There are a number of areas where the evidence base could be strengthened. In respect of health gains, the volume of evidence relating to stroke and respiratory disease was less than for lung cancer and CHD. Larger studies or meta-analysis of existing studies would be required to produce more precise estimates of the effect of exposure to ETS.

10.2 The estimates for the costs of smoking in the workplace were quite limited in their number and methods. Given the relative size of the estimates relating to smoking breaks, better estimates relating to the frequency and timing of smoking breaks under alternative restrictions would improve the precision of the estimates.

10.3 The evidence base for the economic impacts of smoking restrictions on the hospitality sector is not particularly robust. Some of the problems in research design are unavoidable given that the impact of restrictions can only be evaluated where they have been implemented. However, the impacts could be estimated more precisely, and the effect on different types of business or different locations could be examined, if studies were carried out at the level of individual businesses or outlets. Such studies would have to be based on objective data. Consideration should be given to the feasibility of using existing secondary data or to the development of a panel of businesses representative of the whole sector and providing verified data on economic activity.

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