The Effects of Increasing Tobacco Taxation: **A Cost Benefit and Public Finances Analysis**

A report prepared for ASH by Landman Economics

Written by Howard Reed

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action on smoking and health

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LIST OF THE ABBREVIATIONS USED IN THE REPORT

CBA - cost benefit analysis
FCTC - Framework Convention on Tobacco Control
GHS - General Household Survey
HMCE - HM Customs and Excise was merged with the Inland Revenue to become HM Revenue and Customs in 2005
HMRC - HM Revenue and Customs
HRT - hand rolling tobacco
JTI - Japan Tobacco International
MoU - Memorandum of Understanding
NHS - National Health Service
NICE - National Institute for Health and Clinical Excellence
NPV - Net Present Value
OLAF - the European Anti-Fraud Office
PFA - public finances analysis
PMI - Philip Morris International
SEC - socio-economic class
TMA - Tobacco Manufacturers' Association
UKBA - UK Border Agency

EXECUTIVE SUMMARY

This report undertakes an economic analysis of the impact of increasing the level of taxation on tobacco products in the UK, building on previous work for ASH by Paul Johnson.[1] Because smoking imposes significant costs on the UK economy through increased NHS expenditure on smoking-related health conditions and increased mortality rates for smokers of working age, increasing tobacco taxation is likely to have a number of indirect benefits in terms of reduced early deaths in the population (and hence lower NHS costs), reduced ill health, reduced absenteeism from work, and so on.

We find that a tobacco price rise of 5% results in net benefits to the economy as a whole of around £10.2 billion (measured as a net present value of the stream of benefits over 50 years.) The economic benefits in the first five years of the policy are around £270m per year on average. Just over half of these gains are accounted for by the 'human value' of the deaths averted through a reduction in the number of smokers in the UK population. The rest of the gains are split between the value of the increased economic output resulting from fewer working age deaths, reduced absenteeism from work and lower NHS costs as a result of the tax increase.

Our analysis also shows a positive effect of the policy on the public finances, with a net revenue gain to the government of around £520m per year in the first five years on average. Just over four-fifths of this gain is due to the direct effects of increased revenue from tobacco taxation itself, but increased revenue from taxes, reduced benefit spending and reduced NHS costs all have a positive impact on revenues in addition to this.

Methodology

There are two parts to our analysis:

1. A **cost benefit analysis (CBA)** of the wider effects on the economy. A cost-benefit framework is a general approach to evaluating government interventions which attempts to quantify the overall effects of a policy on economic and social well-being, thereby helping policymakers assess whether a particular policy intervention is likely to represent 'value for money'.
2. A **public finances analysis (PFA)** of the effects on government tax revenue and government spending of the tobacco tax increase. This includes both the direct impact of a tax increase on the revenue from tobacco taxation itself, and also the indirect impact of a reduction in the number of people smoking in the UK (the 'prevalence' of smoking) on government spending and revenues.

Currently, the price of a typical pack of twenty cigarettes is just over £6, of which around 76% is tax. This report models the impact of increasing the price of a pack of cigarettes by 5% - i.e. around 30 pence. This is a *real terms* increase, so would be on top of any adjustment to allow for price inflation. It is a one-off change, i.e. we assume that the price of cigarettes increases by 5% in real terms and is then maintained in real terms at that higher level for future years.

1. Johnson P (2009) "Cost Benefit Analysis of the FCTC Protocol on Illicit Trade in Tobacco Products" London, ASH. http://www.ash.org.uk/ash_7iqt6hvz.htm

This is in line with the recommendation that ASH is making in its 2010 Budget submission that in the first instance an increase of 5% above inflation should be for one year only and increases thereafter should be at least at the rate of inflation with increases above inflation considered on an annual basis.

The magnitude of the effects of a tobacco price increase on the number of people giving up smoking in response to a price increase depends on how sensitive smoking behaviour is to tobacco prices. Our central assumption, following work by Townsend (1996)[2], is that the "prevalance elasticity" of tobacco is -0.35. This means that an increase of 5% in tobacco prices would be expected to reduce the proportion of smokers in the population from its current level of 21% of adults to (21 – (0.21 ×(0.35 × 5))) = 20.63% of adults. This equates to a reduction of around 190,000 in the total number of smokers in the population. Annex 2 of the report contains results using higher and lower values of the elasticity.

Our model assumes that half of the reduction in smoking induced by a tobacco price increase is brought about by existing smokers quitting, and the other half is due to people who otherwise would have smoked never starting. Applied to the population demographic in 2010, this would imply that 95,000 smokers quit and there are 95,000 extra people who never start smoking. Annex 4 presents some results from a sensitivity analysis where we vary the proportions of ex-smokers and people who never start smoking, which shows that the precise proportions of each make relatively little difference to the results.

Cost benefit analysis

Our CBA includes estimates of the following effects of a tobacco tax increase:

- **Savings to the National Health Service** - in 2006, £2.7 billion was spent by the NHS on treatment of smoking-related diseases in England. As the risk of developing diseases falls (due to lower smoking prevalence and decreasing risks for ex-smokers), so would the costs of treatment.
- **Output gains due to reduced mortality** - the fact that people live longer implies they will have a higher probability of surviving and being in work until the average age of retirement. Therefore, a reduction in smoking prevalence would result in output gains due to reduced mortality.
- **Output gains due to reduction in absenteeism** - there is evidence that smokers are more prone to absenteeism from work than non-smokers. As more people stop smoking, their output would increase due to reduced absenteeism.
- **Years of life gained** - the fact that people live longer (healthier) lives is in itself a benefit for these individuals and society as a whole. We use UK government departments' preferred estimate of the 'human value' of prevention of a fatality (just under £1 million) to calculate the value of extra years of life to people who give up smoking (or never take up smoking) because of the price increase.

We make the following assumptions about how benefits should be measured:

- All benefits are presented in current (i.e. 2009-10) prices.

2. Townsend J (1996) "Price and Consumption of Tobacco" *British Medical Bulletin*. To be more specific, Townsend finds that the overall elasticity of tobacco consumption - the "price elasticity" - is -0.5, and we have assumed (in line with results from previous research) that the prevalence elasticity is 70% of the price elasticity.

- Benefits are presented as Net Present Values (NPVs) over a 50 year period, using a discount rate of 3.5% per year to discount future benefits in comparison to future benefits. We also present the individual benefits in the first five years of the policy (undiscounted) for comparison.

Full details of the methodology used to produce the estimates, and the assumptions we make, are given in Chapter 3 of the report, with additional technical information in Annex 1.

Table 3 (reproduced from the main report) shows the estimates from the CBA under our central assumptions regarding the prevalence elasticity of tobacco and the health risks which people who give up smoking face compared with people who have never smoked.

Table 3. Results from CBA of 5% increase in tobacco prices: central scenario

All figures in £m, 2010 prices

		Individual years				
Cost/benefit	**Overall NPV**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
NHS cost savings	1,968	23.3	25.3	27.3	29.5	31.7
Output - reduced absenteeism	1,364	22.7	25.9	29.9	34.3	38.5
Output from extra working life	1,146	33.3	34.1	34.7	35.4	36.2
Value of extra life	5,746	178.6	179.9	180.3	181.0	182.1
TOTAL	**10,225**	**257.9**	**265.2**	**272.3**	**280.1**	**288.5**

Overall, the Net Present Value of increasing tobacco prices by 5% adds up to £10.2 billion - a substantial benefit. The benefits in individual years average around £270m per year.

Public Finances Analysis

The PFA includes estimates of the following impacts of the tobacco tax increase on the public finances:

- **Increased revenue from tobacco taxation** - following Townsend (1996) we assume that the price elasticity of tobacco (i.e. the sensitivity of *overall tobacco consumption* to tobacco price - rather than the prevalence elasticity discussed earlier) is -0.5 in our central scenario. This means that an increase in the price of tobacco products leads to an increase in revenue.
- **Savings to the NHS** - calculated as for the CBA above.
- **Increased tax receipts from additional working life** - people of working ages whose deaths are averted through giving up smoking (or not starting smoking) due to the tobacco tax increase will have longer working lives and hence pay more in income tax and National Insurance contributions (NICs) to the Exchequer. They will also spend at least some of their additional disposable income and hence pay more VAT.
- **Increased tax receipts from reduced absenteeism** - the extra output from reduced absenteeism among people who stop smoking (or never take up smoking) following the tax increase leads to increased income tax, NICs and VAT receipts.

- **Reduced spending on benefits related to sickness and disability** - smoking is associated with increased ill-health in the population as well as increased mortality. We estimate the reduction in expenditure on benefits for people of working age with long-standing health conditions (such as Employment and Support Allowance and Disability Living Allowance) which would result from a reduction in smoking caused by the tax increase.
- **Increased spending on benefits for retired people** - increased longevity as a result of reductions in smoking leads to some increased spending on state benefits for people over 65 - the State Retirement Pension and Pension Credit - because of reduced working-age mortality.

The PFA measures the net effects of the tobacco tax increase on government revenue over the five years from 2010-11 to 2014-15 rather than a 50-year Net Present Value. This is because the government is particularly concerned with the effects of policy changes in the next few years (e.g. the life of the next parliament) and there is a large degree of uncertainty over some of the components which would have to be included in a public finances analysis over a fifty-year time horizon but which can be excluded from a shorter-term analysis (e.g. end-of-life healthcare costs for people who survive into old age as a result of not smoking).

Table 4 (taken from the main body of the report) shows the results from the public finances analysis.

Table 4. Results from PFA of 5% increase in tobacco prices: central scenario

All figures in £m, 2010 prices
Positive numbers = net revenue gain, negative numbers = net revenue loss

	Individual years					
Cost/benefit	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
Increased tobacco taxation	427.4	430.6	433.7	436.9	439.9	433.7
NHS cost savings	23.5	24.2	27.6	29.7	31.9	27.4
Income Tax/NICs/VAT - extra working life	14.2	14.6	14.9	15.3	15.7	14.9
Income Tax/NICs/VAT - reduced absenteeism	12.6	14.4	16.5	18.8	21.0	16.7
Reduced disability benefits	33.0	33.1	33.3	33.4	33.5	33.3
Increased pensioner benefits	-3.3	-3.4	-3.5	-3.7	-3.9	-3.6
TOTAL	**504.9**	**511.7**	**518.8**	**526.2**	**533.5**	**519.0**

Increased revenue from tobacco taxation accounts for the majority of the increase in net revenues - around 83% of the total average revenue per year of just over £500m. Reduced spending on disability benefits is the next biggest single item of revenue gain at just over £30m per year.

CHAPTER 1

INTRODUCTION

Landman Economics has been commissioned by Action on Smoking and Health (ASH) to undertake an economic analysis of the impact of increasing the level of taxation on tobacco products in the UK, building on the model developed for ASH by Paul Johnson.[3]

Retail tobacco products in the UK and other countries are already subject to high levels of taxation, and with good reason: tobacco is the only legal consumer product that kills when used as intended and is highly addictive, with half of all long-term users dying from their addiction. The use of tobacco imposes significant costs on the UK economy through increased NHS expenditure on smoking-related health conditions and increased mortality rates for smokers of working age. Therefore, it is widely accepted that tobacco should be subject to a high level of tax (as well as various forms of regulation on its sale, for example advertising bans and minimum age restrictions) to discourage its use.

At the time of writing (February 2010), tax accounts for over 75 per cent of the retail cost of a typical packet of cigarettes. Is there justification for raising the tax level further? We believe there is. A recent report by Matrix Insight for Health England[4] (the national reference group for health and well-being, established to take forward the recommendations in the Health White Paper *Our health, our care, our say: a new direction for community services*) offers empirical support for the notion that increases in tobacco taxation are one of the most cost-effective health interventions. The research evaluated fourteen different preventative health interventions on a range of criteria including cost-effectiveness, the proportion of the population eligible for the intervention, the distribution of benefits (with interventions that are targeted at the lowest-income groups in the population scoring higher), affordability, and the amount of evidence available in support of the intervention having beneficial effects. A policy of increasing tobacco taxation was the second most effective of the interventions evaluated on this model. It was only surpassed by increases in alcohol taxation as an effective policy, and was well ahead of other interventions such as GP interventions to reduce obesity by promoting physical activity, and the provision of statins for reduction of cholesterol levels.

Previous studies of the impact of increases in tobacco taxation have focused only on the *direct* impact of such tax changes on the revenue from tobacco taxation itself. However, there are also a number of *indirect* impacts of increases in tobacco tax because an increase in the retail price of tobacco will result in a reduction in the number of people who smoke in the UK. This leads to health benefits in terms of reduced early deaths from smoking-related health conditions in the population, fewer working-age people being rendered unable to work through smoking-related health problems, reduced absenteeism from work, and so on. This report attempts to quantify how large the wider economic effects of increasing tobacco taxation might be, if taxation were increased by enough to raise the retail price of tobacco by 5 per cent in real terms.

3 Johnson, P. (2009) "Cost Benefit Analysis of the FCTC Protocol on Illicit Trade in Tobacco Products". www.ash.org.uk/itp/cba
4 Matrix Insight (2009) "Prioritising investments in preventative health". http://www.matrixknowledge.com/insight/health/health-publications/

There are two parts to our analysis:

1. A **cost benefit analysis (CBA)** of the effects. A cost-benefit framework is a general approach to evaluating government interventions. This type of analysis can be undertaken before a policy has been implemented (ex ante) or when the policy is underway (ex post). CBA attempts to quantify the overall effects of a policy on economic and social well-being. In so doing, it helps governments to assess whether a particular policy intervention is likely to represent 'value for money' and to choose the most cost-effective intervention from several alternatives.
2. An analysis of the **impact on the public finances**. In the difficult fiscal climate which the UK government finds itself in, the effect of a tobacco tax increase on government revenues (via changes in the overall tax take) and on spending (via changes to spending on the NHS, disability-related benefits and state pensions, and so on) is likely to be of particular interest to policy makers.

The rest of the report is structured as follows:

- Chapter 2 provides background information on the current levels of tobacco taxation in the UK and recent trends in the level and structure of tobacco taxation. It also looks at recent trends in the number of people smoking in the UK.
- Chapter 3 explains the methodology behind the cost benefit analysis (CBA) and the public finances analysis (PFA) of increases in tobacco taxation. The explanation in the main text is rigorous but non-technical. Annex 1 contains additional technical information on the assumptions and methodologies used in our analyses.
- Chapter 4 gives the results from the CBA and PFA. Some additional results, using different assumptions to check the robustness of our main estimates, are also presented in Annexes 2, 3 and 4
- Chapter 5 summarises the results and draws conclusions.

CHAPTER 2

TOBACCO TAXATION IN THE UK

The UK tax paid tobacco market is worth around £14 billion.[5] The market is dominated by cigarettes, which represent 93.3% of the total duty paid market (in value terms). The share of other tobacco products - hand rolling tobacco (HRT) and cigars - is 6.7%. In this chapter, we explain how tobacco taxation in the UK works, and how the level of taxation has changed over time, in response to government policy decisions. We also look at changes in the number of smokers in the UK since the early 1970s.

2.1 THE LEVEL AND STRUCTURE OF TOBACCO TAXATION

This section focuses on the level and structure of taxation on cigarettes given that they account for the vast majority of tobacco sold in the UK. However, taxation of HRT and cigars works in a very similar way.

Cigarette smokers choose between multiple brands, ranging from 'economy' (around £4.50 per pack) to 'premium' (£6.50 per pack and above). According to the Tobacco Manufacturers' Association (TMA), the Recommended Retail Price (RRP) of a typical pack in the Most Popular Price Category (MPPC) in January 2010 was £6.13.[6] However, the actual average price paid by consumers for legal cigarettes tends to be 8 to 10 per cent lower than this.[7]

Cigarette taxation has three components:

1. The **specific duty**. This is a component of excise duty and is set in cash terms - as an amount per 1,000 cigarettes. Currently the rate is £114.31 per 1,000 cigarettes (set in the April 2009 Budget).
2. The **ad valorem duty**. This is also a component of excise duty. It is set equal to a percentage of the overall retail price (currently 24%).
3. **Value Added Tax (VAT)**. This is currently levied at 17.5% on the retail price exclusive of VAT, but after the specific and ad valorem duties have first been added on. This means that VAT is equal to (17.5/(100+17.5)) = 14.9% of the overall retail price. Between December 2008 and December 2009, VAT was reduced from 17.5% to 15% as a temporary fiscal stimulus measure in response to the current economic recession. In January 2010 VAT returned to 17.5%.[8]

5 Tobacco Manufacturers' Association, "Consumer Expenditure on Tobacco Products", http://www.the-tma.org.uk/page.aspx?page_id=45.
6 The TMA website, http://www.the-tma.org.uk/page.aspx?page_id=42
7 West R. (2008) "Smoking and smoking cessation in England: Findings from the smoking toolkit study" Cancer Research UK
8 Note that excise duty rates on tobacco were increased when the VAT reduction came into force so the retail price of tobacco did not fall as a result of the VAT reduction. However, when VAT was raised again in January 2010, the increase in excise duty rates was not reversed. Thus the overall effect of the tax changes was to increase tobacco taxation as a share of the price in 2010 compared with what it was in 2008.

Table 1 below shows the breakdown in tax on a typical packet of cigarettes based on the TMA's January 2010 figures. Tax currently makes up just over 76% of the retail price of cigarettes.

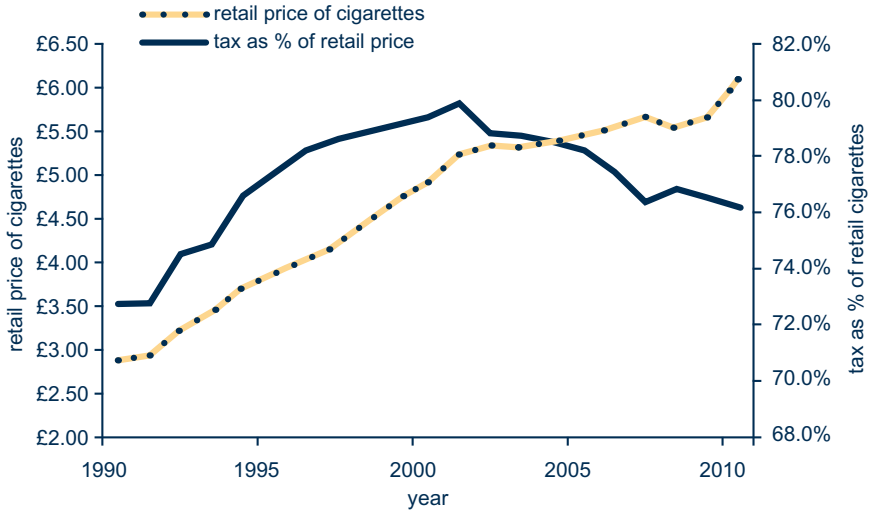
Table 1. Components of price of a packet of cigarettes, March 2010

Component	Amount	% of overall cost
Specific duty	£2.29	37.4%
Ad valorem duty	£1.47	24.0%
VAT	£0.91	14.9%
Remainder (non-tax element)	£1.46	23.8%
TOTAL	£6.13	100.0%
Tax as share of price	**£4.67**	**76.2%**

Source: from author's own calculations

Figure 1 puts the rate of tobacco taxation in historical context by showing cigarette prices in real terms (i.e. allowing for Retail Price Index inflation) on the left hand side, and tax as a percentage of the retail price on the right hand index, since 1990.

Figure 1. Price of cigarettes in real terms and tax as a proportion of price, 1990-2010



Sources: RPI(X) figures from Office for National Statistics (ONS):
http://www.statistics.gov.uk/StatBase/tsdataset.asp?vlnk=7172&More=N&All=Y
Retail price and tax figures: TMA.

Figure 1 shows that between 1991 and 2001 the retail price of cigarettes increased by about 80% in real terms. This is explained to a large extent by tax increases; over the same period the proportion of tax in the retail price rose from 73% to 80%. Three government policy decisions drove this increase:

1. The increase in VAT from 15% to 17.5% in the 1991 Budget under the Conservative Government led by John Major.
2. The introduction of a tobacco duty "escalator" in the Conservatives' autumn 1993 Budget, whereby the government committed to raising tobacco duties by at least 3 per cent per year in real terms.[9]
3. The steepening of the escalator under the incoming Labour Government of 1997, which committed to raise tobacco duties by at least 5 per cent per year in real terms.

From 2001 onwards, the tobacco duty escalator was abandoned in response to concerns that tobacco smuggling into the UK had risen markedly since the mid-1990s following the removal of routine border controls between EU states. There was concern that further increases in tobacco duty might be counter-productive because they could incentivise smuggling. However, in 2000 the Government launched the Tackling Tobacco Smuggling strategy and a range of other anti-smuggling initiatives, and since 2001 the size of the UK's illicit market in cigarettes has been reduced by almost half.[10]

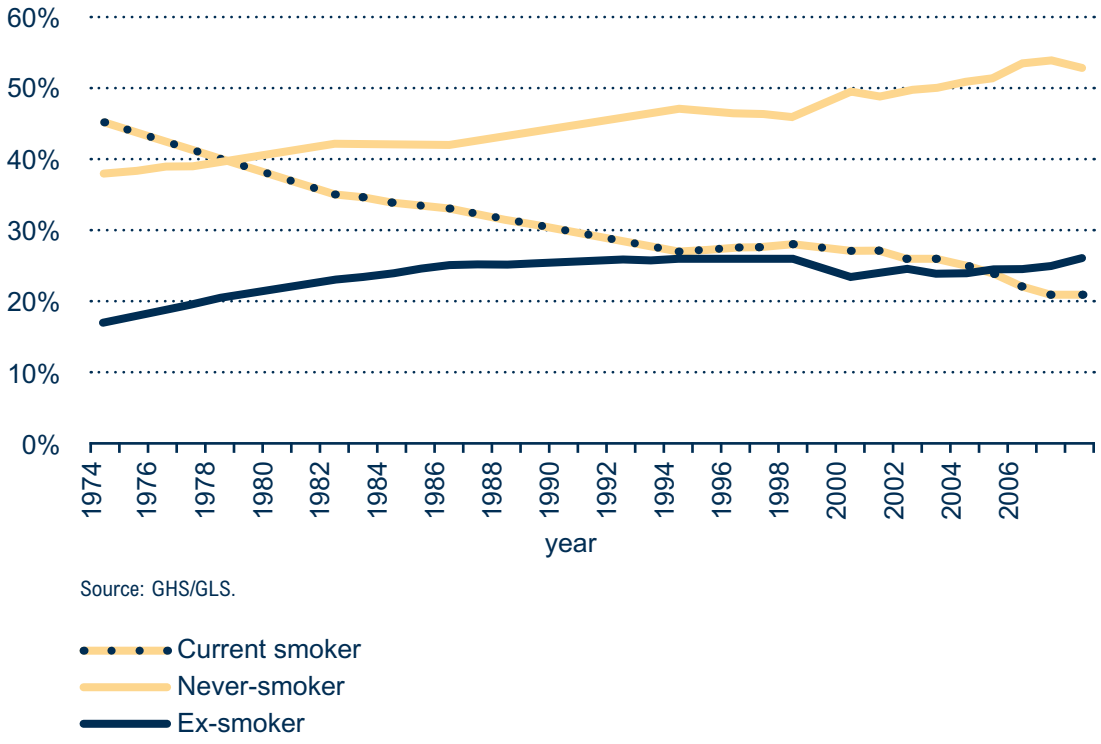
Between 2001 and 2007, tax as a proportion of the retail price of cigarettes actually fell from about 80% to 76%. Although specific duties were uprated in line with inflation, the non-tax component of the cigarette price rose faster than inflation over this period, thus leading to a fall in the proportion of the price of cigarettes accounted for by tax. Since 2007, there has been a slight increase in tax as a proportion of the retail price.

2.2 TRENDS IN THE PREVALENCE OF SMOKING IN THE UK POPULATION

It is instructive to compare the trends in the retail price of cigarettes with historical data on the proportion of smokers in the British population. Figure 2 presents data from the UK General Lifestyle Survey (GLS) - previously known as the General Household Survey - on the proportion of smokers in the adult population of Great Britain.[11] Smoking prevalence has fallen markedly, from 45% of the population in 1974 to around 21% in 2008. Between 1974 and 1990, the decline in smoking was mainly driven by smokers quitting and becoming ex-smokers. However, this trend has changed from the mid-1990s onwards. While the share of ex-smokers remains largely stable, the share of non-smokers is growing, indicating a lower take-up among young people.

9 Information on the introduction and subsequent changes to the tobacco duty escalator is taken from the Institute for Fiscal Studies's *Green Budget January 2001*, "Appendix C: Budgets Since 1979."
10 For details see Johnson P. (2009) "Cost Benefit Analysis of the FCTC Protocol on Illicit Trade in Tobacco Products", Chapter 2.
11 The GLS does not interview people in Northern Ireland so this data relates to England, Scotland and Wales only.

Figure 2. Prevalence of cigarette smoking: Great Britain, 1974-2008



Source: GHS/GLS.

Analysis by Townsend (1996) of cigarette consumption and cigarette price data for the 1970s and 1980s[12] shows that the real price of cigarettes fluctuated during the 1970s and then rose steadily during the 1980s. Overall consumption fell during the 1970s and 1980s - as did the number of smokers in the population (as Figure 2 shows). The fact that prevalence of smoking fell more slowly during the 1990s than the 1980s is at first glance surprising given the steep increases in tobacco taxation during the 1990s. However, the increase in the size of the illicit tobacco market during the 1990s helps account for the change in trends in smoking prevalence. Following the publication of a comprehensive strategy to drive down smoking prevalence in 1998[13] including mass media campaigns, a ban on advertising, the development of NHS Stop Smoking Services and tough measures against smuggling, the size of the illicit tobacco market has been significantly reduced[14] and a steeper downward trend in smoking prevalence has resumed.

12 Townsend, J. (1996) "Price and Consumption of Tobacco", *British Medical Bulletin*,Vol 52 No 1, pp 132-142.
13 Smoking Kills. A White Paper on Tobacco. Department of Health (1998)
14 Measuring Tax Gaps. HMRC (2009)

CHAPTER 3

METHODOLOGY

This chapter gives an exposition of the methods we use to conduct the cost benefit analysis (CBA) and the public finances analysis (PFA) of the effects of increasing tobacco taxation. The chapter is divided into five sections. First we explain the assumptions we are making about the size of the tobacco price change modelled (a one-off increase of 5% in real terms) and its impact on the demand for tobacco products (i.e. the elasticity of demand for tobacco). Second, we explain assumptions which underlie the CBA - such as the discount rate used, the way the results are adjusted to allow for projected demographic changes over the next 50 years and the assumptions made about the welfare effects of tobacco taxation on smokers. Third, we give details of how each of the effects in the CBA is calculated. Fourth, we explain the specific assumptions which underlie the PFA. Finally, we give details of how each of the tax and spending effects in the PFA is calculated.

The explanation in this chapter is rigorous but non-technical. Full technical details of the statistical procedures used for the CBA and PFA are given in Annex 1 to the report.

3.1 TOBACCO PRICE ASSUMPTIONS

Size and timing of the price increase

For this report it was decided to model the impact of a price increase of 5 per cent in real terms in the year 2010. Using the figures from Table 1, this means that, if RPI inflation were zero, the price of a packet of cigarettes would increase by 31 pence – from £6.13 to £6.44. This could be accomplished, for example, by increasing specific duty on cigarettes from £114.31 per 1000 to £123.50 per 1000 = an increase of around 8 per cent in the specific duty, and around 6.5 per cent in the total tax burden on cigarettes.

If RPI inflation were 2 per cent per year in 2010 (the government's long-run target), an increase in the price of cigarettes from £6.13 to £6.57 would be a real terms increase of 5 per cent in one year.

Five per cent seems a reasonable figure to use to illustrate the effects of a tobacco price increase. It is large enough to produce significant results in our model, but not so large as to be politically unfeasible in the short run.

It is important to be clear that this is a one-off 'step' increase in the price of cigarettes. The assumption is that the price of a packet of 20 cigarettes increases by 5% in real terms and then is maintained at that new higher level (in real terms) for all future years. We are not assuming an 'escalator' where the price is increased in real terms this year, and then again next year, and again the year after that, and so on. This makes the interpretation of the results of the modelling more straightforward and is in line with the recommendation that ASH is making In its submission for the 2010 Budget that in the first instance an increase of 5% above inflation should be for one year only and increases thereafter should be at least at the rate of inflation with increases above inflation considered on an annual basis.

(The model could easily be adapted to calculate the effects of an escalator as compared to a one-off price change, however).

All the figures presented in this report are in 2009/10 prices and hence abstract from retail price inflation - giving the cost-benefit and public finance effects in today's prices.

It should also be noted that we assume that the price of all other tobacco products (e.g. hand-rolling tobacco, cigars, etc.) increases in line with the price of cigarettes.

The responsiveness of the demand for tobacco to price changes

Typically, when faced with higher prices for a good or service, consumers tend to reduce their consumption of that good or service. For tobacco products, the effect is likely to be threefold:

- Some smokers will smoke less;
- Others will stop smoking altogether; and
- Smoking take-up may also decline, increasing the number of non-smokers.

The magnitude of the reduction in overall consumption of tobacco (e.g. the number of packets of cigarettes bought) depends on the **price elasticity of demand** for tobacco products. This is a negative number[15] which corresponds to the decrease in consumption which occurs in response to an increase in the price of tobacco. So for example, an elasticity of -0.6 would mean that a 10% increase in price leads to a 6% reduction in consumption.

There is a considerable body of literature estimating price elasticity of demand for tobacco products. Townsend (1996) summarises this literature for the UK and finds the average price elasticity to be -0.5.[16] There is also evidence that price elasticity varies by gender, socioeconomic class and age. For example, smokers from SEC 4 and 5 (semi-skilled and unskilled manual workers) have higher price elasticity of -0.6 and -0.9 respectively.[17]

A study based on more recent UK data by Cullum and Pissarides (2004)[18] finds a somewhat higher price of elasticity for tobacco of -0.72, with an elasticity for duty-paid tobacco (i.e. tobacco products legally purchased in the UK rather than smuggled or imported) of between -1.08 and -1.45. However, the data used by Cullum and Pissarides are taken from the late 1990s and early 2000s when tobacco smuggling into the UK was at its height. Since then, the UK market for illicit tobacco products has shrunk markedly, and the situation arguably looks a lot more like the early 1990s than the early 2000s. Thus, we have decided to use the elasticity estimates from Townsend as the basis for our calculations rather than those from Cullum and Pissarides - on the basis that the latter estimates were inflated by the increase in smuggling during the late 1990s, which has now been reversed to a large extent, with further measures planned.[19]

15 It is theoretically possible for the price elasticity of demand for a good or service to be *positive* - but this would mean that consumers *increase* their consumption of the good or service when the price increases, which is unusual in practice.
16 Townsend, J. (1996) "Price and consumption of tobacco" *British Medical Bulletin*
17 Townsend J, Roderick P and Cooper J (1994) "Cigarette smoking by socioeconomic group, sex and age: effects of price, income and health publicity" *British Medical Journal* 309: 923-927
18 Cullum P and Pissarides C (2004) "The demand for tobacco products in the UK" Government Economic Service Working Paper No 150
19 For details see Johnson P (2009) "Cost Benefit Analysis of the FCTC Protocol on Illicit Trade in Tobacco Products"

While our estimates for the change in tobacco tax revenues arising from the tobacco tax increase use the price elasticity for tobacco to calculate the change in revenues, the rest of the estimates from the CBA and PFA focus on changes in the *prevalence* of smoking in the population (i.e. the number of people who smoke at all) rather than the overall amount of tobacco consumed. This is because there are clear health benefits for smokers who stop smoking altogether, and for people who never begin to smoke in the first place, as a result of a tobacco price increase. The risks of developing smoking-related diseases such as lung cancer and coronary heart disease are significantly lower for both non-smokers and ex-smokers compared to smokers.

The benefits for people who smoke less as a result of a price increase, but do not give up entirely, are less clear-cut. While some studies find a small positive impact on mortality risks,[20] other studies find that those who reduce their consumption "smoke each cigarette more intensively and end up with the same amount of smoke exposure".[21] Given that the evidence on changes in risks for this group is inconclusive, we make a conservative assumption that these risks do not change and that this group does not experience any significant health benefits.

Most studies find that the prevalence elasticity contributes 50%-75% to the total price elasticity.[22] Moreover, in our analysis, we focus on *long-run* elasticities, which incorporate two effects: (i) a reduction in smoking prevalence due to current smokers' quitting and (ii) a reduction in prevalence due to current lower take-up of smoking. This means that, apart from affecting the current smokers, a price rise also affects potential future smokers, who are now less likely to take up smoking.

Taking this information into account, the central elasticity scenario we model is a prevalence elasticity of **-0.35**. This is based on Townsend's finding of an average overall price elasticity of -0.5, and the assumption that the prevalence elasticity is 70% of the price elasticity. In Annexe 2 of the report we also present results from two other scenarios:

- A *lower bound* estimate for the prevalence elasticity of **-0.25** - based on Townsend's overall price elasticity and the lower bound assumption of 50% for the prevalence elasticity as a proportion of the price elasticity.
- An *upper bound* estimate for the prevalence elasticity of **-0.54** - based on Cullum and Pissarides' estimate of -0.72 for the overall price elasticity, and the upper bound assumption of 75% for the prevalence elasticity as a proportion of the price elasticity.

20 Godtfredsen, NS et al (2002) "Smoking reduction, smoking cessation and mortality: a 16 year follow-up of 19,732 men and women from the Copenhagen Centre for prospective population studies" *American Journal of Epidemiology* 156: 994-1001
21 West R (2006) "Tobacco control: present and future." *British Medical Bulletin* 1-14
22 See the World Bank study Grossman et al (1993) and the US Surgeon General report (2004).

3.2 ASSUMPTIONS UNDERLYING THE COST BENEFIT ANALYSIS

A CBA uses a standard and relatively straightforward toolkit in order to assist decision making. In conducting this CBA we follow the guidance set out in the UK Treasury's *Green Book*[23] and methods used across government in Regulatory Impact Assessments (RIAs). Similar techniques are used in policy appraisal at the EU level, by international agencies, in the US, Canada and numerous other countries. This section investigates methodological issues which pertain to the Cost Benefit Analysis.

Monetisation of costs and benefits

To carry out these analyses we first of all need to be able to compare the effects of the tobacco tax change using a single metric. To do that, effects need to be "monetised" (converted into monetary values). All of the impacts in the CBA and PFA are monetised using assumptions detailed later in this chapter.

Discounting future costs and benefits

In order to compare costs and benefits which accrue at different times it is important to convert streams of costs and benefits into **Net Present Values (NPVs)**. That is, costs or benefits which accrue in the future need to be discounted back into the present and aggregated. Costs or benefits accruing at a later date are generally considered to be of lower value than those which accrue immediately. The standard real discount rate recommended by the Treasury Green Book is 3.5%,[24] and that is the rate we use throughout this analysis. This is particularly pertinent in this analysis because while some of the benefits from reductions in smoking induced by the increase in the price of cigarettes will begin to accrue immediately (e.g. increased productivity arising from reduced absenteeism from work), others will take rather longer to become evident (e.g. much of the cost savings to the NHS). We calculate the NPV of the costs and benefits over a 50 year period (from 2010 up to 2059) as the benefits are likely to accrue over many decades. We do not include any costs and benefits after 2059 as there are many uncertainties involved over a longer time horizon.

Future population demographics

As far as possible, the CBA adjusts the NPVs to take account of changes in the size and age structure of the UK population between 2010 and 2059 using estimates from the Office for National Statistics (ONS) of how the population size and structure will change over the next 50 years.[25] This has two main effects:

1. The costs and benefits for the 2020s and beyond increase relative to 2010 (because the overall UK population is predicted to rise in future decades).
2. Costs and benefits which relate to people aged over 65 increase markedly in later decades (because life expectancy is projected to increase over the next 50 years).

Full details of the procedures used are contained in Annex 1.

23 The Green Book: appraisal and evaluation in central government. http://www.hm-treasury.gov.uk/data_greenbook_index.htm
24 This incorporates an allowance for expected annual economic growth of 2% and a combination of "pure rate of time preference" and "catastrophe risk" which are estimated at 1.5% between them.
25 ONS (2009) "2008-based National Population Projections". http://www.statistics.gov.uk/downloads/theme_population/NPP2008/NatPopProj2008.pdf

The public finances analysis also uses demographic adjustments but the impact of these is much more minor because we only model public finance effects up to the year 2014 (see Section 3.4).

The treatment of tax revenues and transfer payments

There is an obvious direct impact of an increase in tobacco taxation on revenue from tobacco sales. Whether the impact on overall revenue is positive or negative depends on how responsive the demand for tobacco is to the price increase (the 'price elasticity' of demand, discussed in more detail earlier in this section).

However, there is an equal and opposite effect of the change in tax revenue on other people in the economy, because increased tax revenue for government from tobacco products should result in reduced taxes or increased spending elsewhere in the economy. Therefore we don't include increased tax payments by smokers as a cost - or a benefit - to society *as a whole*.

There are also indirect impacts on tax revenue: for example, if the number of people smoking in the UK decreases in response to the tobacco price increase, it is likely that fewer people of working age will develop smoking-related health conditions which cause them to die early or become incapacitated and unable to work. Instead, they are likely to stay healthy and in work for more of their working lives, generating extra income tax revenue for the Exchequer. Conversely, fewer people incapacitated through smoking-related diseases will mean that spending on state benefits relating to ill-health and disability (such as Employment and Support Allowance) is reduced. In these cases what we do is to treat the increase in productivity resulting from the reduction in smoking as a benefit in itself. The *increase in productivity* is the extra benefit, whereas the additional tax revenue is a *transfer* of that benefit from one part of the economy to another. The way we calculate increased productivity for the CBA is dealt with in more detail below.

Note that changes in tax revenue and public spending certainly *are* included in the public finances analysis (as explained in Sections 3.4 and 3.5).

The welfare implications of tax-induced changes in smoking behaviour

In most cases where the imposition of a tax changes the consumption patterns of individuals and households, economists consider the change in consumption to be a distortion created by the tax system and hence an economic "welfare" cost. In the specific case of smoking, to the extent that a tax rise reduces smoking, it could be argued that smokers are made worse off because their decisions over what to consume have been altered and there is no offsetting increase in tax revenues. It looks like this implies a cost which should be included in the CBA.

However, there are two reasons for rejecting this view as too simplistic, one of which is common to any tax rise and one of which is specific to taxes on tobacco (and other addictive products).

The first reason is that the overall welfare impact depends on the impact of the tax change on the tax base *as a whole*. If the price elasticity of demand for cigarettes is between zero and -1 (a reasonable assumption given the previous estimates assessed above) then a rise in tax will lead to an increase in revenue from tobacco taxation, which allows reductions in other taxes - which in turn reduces the distorting impact of those taxes. Also, to the extent that people smoke less (or not at all) as a result of the increased price of tobacco products, they are likely to spend the money they save from not buying tobacco on other products instead - most of which are subject to VAT and/or excise duties.

In other words, one should only count any negative impact of tobacco taxes on smokers if one is sure that those effects are greater than the positive effects on the revenue from other taxes - income tax, excise duties, VAT etc. Given that there is an extensive literature on the welfare effects of these taxes, we see no reason to make this supposition.

Second, there is the specific question in this instance as to whether increases in tobacco taxes really do make smokers worse off at all. By this we do not mean that they might be made better off because they end up healthier. Rather, there is evidence that smokers and potential smokers see increased taxes, or in this case increased enforcement, as welfare-enhancing in their own right.

In the standard economic model, consumers make rational decisions, and taxes which alter their behaviour are welfare-reducing. This model has been extended to account for addictive behaviour,[26] but recent work in economics gives strong reasons for rejecting the standard model outright when it comes to addictive products. Jonathan Gruber and co-authors[27] have pointed out the many flaws in the standard model, and indeed find evidence that smokers and potential smokers actually value higher taxes as devices to increase their own commitment to give up. Decisions over consumption of addictive products are not made rationally, and it is wrong to apply the standard rational choice model when calculating the costs and benefits of policies which involve these products.

In sum, interactions with other parts of the tax system make it unclear that increased taxes on smokers reduce economic welfare overall - they may well *actually increase it* (even ignoring actual health and other benefits). We conclude that the most appropriate, and indeed conservative, assumption to make is that the net immediate welfare impact from increased taxes on tobacco is zero.

The impacts on health

The reduction in smoking prevalence arising as a result of an increase in the price of tobacco is associated with:

- A decrease in the number of people developing smoking-related diseases; and
- A decrease in mortality.

This is because ex-smokers and non-smokers have lower risks of developing smoking-related diseases. As more people stop smoking (or do not start smoking) due to the protocol, fewer will develop smoking-related diseases and/or die prematurely.

26 See for example Becker G and Murphy K (1988) "A theory of rational addiction" *Journal of Political Economy* 96: 675-700
27 Gruber J and Koszegi B (2004) "Tax incidence when individuals are time-inconsistent: the case of cigarette excise taxes" *Journal of Public Economics* 88:9-10, 1959-1988

Below, we review existing evidence on (i) relative risks of developing smoking-related diseses for ex-smokers by time since smoking cessation and (ii) mortality rates for smokers and ex-smokers by age.

Evolution of relative risks for ex-smokers over time

When people stop smoking, their relative risk of developing smoking-related diseases (compared to smokers) does not fall instantaneously, but declines gradually. Some risks fall faster, and others slower.[28] For example, there is evidence of a small more-or-less instantaneous decline in the risks of acute myocardial infarction and stroke following smoking cessation.[29] Following this initial decline, the risks of stroke and coronary heart disease fall gradually to the same level as for non-smokers within 5 and 15 years[30] (respectively). The risk of developing lung cancer falls dramatically, but remains positive even 25 years after the last cigarette.[31]

There is a huge and complex literature that analyses relative risks by disease. However, it is also possible to analyse the problem at a more aggregated level. Following Naidoo et al (2000)[32] we assume that the aggregated risk declines by 2 percentage points instantaneously for ex-smokers compared with people who carry on smoking. For the rest of the risk profile we follow the approach adopted in Rasmussen et al (2005)[33] and assume that the aggregated risk declines linearly for 15 years and stabilises afterwards.

There seems to be a consensus that "after 10 to 15 years of abstinence, risk of all–cause *mortality* returns nearly to that of persons who never smoked".[34] The relative risk of *morbidity* (ill health), however, may remain positive even 15 years after cessation.

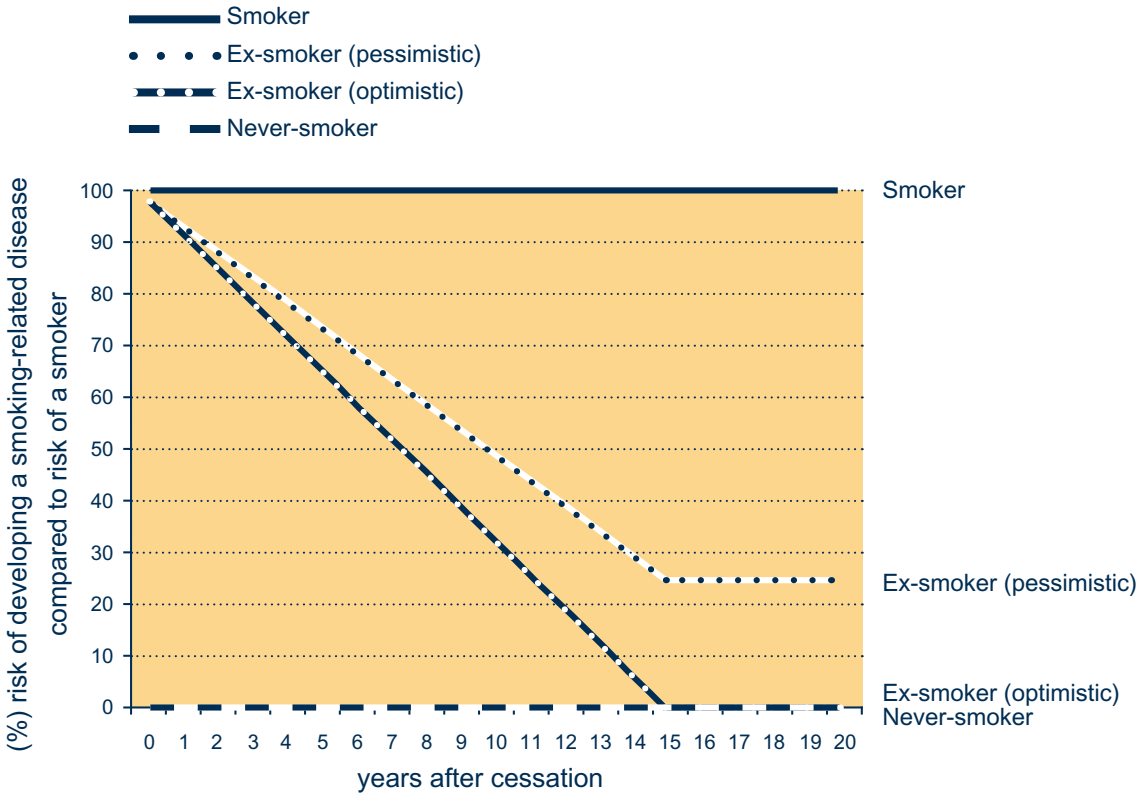
This report considers two possibilities for the aggregate risk evolution (shown in Figure 3 overleaf):

- **Low risk** - the risk declines from 98% of the risk for smokers linearly over 15 years to that of non-smokers, i.e. no additional risk after 15 years; and
- **High risk** - the risk declines from 98% linearly over 15 years but remains 25% higher than for non-smokers.

In each case, the risks are normalised to 100% for smokers and 0% for non-smokers. Chapters 4 and 5 present a set of results which uses an average across both sets of assumptions to give our central scenario. Annex 2 presents separate results for the pessimistic and optimistic risk scenarios.

28 "The health consequences of smoking: a report of the Surgeon-General" (2004), US Department of Health and Human Services.
29 Naidoo, B et al (2000) "Modelling the short term consequences of smoking cessation in England on the hospitalisation rates for acute myocardial infarction and stroke" *Tobacco Control* 9: 397-400
30 See for example Hurley S (2005) "Short-term impact of smoking cessation on myocardial infarction and stroke hospitalisations and costs in Australia" MJA 183 (1): 13-17
31 Peto R, Darby S, Deo H, Silcocks P, Whiteley E and Doll R (2000) "Smoking, smoking cessation and lung cancer in the UK since 1950: combination of national statistics with two case-control studies", BMJ 321: 323-329
32 Op cit.
33 Rasmussen A, Prescott E, Sorensen T and Sogaard J (2005) "The total lifetime health cost savings of smoking cessation to society" European Journal of Public Health 15(6): 601-660
34 "The health benefits of smoking cessation: a report of the Surgeon General" (1990) US Department of Health and Human Services

Figure 3. Scenarios of risk evolution for ex-smokers



Source: author's assumptions

These risk profiles suggest that the benefits of the increase in tobacco taxation (e.g. NHS savings) are likely to increase gradually over time. In the first few years, the relative risks for ex-smokers are still high and the corresponding health benefits are low. However, as the risks fall, we would expect the benefits to increase.

Mortality by age and smoking status

In order to estimate the number of deaths averted as a result of the reduction in smoking prevalence caused by the increase in tobacco taxation (if these people are younger than 60 and are still working) we rely on age-adjusted mortality figures for smokers and ex-smokers estimated by Doll et al (1994) (presented in Table 2 below). These figures are used by the National Institute for Health and Clinical Excellence (NICE) and in other smoking-related research.[35]

These mortality figures allow us to estimate the number of annual smoking-related deaths which will occur as a result of smoking prevalence rates in 2007 (for both smokers and former smokers).[36] This is lower than the current annual UK mortality rates from smoking as there is a lag of up to 15 to 20 years between tobacco consumption and mortality, and mortality is currently declining because of falling tobacco consumption over the past 20 years.

35 See for example Raikou M, McGuire A (2008) "Cost-effectiveness of a mass media campaign and a point of sale intervention to prevent the uptake of smoking in children and young people: Economic modelling report." LSE Health, London School of Economics and Political Science.

36 We adjust the numbers of dead to account for the fact that some deaths among smokers and former smokers may be caused by non-smoking related reasons. This is done by applying relevant non-smoker mortality rates.

Table 2. Mortality by age and smoking status per 1,000 people

Age	Current smoker	Ex-smoker	Never smoked
35-44	2.8	2.0	1.6
45-54	8.1	4.9	4.0
55-64	20.3	13.4	9.5
65-74	47.0	31.6	23.7
75-84	106.0	77.3	67.4
85+	218.7	179.7	168.6

Source: NICE, from Doll et al (1994)

Given that the protocol is expected to reduce the number of smokers and increase the number of ex-smokers and non-smokers, the number of smoking-related deaths is expected to decline.

Treatment of end-of-life healthcare costs

Sometimes it is argued that in cost benefit analyses of policies which result in a reduction in the number of premature deaths in the population (such as the tobacco tax increase analysed here, or other policies aimed at reducing the prevalence of smoking, such as tougher tobacco regulations), the additional end-of-life healthcare costs incurred by the people who live longer should be taken into account. In our view it would be a mistake to include these costs in the CBA, because there is a fundamental methodological flaw in this approach.

Taken to its logical conclusion, the inclusion of end-of-life healthcare costs in CBAs of this type would lead to the perverse conclusion that policies which result in larger numbers of premature deaths in the population have a positive benefit to society because they reduce healthcare expenditure on elderly people.

The health impact evaluation literature in medicine and epidemiology, which uses very similar techniques to those employed in this report, has already taken this insight on board. Evaluations of healthcare interventions, such as new drugs or other treatments, do not generally include the medical costs of people living longer as an addition to costs for obvious reasons: one of the key objectives of advances in medical care is to increase life expectancy in the population.

For these reasons, we have not included end-of-life healthcare costs in the CBA. (In section 3.4 overleaf we examine the arguments for and against including them in the PFA.)

3.3 IMPACTS INCLUDED IN THE COST BENEFIT ANALYSIS

The CBA includes the following set of potential benefits resulting from a reduction in smoking:

- **Savings to the National Health Service** - in 2006, £2.7 billion was spent by the NHS on treatment of smoking-related diseases in England.[37] The equivalent figure in Wales (2007) was around £400 million.[38] As the risk of developing smoking-related diseases falls (due to lower smoking prevalence and decreasing risks for ex-smokers), so would the costs of treatment.
- **Output gains due to reduced mortality** - the fact that people live longer implies that they will have a higher probability of surviving and being in work until the average age of retirement. Therefore, a reduction in smoking prevalence would result in output gains due to reduced mortality.
- **Output gains due to reduction in absenteeism** - there is evidence that smokers are more prone to absenteeism from work than non-smokers.[39] As more people stop smoking, their output would increase due to reduced absenteeism.
- **Years of life gained** - the fact that people live longer (healthier) lives is in itself a benefit for these individuals and society as a whole. The Department for Transport has calculated that in 2005, the 'human value' of prevention of a fatality was just under £1 million. We use this estimate (which is also used by other government departments including the Department of Health) to calculate the value of extra years of life to people who give up smoking (or never take up smoking) because of the tobacco price increase.

We express all four categories of benefits in monetary terms. Technical details of the procedures involved are given in Annex 1.

3.4 ADDITIONAL ASSUMPTIONS UNDERLYING THE PUBLIC FINANCES ANALYSIS

This section explores additional assumptions that are specific to the PFA rather than the CBA.

Treatment of tax revenue and benefit expenditure

Whereas changes in tax revenues and benefit expenditure are not included in the CBA, they most definitely are included in the PFA. Details of how these effects are calculated are given in Section 3.5.

37 ASH (2008) "Beyond smoking kills: Protecting children, reducing inequalities". Note that Allender *et al* ("The burden of smoking-related ill health in the United Kingdom, Tobacco Control online, 2009) states a higher figure (£4.4 billion). We consider the ASH data to be more accurate as it uses more recent data sources.

38 Phillips C and Bloodworth A (2009), "Cost of Smoking to the NHS in Wales", ASH Wales/ BHF Cymru.

39 According to NICE statistics, smokers spend more time off sick compared to non-smokers (33 extra hours per year). http://www.nice.org.uk/nicemedia/pdf/PHI5SimplifiedBusinessCase.htm Note that McGuire et al (2009) "An economic analysis of the costs of employee smoking borne by employers, LSE, use a lower figure (1.77 days), which represents an average across a number of estimates (some of which are not UK specific). We consider the NICE estimates to be more reliable as they are UK-specific.

Time horizon for modelling the public finance effects

For the PFA, we have decided to present the results over a five year period from 2010 to 2014 (i.e . the potential length of the next parliament) rather than doing a net present value analysis over a 50-year time period (as shown in the CBA). This is for two reasons. First, public finance issues are a particular concern for governments in the short term. It is most important for them to know what the effect of policy changes on revenue and spending in the next few years will be. The longer-term effects of policy decisions are of less immediate usefulness (although obviously still interesting).

Second, there is huge uncertainty regarding the long-term effect of some of the components which would have to be included in a public finances analysis over a fifty-year time horizon. This is most obviously the case with end-of-life healthcare costs, which we decided not to include in the CBA on methodological grounds (see Section 3.2). Ideally they would be included in a longer-run public finances analysis because it is likely that some of the healthcare costs of people who survive into old age as a result of the reduction in smoking induced by the tobacco tax increase will be borne by the NHS (e.g. hospital and drug treatment costs) and local authorities (e.g. personal and residential care costs for people who meet the means test criteria).[40]

However, there are substantial methodological problems with including end-of-life healthcare costs in a PFA:

- **Lack of data on overall end-of-life costs.** There is relatively little good-quality research on end-of-life healthcare costs to the NHS in the UK. The National Audit Office's 2008 report on end-of-life care services in the UK[41] included some analysis commissioned from RAND Corporation which estimated that the annual cost to NHS and social care services of providing care to cancer patients in the 12 months prior to death (27 percent of overall deaths) was £1.8 billion. However, comparable costs for other forms of death are not available. This makes it difficult to estimate the impact of increased survival into old age on end-of-life care costs with any reliability.
- **Technological uncertainties.** In terms of the time path of the impacts measured in our PFA, much of the additional costs of end-of-life care are likely to be incurred in the 2030s, 2040s and 2050s as people whose deaths are averted in working age through giving up smoking survive into old age. It is very hard to predict how the technologies available for treating many end-of-life conditions will have improved 20, 30 or 40 years into the future - and what they will cost. Obviously there are a whole range of uncertainties regarding healthcare costs this far into the future but projection end-of-life costs seems particularly problematic. This is also an issue for modelling the costs of state spending on elderly people through the benefit system (e.g. state pensions costs).

40 Currently, these criteria depend on where you live in the UK. In England, Wales and Northern Ireland, residential care for old people is means-tested dependent on assets (including housing wealth) but in Scotland it is not means-tested.
41 National Audit Office (2008), "End of Life Care". London: The Stationery Office.

- **Policy uncertainties.** The government has been reasonably clear about how the level of the State Pension and Pension Credit, and the state pension age, will evolve for the next 30 or 40 years - and there is a reasonable level of cross-party support for the reforms it has made to the pensions system. But there is much less consensus about how the division of the burden of end-of-life healthcare costs should be shared between the state and the individual in future decades. For example, Scotland provides free long-term residential care, whereas England does not. On one hand It is possible that the balance of responsibility for end-of-life costs might shift towards the individual in future decades (for example through increased use of means-testing). On the other hand, there may be a trend towards increased socialisation of long-term care in England. It is very hard to predict how the balance between tax funding and user charges (or insurance payments) for end-of-life care will change in future decades.

We have decided not to include end-of-life healthcare costs in the PFA - because of the methodological problems explained above, and also because these costs are likely to be small in the short run (due to the lag between people giving up smoking, or never taking up smoking, and thus not dying early, and those same people needing end-of-life care, which will be decades into the future in many cases).

3.5 IMPACTS INCLUDED IN THE PUBLIC FINANCES ANALYSIS

The public finances analysis (PFA) includes estimates of the following impacts of the tobacco tax increase on the public finances:

- **Increased revenue from tobacco taxation** - calculation of the revenue effects from tax on tobacco products is relatively straightforward - they will depend on the price elasticity of demand for tobacco. (Note that for this particular calculation, we use the overall price elasticity rather than the prevalence elasticity; in our central scenario, the overall price elasticity is assumed to be -0.5). As all our price elasticity estimates are between zero and -1, an increase in the price of tobacco products always leads to an increase in revenue. (If the price elasticity was less than -1 (e.g. -1.5), then an increase in the tax rate would lead to a decrease in revenue from tax).
- **Savings to the National Health Service** - these are calculated in exactly the same way as for the CBA above.
- **Increased tax receipts from additional years of working life** - these are calculated using the results for 'output gains due to reduced mortality' from the CBA above. People of working age whose deaths are averted due to the tobacco tax increase will have longer working lives, and hence will pay more in income tax and National Insurance Contributions (NICs) to the Exchequer. They will also use at least some of their take-home pay to purchase goods that are subject to VAT, and hence will contribute increased VAT to the public purse as well.

- **Increased tax receipts from reduced absenteeism** - just as the extra output from reduced mortality leads to increased income tax, NICs and VAT receipts, so does the extra output from reduced absenteeism among people who stop smoking (or never take up smoking) as a result of the tobacco tax increase.
- **Reduced spending on benefits related to sickness and disability** - smoking is associated with increased morbidity (ill-health) in the population as well as increased mortality. Expenditure on benefits for people of working age with long-standing health conditions (such as Employment and Support Allowance and Disability Living Allowance) accounted for around £18bn of government spending in the fiscal year 2007-08. We estimate the reduction in benefit spending which would result from a reduction in the number of smokers in the UK population caused by the tax increase.
- **Increased spending on benefits for retired people** - increased longevity as a result of reductions in smoking prevalence in the population does lead to some increased costs to the public purse in the five year period we look at, because the number of pensioners increases slightly.[42] We model the increased spending on state benefits for people aged over 65 - the Basic State Pension, State Second Pension, and Pension Credit - which results from reduced mortality.

As for the CBA, technical details of the procedures involved are given in Annex 1.

42 In the longer run, the issue of uncertainty regarding technological advances which, as explained in Section 3.4, is one of the factors making long-run estimation of end-of-life healthcare costs problematic, also makes estimation of state spending on benefits for pensioners problematic - but over the much shorter time horizon of the next five years, technology is much less of an issue.

CHAPTER 4

RESULTS

4.1 COST BENEFIT ANALYSIS

The results from the CBA use our central assumption on the size of the prevalence elasticity for tobacco products (-0.35). and an average between the 'pessimistic' and 'optimistic' profiles for the relative risks of smoking related health conditions for ex-smokers compared with non-smokers (as explained in section 3.2). Table 3 gives the Net Present Value of the benefits arising from the increase of 5% in the price of cigarettes and other tobacco products, and the individual (non-discounted) revenue streams from 2010 to 2014 (assuming that the policy is implemented at the beginning of 2010).

Table 3. Results from CBA of 5% increase in tobacco prices: central scenario

All figures in £m, 2010 prices

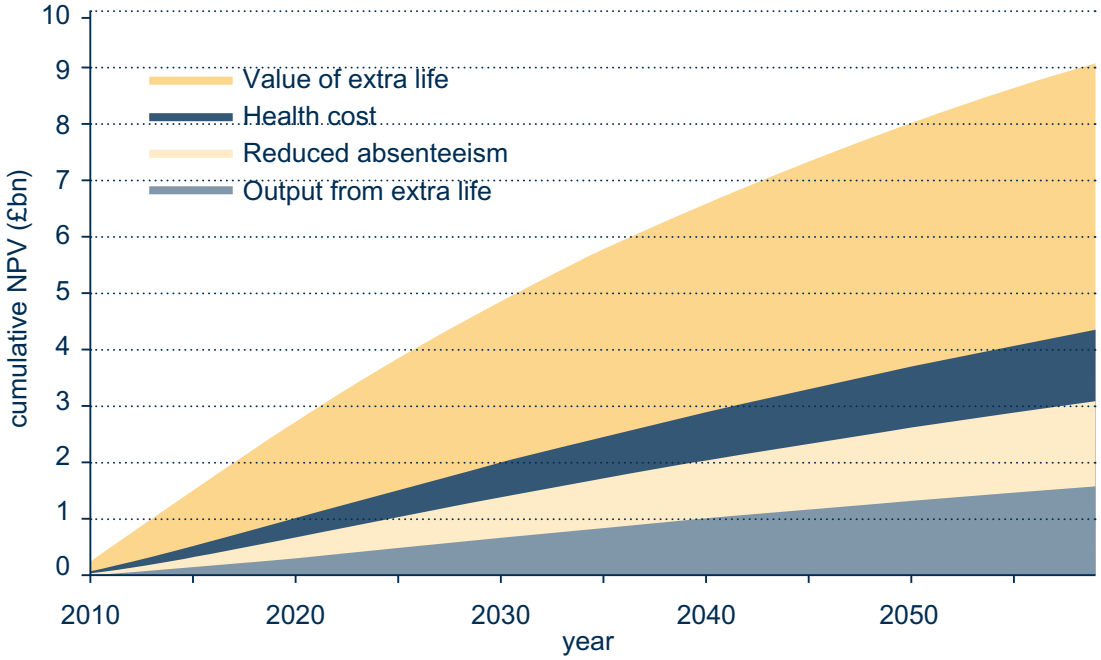
		Individual years				
Cost/benefit	**Overall NPV**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
NHS cost savings	1,968	23.3	25.3	27.3	29.5	31.7
Output - reduced absenteeism	1,364	22.7	25.9	29.9	34.3	38.5
Output from extra working life	1,146	33.3	34.1	34.7	35.4	36.2
Value of extra life	5,746	178.6	179.9	180.3	181.0	182.1
TOTAL	**10,225**	**257.9**	**265.2**	**272.3**	**280.1**	**288.5**

The results show substantial overall benefits from the tobacco tax increase. Roughly speaking, just over half of the benefits are accounted for by the increased value of extra life (i.e. the value to the individuals themselves rather than the extra output), with the rest accounted for by NHS cost savings, the value of the output resulting from reduced absenteeism, and the value of the output resulting from extra years of working life.

Overall, the NPV adds up to around £10.2 billion – a substantial benefit. The benefits in individual years begin at around £258m for 2010 and increase to £288 million by 2014. This increase is driven mainly by increased NHS cost savings and the extra output from reduced absenteeism.

Figure 4 shows how the (discounted) benefits arising from the tax increase add up over the years 2010 to 2059. The overall size of the total benefits increases more slowly in the 2040s and 2050s than in the 2020s and 2030s because of the 3.5% discount rate.

Figure 4. Cumulative discounted benefits from tax increase, £billion, 2010-2059 (central scenario)



How robust are these results? Table A6 in Annex 2 at the end of this report shows that the estimated NPVs of the cost benefit analysis are reasonably sensitive to the assumptions used. Using pessimistic assumptions about the health risks to ex-smokers, the NPV of the overall benefits ranges from £7.1bn (assuming a 'low' prevalence elasticity of -0.2) to £15.3bn (assuming a 'high' prevalence elasticity of -0.54). Using optimistic health risk assumptions, the estimated NPV of overall benefits is slightly higher, ranging from £7.5bn to £16.2bn depending on which prevalence elasticity is used.

Annex 3 gives a breakdown of the results by country in the UK. The figures for the breakdown of the Net Present Value arising from the tobacco tax increase (in Table A8) suggest that around 8.45bn (83%) of the NPV accrues to England, with £590m (6%) accruing to Wales, £882m (9%) to Scotland and £300m (3%) to Northern Ireland.

4.2 PUBLIC FINANCES ANALYSIS

As with the CBA, the results for the PFA assume a prevalence elasticity for tobacco products of -0.35. Again we present a central scenario with a prevalence elasticity for tobacco of -0.35 and an average risk profile for ex-smokers compared with people who have never smoked. Table 4 gives the effects of the increase in tobacco taxation of government revenue for the fiscal years 2010-11, 2011-12, 2012-13, 2013-14 and 2014-15, as well as an average over the five years. Increases in government revenue or reduced public spending arising from the tobacco tax increase produce positive net revenue effects in the table, whereas reductions in tax revenue or increased public spending produce negative revenue effects.

Table 4. Results from PFA of 5% increase in tobacco prices: central scenario

All figures in £m, 2010 prices
Positive numbers = net revenue gain, negative numbers = net revenue loss

	Individual years					
Cost/benefit	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Average**
Increased tobacco taxation	427.4	430.6	433.7	436.9	439.9	433.7
NHS cost savings	23.5	24.2	27.6	29.7	31.9	27.4
Income Tax/NICs/VAT - extra working life	14.2	14.6	14.9	15.3	15.7	14.9
Income Tax/NICs/VAT - reduced absenteeism	12.6	14.4	16.5	18.8	21.0	16.7
Reduced disability benefits	33.0	33.1	33.3	33.4	33.5	33.3
Increased pensioner benefits	-3.3	-3.4	-3.5	-3.7	-3.9	-3.6
TOTAL	**507.0**	**514.4**	**522.1**	**530.3**	**537.8**	**522.2**

The analysis of government revenue effects suggests that increased revenue from tobacco taxation accounts for the majority of the increase in net revenues – around 83% of the total average revenue per year of just over £500 million. Reduced spending on Employment and Support Allowance and Disability Living Allowance is the next biggest single item of revenue gain at just over £30m per year. Savings in NHS costs contribute about £27m per year on average. Increased income tax, NICs and VAT from extra working life and reduced absenteeism both contribute smaller net revenues of around £15m and £17m respectively on average. Increased spending on pensioners is a relatively minor item in these five years at around £4m on average.

The robustness of the estimated public finance results is analysed in Table A7 in Annex 2. Whereas for the CBA, the size of the assumed (prevalence) elasticity of demand for tobacco was positively correlated with the size of the effects (i.e. the estimates under a 'high' elasticity assumption were bigger than the estimates under a 'low' elasticity assumption), in the PFA the net revenue gains are lower in the high elasticity scenario than the other two scenarios. This is because a more elastic demand for tobacco lowers the revenue from a tobacco price increase, and this effect outweighs the positive effect of a higher tobacco prevalance elasticity on the other public finance impacts. Overall there is less variation in the estimated impacts from the public finances analysis than those from the cost benefit analysis; the estimated average revenue gains range from £440m per year to £560m per year depending on which set of assumptions about ex-smokers' health risks and the elasticity of demand for tobacco products are used.

The split of the net benefits to the public finances between countries in the UK (shown in Table A9) is similar, in terms of proportions of net benefit accounted for by each country, to the split in the Net Present Values of the CBA shown in Table A8, although it is important to stress that out of the elements considered in the PFA, only NHS spending is handled by the devolved administrations; tax and National Insurance revenues, and benefit spending, are all competencies of central government.[43]

43 The Scottish Administration does have the constitutional power to vary a higher rate of income tax but so far it has not chosen to exercise this power and income tax remains at a uniform rate throughout the UK.

CHAPTER 5

SUMMARY AND CONCLUSIONS

This report has assessed the likely benefits from, and the effects on the public finances of, an increase in tobacco taxation which would cause the retail price of tobacco products to rise by 5% in real terms. We find that, using the most plausible estimates for the responsiveness of tobacco consumption and smoking behaviour to price increases, a tobacco price rise of 5% results in net benefits to the economy as a whole of around £10.2bn (measured as a net present value of the stream of benefits over 50 years). The economic benefits in the first five years of the policy are around £270m per year on average. Just over half of these gains are accounted for by the 'human value' of the deaths averted through a reduction in the number of smokers in the UK population. The rest of the gains are split between the value of the increased economic output resulting from fewer working-age deaths, reduced absenteeism from work, and lower NHS costs as a result of the tax increase.

Our analysis of the public finance effects of the policy suggest a net revenue gain of around £520m per year in the first five years on average. Just over four-fifths of this gain is due to the direct effects of increased revenue from tobacco taxation itself, but increased revenue from other taxes, reduced benefit spending and reduced NHS costs all have a positive impact on net revenues in addition to this.

In short, the analysis in this report demonstrates that raising the level of tobacco taxation would have signficant benefits to the UK economy as a whole, and to the public finances, that go well beyond the direct impact on the tax revenue from tobacco products (important as that is from a public finance perspective). If individual tax changes were subject to an Impact Assessment (IA) in the same way as new regulations and changes to existing regulations currently are, the IA for the policy option of 'increased tobacco taxation' would be strongly positive in terms of benefits compared with costs.

ANNEX 1: TECHNICAL DETAILS OF MODELLING OF COSTS AND BENEFITS

This annex provides details of how we model the costs and benefits used in the CBA and PFA. Much of the CBA methodology in particular, is a modified and extended version of the model and methods used in a previous report for ASH by Johnson (2009).[44]

Modelling the impact on healthcare costs

Recent studies of the costs of smoking to the NHS estimate that smoking cost the NHS in England £2.7bn in 2006, and the NHS in Wales £386m in 2007. Ninety-three percent of the costs for England are accounted for by cancer, circulatory disease and respiratory disease.

In the absence of comparable studies of the costs of smoking to the NHS in Scotland and Northern Ireland, these NHS cost figures are uprated to the UK level using information from National Statistics on the relative population of Scotland and Northern Ireland compared with England and Wales,[45] combined with data from a recent study for the Nuffield Foundation on the overall cost per capita of NHS treatment in the 4 countries of the UK.[46] (These calculations of the relative costs of smoking in each country are also used to apportion the overall savings in NHS costs to each country in Annex 3, which breaks down the results by country).

We analyse the yearly evolution of the NHS costs with and without the protocol and compute the NPV of the healthcare savings due to the protocol's implementation.

To do so, we first split the population into different categories based on their smoking status. More specifically, we use the GHS data on smoking prevalence over time and split the population of ex-smokers into 15 categories according to the number of elapsed years since they stopped smoking (from 1 to 15 or more). Table A1 presents this split for 2007.

Using our two risk scenarios (see Figure 11), we allocate the total healthcare cost to each group. The cost for non-smokers is zero as their relative risk of developing smoking-related diseases is assumed to be zero.[47]

The increase in the price of tobacco products resulting from the tax increase means that the number of smokers is reduced (the exact magnitude of the reduction depends on the assumptions we make about the prevalence elasticity of demand for tobacco products. For example, assuming a prevalence elasticity of -0.35 means that the proportion of smokers in the population reduces from 21% to (21 – (0.21 ×(0.35 × 5))) = 20.63% of adults in response to a price increase of 5%.). Therefore, over time some people 'migrate' from the 'current smoker' category to the ex-smoker category Year 1, then Year 2 and so on. The non-smoker group also evolves (as some people who would have become future smokers in the absence of the price increase do not in fact take up smoking).[48]

44 Johnson P (2009) "Cost Benefit Analysis of the FCTC Protocol on Illicit Trade in Tobacco Products".
45 ONS (2009) "2008-based National Population Projections".
46 Connolly S, Bevan G and Mays N (2010), "Funding and performance of healthcare systems in the four countries of the UK before and after devolution" Nuffield Foundation. The comparative NHS costs per capita are: England - £1,520; Scotland - £1,750; Wales - £1,650; N Ireland - £1,670.
47 In reality, non-smokers' risk may be positive due to passive smoking.
48 This evolution is based on the underlying prevalence elasticities.

Table A1. Split of the population in 2007 by smoking status

Smoking	Smoking category Share (%)
Current smoker	21.00
ex-smoker year 1	1.50
ex-smoker year 2	2.50
ex-smoker year 3	1.50
ex-smoker year 4	0.50
ex-smoker year 5	1.50
ex-smoker year 6	0.50
ex-smoker year 7	1.00
ex-smoker year 8	1.00
ex-smoker year 9	1.00
ex-smoker year 10	0.25
ex-smoker year 11	0.25
ex-smoker year 12	0.25
ex-smoker year 13	0.25
ex-smoker year 14	1.25
ex-smoker year 15+	11.25
Non smoker	54.00
TOTAL	100.00

Source: NICE, from Doll et al (1994)

Based on a total working age population of around 50.2 million (in 2009)[49], a reduction from an overall smoking prevalence of 21% to 20.63% would represent a reduction of around 190,000 in the total number of people in the UK who smoke.

Our model assumes that half of the reduction in smoking induced by a tobacco price increase is brought about by existing smokers quitting, and the other half is due to people who otherwise would have smoked never starting. Applied to the population demographic in 2010, this would imply that 95,000 smokers quit and there are 95,000 extra people who never start smoking. Tables A10 and A 11 in Annex 4 present some results from a sensitivity analysis where we vary the proportions of ex-smokers from 25% to 75% (and conversely, the proportions of people who never take up smoking from 75% to 25%). This makes relatively little difference to the overall results.

As the population split evolves, so does the corresponding healthcare cost. Given that the ex-smokers and non-smokers are less likely to develop smoking-related diseases, the overall healthcare cost is expected to fall.

49 ONS (2009) "2008-based National Population Projections".

Modelling output gains due to reduced mortality

Our starting point is the number of deaths (by age) in England and Wales in 2007.[50] Using the smoking prevalence figures (based on the GHS) and the mortality rates by age for smokers, ex-smokers and non-smokers (as presented in Table 2), we estimate the number of smoking-related deaths for smokers and ex-smokers by age (Table A2).

Table A2. Number of smoking-related deaths by age

Age	Number of deaths elasticity	Number of deaths elasticity
35-44	1,462	467
45-54	3,785	796
55-64	7,982	4,255
65-74	7,706	8,709
75-84	9,752	8,337
85+	5,865	4,332

Source: Own estimates.

We then model the evolution of the population over time due to the tobacco tax increase, i.e. a decline in the number of smokers and an increase in the number of ex-smokers and non-smokers (as in the previous model). This allows us to estimate the number of averted deaths (for each age group).

Assuming that 60 is the average age of retirement, we calculate the number of 'productive' years gained (for 'survivors' who are younger than 60)[51] and the corresponding increase in output (in NPV terms) using the average annual wage in the UK (£24,538 in 2008)[52] as a proxy for output[53] and assuming that the employment rate of the survivors equals the average working age employment rate in the UK.[54] When doing so, we adjust the number of 'survivors', taking into account the probability of dying from non-smoking related causes.

Modelling the value of extra years of life

As we have estimated the number of averted deaths as a result of the tobacco tax increase for each age group, this can easily be translated into a figure for the value of extra years of life to the people whose death is averted by their decision to give up smoking, or not to start - i.e. the value of life in itself, over and above the increased output resulting from extra years of working life. There is a substantial academic literature which attempts to estimate the value of a statistical life.[55] Government departments and agencies including NICE use the Department for Transport's 2005 estimate of the 'human value of prevention of a fatality'.[56]

50 "Mortality statistics – deaths registered in 2007" ONS http://www.statistics.gov.uk/STATBASE/Expodata/Spreadsheets/D9543.xls
51 For example, for someone aged 40, who is predicted to survive as a result of the Protocol, there will be 20 years of productive life gained.
52 National Statistics – Table 2.1a weekly pay – Gross (£) for all employee jobs: United Kingdom, 2008
53 One potential criticism of this methodology might be that it overstates the potential gains from reductions in smoking, because smokers have lower wages than the population for a whole. Analysis using the 2006 GHS (the most recent available microdata containing information on both smoking behaviour and earnings) shows that weekly average earnings for smokers are indeed around 11% lower than for the population as a whole. However, weekly average earnings for ex-smokers are not significantly different from average earnings for the population as a whole. Hence we feel justified in using the overall average wage measure in our calculations.
54 We take 74.5% - the working age employment rate in the UK in autumn 2007 – as a good measure of the 'long-run' likely average employment rate in the future. Employment rates fell a few percentage points below this in 2008 and 2009 due to the economic recession but are likely to rise again once the recession ends.
55 See for example Viscusi K and Aldy J (2003) "The value of a statistical life: a critical review of market estimates throughout the world" Journal of Risk and Uncertainty 27:1, 5-76 for a comprehensive review of the literature.
56 DfT (2007) Highway Economics Note No 1, "2005 Valuation of the Benefits of Prevention of Road Accidents and Casualties" http://www.dft.gov.uk/pgr/roadsafety/ea/pdfeconnote105.pdf

Uprating this estimate to 2010 prices to take account of inflation gives an average value for each extra life saved of £1,033,000. This estimate is entirely separate from DfT's calculation of the value of lost output or tax revenue resulting from a fatality, and so is the correct estimate to use for our purposes. This estimate can be converted to a value for each individual extra year of life using research previously carried out for NICE of how many individual healthy years each live saved corresponds to on average (around 27).[57] This results in a value for each life-year of approximately £36,000, which is what we use in the CBA.

Modelling output gains due to reduced absenteeism

NICE estimates that "a person who smokes will have 33 hours off sick more per year than a non-smoker".[58] We assume that for ex-smokers this number does not fall to zero as soon as they stop smoking, but changes gradually according to the relative risks of developing a smoking-related illness (as shown in Figure 3).

Using the 2007 population split shown in Table A1, we calculate the output lost due to smokers and ex-smokers taking time off sick in 2007. This is done by multiplying 33 hours by the average hourly wage and by the number of smokers and ex-smokers (adjusting for relative risks).[59]

The dynamics of the model are similar to the one that estimates the healthcare savings.

Modelling changes in revenue from tobacco taxation

The change in revenue arising from a 5% increase in tobacco taxation can be calculated if we know the current revenue from tobacco taxation, given an assumption about the price elasticity of demand for tobacco. HMRC estimates that revenue from tobacco excise duties will be approximately £8.8 billion in 2009-10.[60] This implies that VAT receipts from tobacco are approximately £1.8 billion.

For this calculation only, we need to use the overall price elasticity estimate for tobacco rather than the prevalence elasticity. Table A3 shows the prevalence and price elasticities used in each of the scenarios presented in this report (the central scenario in the main report and the upper and lower bound scenarios in Annex 2).

Table A3. Elasticity assumptions

Scenario	Assumed prevalence elasticity	Assumed price elasticity
Lower bound	-0.25	-0.4
Central	**-0.35**	**-0.5**
Upper bound	-0.54	-0.72

57 Mason H, Marshall A, Jones-Lee M and Donaldson C. "Estimating a monetary value of a QALY from existing UK values of prevented fatalities and serious injuries". SVQ (Social Value of a QALY) Research Team, National Institute for Health Research. http://www.hta.ac.uk/nihrmethodology/reports/1569.pdf

58 http://www.nice.org.uk/media/pdf/PHI5SimplifiedBusinessCase.htm

59 Note that this method of working out the output gains assumes that there is a straightforward relation between extra hours worked by the ex-smokers whose absenteeism is reduced, and extra productivity. This is the standard assumption based on 'human capital' theory used in most of the economics literature. However, alternative methods based on "friction costs", which measure the extent to which replacement staff (who would otherwise be unemployed or underemployed) can be used to cover for absent staff, tend to produce lower estimates of costs relating to absenteeism. See Koopmanschap M, Rutten F, van Ineveld B, van Roijen L. (1995) " The friction cost method for measuring indirect costs of disease" Journal of Health Economics 14: 171-189

60 See HMRC Annual Statistics Table 1.2, December 2009. Online at http://www.hmrc.gov.uk/stats/tax_receipts/table1-2.pdf

Modelling increased tax receipts from extra years of working life

The additional tax receipts from additional years of working life are modelled by assuming that each additional person who is in work as a result of the tobacco tax increase earns the average wage (£24,058 in 2008, inflated at 2% per year in real terms each subsequent year to reflect aggregate earnings growth in the economy). The additional tax receipts are then worked out as follows:

- **Income tax** receipts are collected using the current (2009/10) tax system (i.e. a personal allowance of £6,475, and then 20% tax above this).
- **National Insurance Contributions (NICs)** are calculated using the annual equivalent values of the employee and employer NICs weekly thresholds and charging 11% employee NICs and 12.8% employer NICs above this.
- **Value Added Tax (VAT)** receipts are calculated by working out 'take-home' pay (i.e. pay minus income tax and employee NICs[61] and then assuming that 80% of this pay is spent on goods subject to VAT, using a VAT rate of 17.5%.

Modelling increased tax receipts from reduced absenteeism

Additional tax receipts from reduced absenteeism are modelled by taking the figure for the increase in gross output arising from the reduction in absenteeism and then assuming that:

- **Income tax** is paid at 20% on the additional gross output;
- **National insurance** is paid at 11% and 12.8% for employer and employee NICs, respectively;
- **VAT** is paid on 80% of the 'take-home' increase in gross output (i.e. after income tax and employee NICs are taken off), at a rate of 17.5%.

Modelling reduced spending on benefits related to sickness and disability

There is little, if any, existing research on the relationship between the incidence of smoking and receipt of sickness and disability-related state benefits in the population. The two main sickness and disability benefits for working age people in the UK are:

- **Employment and Support Allowance (ESA)** – which is paid to people who are unable to work because of a long-term health condition. ESA replaced Incapacity Benefit (IB), the previous benefit for this category of people, in 2008. Expenditure on IB in 2007/08 was around £6.7bn in total.
- **Disability Living Allowance (DLA)** – which provides assistance with costs relating to care and mobility needs for disabled people. Total expenditure on DLA in 2007/08 was around £8.7bn.

The modelling of these costs proceeded in three stages. First, the 2006 General Household Survey was used to estimate the likelihood of working age people being in receipt of each of these benefits using logistic regression of benefit receipt on the following variables:

- Being a current smoker
- Being an ex-smoker (having given up less than 10 years ago)
- Being an ex-smoker (having given up 10 years or more ago)
- Sex

61 Note that employer NICs are not deducted from gross pay to arrive at take-home pay because gross pay does not include employer NICs, which are paid separately by employers.

- Age (in 10 year bands e.g. 25-34, 35-44 etc.)
- The five-point socio-economic category (SEC) of the household
- Marital status
- Standard region

Table A4 shows the relative likelihood of receipt of each benefit for smokers, ex-smokers and non-smokers (the base category), controlling for these other factors.

Table A4. Regression-adjusted relative risks of benefit receipt, GHS, 2006

	Relative likelihood of benefit receipt	
Category	**IB**	**DLA**
Current smoker	2.05	1.70
Ex-smoker (<10 years)	1.45	1.25*
Ex-Smoker (10 years+)	1.30	1.25*
Never smoked (base)	1.00	1.00

Source: author's own calculations on GHS.
*due to small sample sizes, all ex-smokers were combined into one category for the DLA regression.

Next, these relative likelihoods of IB and DLA receipt were used to apportion expenditure on both benefits across current smokers, ex-smokers and people who had never smoked in the base year (2009), and to work out an average level of expenditure on IB and DLA per person in each category.[62]

Finally, the calculations for the evolution of the population split between smokers, ex-smokers and never-smokers between 2010 and 2059 which we made when calculating the health costs were used to estimate the evolution of expenditure on IB and DLA over the next 50 years. Because smokers are more likely to claim either benefit than non-smokers, a higher incidence of smoking in the population means higher estimated benefit expenditure. This means that (as we might expect a *priori)* an increase in tobacco taxation will lead to a reduction in benefit expenditure, through the reduction in smoking prevalence.

Modelling increased spending on benefits for pensioners

The calculations of the number of deaths averted in different age groups (including the over-65s) already carried out for the CBA give us the necessary data on the additional number of pensioners that survive as a result of the reduction in smoking prevalence which the increase in the tobacco price gives rise to. In order to derive an estimate of increased spending on benefits for pensioners, this needs to be combined with information on the average amount paid to each pensioner.

62 IB was replaced by ESA in 2008, but to keep the calculations tractable we assume that the average level of ESA per claimant, and the probability of claiming for any of the three groups in the population (smokers/ex-smokers/never-smokers) is not affected by the transition from IB to ESA.

ONS's *Pension Trends* publication[63] gives figures for the average benefit income (from State Pension and/or Pension Credit) for single and couple pensioners in 2006/07. We combined this with information from the 2007/08 Family Resources Survey on the split of the pensioner population between single men, single women and couples to produce a figure for the average benefit payment *per pensioner*. This calculation is shown in Table A5. (Note that the £97.99 figure in the 'couples' row is *per pensioner*; the combined average figure for pensioner couples is twice this).

Using this figure, we assume that between 2010 and 2012, £109.89 per week is paid to everybody over 65 in the UK.[64] From 2012 onwards, the amount paid per pensioner increases by 2% in real terms per year. This is to reflect the government's stated intention to increase the Basic State Pension and the Pension Credit in line with average earnings rather than prices from 2012 onwards.

An increase in tobacco taxation produces increased pensions costs in this model because the reduction in smoking prevalence mean that fewer people die before reaching pension age.

Table A5. Average State Pension and/or Pension Credit payment to pensioners, 2006/07

Category	Proportion of pensioner population (%)	Average weekly payment per pensioner (£)
Single men	12	132.90
Single women	25	128.85
Couples	63	97.99
Overall	100	£109.89

Correcting the results for changes in the population size and age structure between 2010 and 2059

The size and age structure of the UK population is unlikely to stay the same between 2010 and 2059, but will gradually change due to increases in life expectancy, changes in fertility rates, and migration into and out of the UK. The ONS produces projections for the size of the UK population by age group between 2010 and 2083.[65] We use these to adjust our estimates of the various costs and benefits of the policy change by age band (where information is available) or according to ONS's overall estimates of the change in working-age population (where an age breakdown is inappropriate) to correct the results for projected demographic changes. As the UK population is projected to increase over the next 50 years, this results in a increase in the size of the effects for later years compared with the alternative assumption that population size and structure is constant. The effect is particularly pronounced for pensioners, where increased longevity means that ONS is projecting a large increase in the number of people aged 65 or over in the UK over the next 50 years.

63 ONS (2008), "Pension Trends", ch 12

64 This is a slight simplification as the state pension age for women will rise only gradually from 60 to 65 between 2010 and 2020. On the other hand, the state pension age for both men and women is planned to rise from 65 to 68 between 2024 and 2046. Overall, assuming a constant retirement age of 65 is considerably easier than varying the retirement age year by year, given that our analysis of additional years of life is stratified by 10-year age bands. It is a simplification which makes only a minor difference to the results.

65 ONS (2009), "2008-based National Population Projections". We use the principal (central) projections in this analysis, rather than any of the other variant projections.

ANNEX 2: ALTERNATIVE CALCULATIONS OF CBA AND PFA UNDER DIFFERENT ELASTICITY AND EX-SMOKER HEALTH RISK ASSUMPTIONS

Chapter 4 of the main report gave our results using our central assumptions on the elasticity of smoking prevalence with regard to tobacco price, and the trajectory for the health risks faced by ex-smokers compared with people who have never smoked. This section presents results using our upper and lower bound estimates on the smoking elasticity and the health risks faced by ex-smokers to show how robust the results are to different assumptions.

Table A6 shows the effect of different assumptions on the calculated Net Present Value of benefits from the CBA, while Table A7 shows the effect of different assumptions on the average annual net revenue gain from the policy over the first five years of the policy.

Table A6. NPV of benefits from tobacco tax change under different assumptions

All figures in £m, 2009-10 prices

Risk scenario	Pessimistic			Optimistic		
Elasticity	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
Cost/benefit						
NHS cost savings	1,215	1,680	2,564	1,626	2,256	3,453
Output - reduced absenteeism	970	1,358	2,096	979	1,371	2,115
Output - extra working life	819	1,146	1,768	819	1,146	1,768
Value of extra working life	4,104	5,746	8,866	4,104	5,476	8,866
TOTAL	**7,109**	**9,931**	**15,294**	**7,529**	**10,519**	**16,202**

Notes:
Pessimistic risk scenario assumes that ex-smokers' relative risk of developing smoking-related health conditions declines linearly from 98% to 25% over 15 years, where 100% is average risk faced by ongoing smokers and 0% is average risk faced by those who have never smoked.
Optimistic risk scenario assumes that ex-smokers' relative risk of developing smoking-related health conditions declines linearly from 98% to 0% over 15 years, where 100% is average risk faced by ongoing smokers and 0% is average risk faced by those who have never smoked.
Prevalence smoking elasticities: 'low' = -0.25, 'medium' = -0.35, 'high' = -0.54
Results in Chapter 4 of main text are an average of pessimistic and optimistic risk scenario, and assume medium smoking prevalence elasticity.

Table A7. Average value of net effects on the public finances from tobacco tax change in the first five years of the policy (2010/11-2014/15) under different assumptions

All figures in £m, 2009-10 prices

Risk scenario	Pessimistic			Optimistic		
Elasticity	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
Cost/benefit						
Increased tobacco taxation	491.0	433.7	307.5	491.0	433.7	307.5
NHS cost savings	17.4	24.3	37.6	21.8	30.5	47.0
IT/NICs/VAT - extra working life	10.6	14.9	23.0	10.6	14.9	23.0
IT/NICs/VAT - reduced absenteeism	11.5	16.1	24.9	12.1	17.0	26.2
Reduced disability benefits	23.8	33.3	51.3	23.8	33.3	51.3
Reduced pensioner benefits	-2.5	-3.6	-5.5	-2.5	-3.6	-5.5
TOTAL	**551.8**	**518.8**	**438.8**	**556.8**	**525.7**	**449.5**

Notes:
'Increased tobacco taxation' results use smoking price (not prevalence) elasticity assumptions as follows:
Low = -0.5, medium = -0.5, high = -0.72.
All other risk and elasticity assumptions as for Table A6.

ANNEX 3: RESULTS FOR COUNTRIES WITHIN THE UK

This annex presents results for England, Wales, Scotland and Northern Ireland. The NHS costs are apportioned according to the formulae shown on page 34. Other costs are apportioned according to relative population size of each country. All the results here use the central scenarios as outlined in Chapter 4 of the main report (i.e. tobacco prevalence elasticity = -0.33, tobacco price elasticity = -0.5, average of 'optimistic' and 'pessimistic' health risk scenarios for ex-smokers).

Table A8. NPV of benefits from tobacco tax change for each country

All figures in £m, 2009-10 prices

Country	England	Wales	Scotland	Northern Ireland	United Kingdom
Cost/benefit					
NHS cost savings	1,532	188	187	61	1,968
Output - reduced absenteeism	1,144	66	115	39	1,364
Output - extra working life	961	56	97	33	1,146
Value of extra working life	4,816	280	484	166	5,746
TOTAL	**8,453**	**590**	**882**	**300**	**10,225**

Notes:
Results are an average of pessimistic and optimistic risk scenario, and assume medium smoking prevalence elasticity.

Table A9. Average value of net effects on the public finances from tobacco tax change in the first five years of the policy (2010/11-2014/15) under different assumptions

All figures in £m, 2009-10 prices

Country	England	Wales	Scotland	Northern Ireland	United Kingdom
Cost/benefit	363.5	21.1	36.5	0.0	433.7
Increased tobacco taxation	21.3	2.6	2.6	0.9	27.4
NHS cost savings	12.5	0.7	1.3	0.4	14.9
IT/NICs/VAT - extra working life	13.9	0.8	1.4	0.5	16.6
IT/NICs/VAT - reduced absenteeism	27.9	1.6	2.8	1.0	33.3
Reduced disability benefits	-3.0	-0.2	-0.3	-0.1	-3.6
Reduced pensioner benefits	436.1	26.7	44.3	2.6	522.2
TOTAL	**363.5**	**21.1**	**36.5**	**0.0**	**433.7**

Notes:
Risk and elasticity assumptions as for Table A8.

ANNEX 4. THE EFFECTS OF DIFFERENT ASSUMPTIONS ON HOW THE REDUCTION IN THE NUMBER OF SMOKERS IS ACHIEVED

The results under our central scenarios for the sensitivity of tobacco demand to price suggest that there will be 190,000 fewer smokers in 2010 as a result of the tobacco price increase. Our assumption in the results presented in Chapter 4 of the report is that half (50%) of this reduction will be due to people stopping smoking (i.e. current smokers becoming ex-smokers) and the other half will be due to non-smokers who would have taken up smoking if tobacco prices had not been increased, now not doing so. This annex shows what the effect on the results is if we vary this assumption. We present three scenarios for the composition of the reduction in smoking prevalence of 190,000 people:

1. 25% ex-smokers, 75% non-smokers never taking up smoking;
2. 50% ex-smokers, 50% non-smokers never taking up smoking (the central scenario);
3. 75% ex-smokers, 25% non-smokers never taking up smoking.

It seems reasonable that the true contribution of ex-smokers and never-smokers to the reduction in smoking prevalence will lie somewhere between scenarios 1 and 3.

Tables A10 and A11 show the effect of these assumptions on the results from the CBA and PFA respectively.

Table A10. NPV of benefits from tobacco tax change according to assumption over breakdown of non-smokers into ex-smokers and never-smokers

All figures in £m, 2009-10 prices

Ex-smokers/Never smokers split			
Cost/benefit	**25/75**	**50/50**	**75/25**
NHS cost savings	2,113	1,968	1,823
Output - reduced absenteeism	1,399	1,364	1,330
Output - extra working life	1,239	1,146	1,054
Value of extra working life	6,577	5,746	4,915
TOTAL	**11,328**	**10,225**	**9,123**

Notes:
Results are an average of pessimistic and optimistic risk scenario, and assume medium smoking prevalence elasticity.

Table A10 shows that the lower the proportion of ex-smokers in the total reduction in smoking prevalence, the higher are the overall benefits. However there is not a huge variation in the overall size of the NPV of benefits. Varying the proportion of ex-smokers between 25% and 75% only varies the overall estimated benefits by about 10% either side of the central estimate of £10.2 billion.

Table A11. Average value of net effects on the public finances from tobacco tax change in the first five years of the policy (2010/11-2014/15) under different assumptions about split between ex-smokers and never-smokers

All figures in £m, 2009-10 prices

Ex-smokers/Never smokers split			
Cost/benefit	**25/75**	**50/50**	**75/25**
Increased tobacco taxation	433.7	433.7	433.7
NHS cost savings	36.9	27.4	17.9
IT/NICs/VAT - extra working life	16.1	14.9	13.7
IT/NICs/VAT - reduced absenteeism	20.4	16.6	12.7
Reduced disability benefits	37.3	33.3	29.2
Reduced pensioner benefits	-5.2	-3.6	-2.0
TOTAL	**539.2**	**522.2**	**505.3**

Risk and elasticity assumptions as for Table A8.

Table A11 shows that the results from the PFA are less sensitive to the assumption on how the reduction in smoking prevalence breaks down between ex-smokers and never-smokers than are the results from the CBA. This is because in our model the extra revenue from increased tobacco taxation depends only on the price elasticity of demand for tobacco – which is not affected by the split between ex-smokers and never-smokers. As this item accounts for around 80% of the net public finance benefits it is not suprising that the overall results are less sensitive, varying by only about 3% either way as the proportion of ex-smokers varies between 25% and 75%.

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