Setting the Appropriate Tax on Cigarettes in Ireland

Dave Madden, University College Dublin and
Foundation for Fiscal Studies

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David Madden

(University College Dublin and Foundation for Fiscal Studies)

August 2002

Paper prepared for *Budget Perspectives* Conference.

Abstract: This paper examines the issues involved in setting the appropriate tax on cigarettes in Ireland. It compares Irish tax rates with those in other EU countries and then examines the external costs of cigarette consumption in Ireland. The paper concludes by reviewing some recent evidence that smokers do not fully take on board the internal costs of cigarette consumption which in turn could have major implications for appropriate levels of tax.

Setting the Appropriate Tax on Cigarettes in Ireland[1]

1. Introduction

Tobacco is one of the most heavily taxed commodities in Ireland. The reasons for this include the undoubted negative health effects of tobacco consumption and the relative insensitivity of tobacco consumption to price increases. Most years in the lead-up to the Budget there is some discussion of further increases in taxation. This paper discusses the issues involved in the taxation of tobacco in general and in Ireland in particular. How do current levels of taxation compare with those elsewhere in Europe? What are the economic factors which should be taken into account when determining the appropriate level of taxation for tobacco? How near are current levels of tobacco taxation in Ireland to this optimal level? And consequently should current levels be increased or perhaps decreased?

We will see that while there is a degree of certainty regarding some of the issues involved in determining appropriate taxation levels for tobacco, there are also crucial areas where there is either uncertainty or where complex value judgements must be made. Thus it may not be possible to give definitive answers some of the questions posed above. However the hope is that by focussing attention on these unresolved issues, this paper will advance the debate.

We should also stress that in terms of trying to assess what is the "correct" tax on cigarettes we are concentrating on the perspective from economics. It is clear that other disciplines might come to different conclusions. However, it is hoped that the economist's perspective, with the associated emphasis on efficiency and equity, can offer valuable insights into determining what this tax should be.

The remainder of the paper is laid out as follows: in the next section there is a brief outlining of the different taxes applying to tobacco, as well as a discussion of tobacco taxation in Ireland in both a historical and comparative context. Section 3 examines the issues involved in determining the appropriate level of taxation on tobacco, as well as outlining what precisely we mean by the term "appropriate". In section 4 we attempt to put some flesh on the issues discussed in section 3. We try to indicate the magnitude of the various external costs associated with tobacco consumption as well as the degree to which consumption is sensitive to changes in price. Section 5 examines the extent to which smokers fully take account of the internal costs of smoking and discusses the implications this could have for taxation levels. In section 6 we examine some practical issues associated with tobacco taxation such as the choice of specific or *ad valorem* taxes. We also analyse the importance of smuggling, while section 7 offers some concluding remarks.

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[1] This paper has benefited from discussion with Peter Clinch, Shelagh Drudy, Niall Lynch, Mary McDonnell, Moore McDowell, Brendan Walsh and members of the Foundation for Fiscal Studies and the Economic and Social Research Institute. The usual disclaimer applies.

2. Tobacco Taxation in Ireland and the Rest of Europe

This section outlines the various taxes levied on tobacco and how tobacco taxation has evolved in Ireland. We also compare taxation levels in Ireland to those applying elsewhere in Europe. We confine the comparison to Europe mainly as tobacco taxation is affected by EU resolutions on tax harmonisation, but we also make some references to taxation in North America. We will have nothing to say about taxation levels in the developing world, although tobacco consumption in this area is an issue of major concern to the World Health Organisation.[2]

We now describe the design of tobacco taxation in Ireland and elsewhere. We confine our discussion to the taxation of cigarettes as these constitute the overwhelming majority of tobacco consumption.

In accordance with the EU codification directive 95/59 the tax on cigarettes in Ireland (expressed in Euro in November 2001) comprises three elements:

- a specific excise at a fixed amount of €103.71 per thousand cigarettes or €2.07 per pack of twenty

- an ad valorem excise levied at a fixed percentage of 18.89 per cent of the retail price

- VAT of 16.67 per cent (as a percentage of the retail price).

Clearly the ad valorem excise and the VAT are identical in effect. If we denote the specific excise as t_s, the ad valorem excise as t_{a1} and VAT as t_{a2} then the total tax burden, T, can be expressed as $T = \dfrac{t_s + (t_{a1} + t_{a2})p}{p}$ where p is the retail price.[3] Below we give the tax burden and retail price for the EU countries.

Member State	Tax Burden (%)	Share of Excise in Total Tax (%)	Retail Price (value of most popular price category), €
Austria	73	20	2.68
Belgium	74	15	2.82
Denmark	82	50	4.02
Finland	76	10	4.00
France	75	5	3.36
Germany	69	49	2.96
Greece	73	5	2.06
Ireland	**79**	**55**	**4.78**
Italy	75	5	2.06

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[2] For example, see the recent volume by Jha and Chaloupka (2000).
[3] Here we follow the notation of Cnossen and Smart (2002), from whom we also take the comparative tax and price data.

Luxembourg	68	15	2.08
Netherlands	73	50	2.84
Portugal	81	50	1.74
Spain	71	5	2.08
United Kingdom	80	54	7.22
Average (unweighted)	**75**	**28**	**3.17**

As we can see, Ireland is above average in terms of both tax burden and retail price. What is also remarkable however is the extent to which the variation in tax burden is considerably less than the variation in retail price. The gap between the highest and lowest tax burdens is 14 per cent (Denmark versus Luxembourg) while the gap between highest and lowest prices is €5.48 or a multiple of over 4 (UK versus Portugal). This indicates considerable between-country variation in either the pre-tax price or the relative incidence of the tax on producer and consumer. This presumably reflects the fact that there is greater *within-country* variation in the price of cigarettes in those countries in Southern Europe who have their own tobacco industry. In these countries cheap domestic brands coexist with more expensive imports from North America, while in Northern Europe the imported brands account for a much higher share of the market. Thus the most popular price category (MPPC) may refer to a domestic brand in Southern Europe but an imported brand in Northern Europe.

Overall, the table reveals a broad distinction between the "North" and the "South" with North European countries having on average considerably higher retail prices, though as mentioned above, the variation in tax burden is somewhat less. Another distinction worth noting is the share of the specific excise in the overall tax. Specific taxes will shrink relative price differences between low-cost and high-cost brands whereas an ad valorem regime will not. Hence the higher share of specific excises in overall tax in North European countries who do not have domestic tobacco producers to protect.[4] We discuss this in more detail in section 6.

It is worth noting that both the United States of America and Canada also exhibit considerable variation in cigarette prices and taxes across states and provinces, though the overall level is lower than Europe, particularly in the US. The unweighted average of the total tax burden in the US is 35 per cent, compared with 64 per cent in Canada and 75 per cent in Europe. The total tax in the highest tobacco tax state in the US (Washington) is about the same as that of the lowest member state of the EU. Once again the variation follows a distinct geographical pattern in line with where tobacco is grown, with higher taxes in northern states such as Washington and Michigan and lower taxes in Kentucky and Virginia.

We now look at the historical evolution of cigarette taxes in Ireland. Because the fixed excise plays such an important role in the tax on cigarettes it is crucially important to take account of overall prices and calculate the real value of cigarette taxes. Figure 1 shows

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[4] EU harmonisation on the share of specific tobacco excises in total tax stipulates a range of 5-55%.

the real value of the tax content of the price of the most popular brand of cigarettes i.e. we express the tax burden as an absolute amount and deflate it by the change in the overall CPI, normalising it at 100 in 1995. We also show the real price of cigarettes in the same graph (given that taxes make up such a large fraction of the overall retail price it is not surprising that the two series move very much in line, with a correlation coefficient of over 0.95).

Figure 1 shows that cigarette taxes were relatively high up to the mid-1960s but started to fall in real terms from about 1965. This lasted till about 1979 when they started to increase again quite sharply in real terms. This levelled off between about 1986 and 1990 and then picked up again. Thus even though excise duties may have been increased on frequent occasions during the 1970s, because this was an era of high inflation the real tax on tobacco was actually falling.

Figure 1 also shows that cigarette taxes are at an all-time high at present. But are there reasons for believing they should be even higher? Before answering that question, we will briefly run through the typical reasons put forward for high taxes on tobacco.

3. Determining the optimal tax on tobacco

Broadly speaking there are two (not mutually exclusive) approaches to be adopted when determining the optimal tax on tobacco. The first approach relies on the insights from optimal tax theory in general, while the second approach regards the tax on tobacco as a means of correcting for the externality involved in tobacco consumption.

Dealing with optimal tax theory first, the three factors which must be taken account of are efficiency, equity and simplicity. Efficiency in a tax system arises because, in general, taxes create distortions. They create distortions because they drive a wedge between the producer price of a good or service and the consumer price of that good. Ideally, for the collection of a given amount of revenue, we would like to have a system of taxes which minimizes the degree to which agents actions deviate from what they would have done in the non-tax situation. Broadly speaking this implies higher taxes on goods with low own and cross-price elasticities. If cross-price elasticities are ignored then we have the *inverse-elasticity rule* whereby indirect taxes should be set inversely proportional to own-price elasticities. Empirical demand studies for Ireland and elsewhere suggest that own-price elasticities for tobacco are low, in the region of –0.3 to –0.5, which provides some justification for a relatively high tax on tobacco.[5]

In addition to efficiency however, equity must also be taken into consideration. Analysis of household budget data indicates that consumption of cigarettes is concentrated mainly amongst lower-income groups. Thus it is argued that high taxes on cigarettes impose an unfair burden on the less well-off. However, it can be argued that cigarette taxation is not necessarily as regressive as might be thought at first glance. The regressivity of a tax at a point in time may not be an accurate measure of the lifetime burden of a tax. This may be especially true of cigarette taxes since smoking rates tend to be highest among young

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[5] See Madden (1993) and Conniffe (1995).

adults (see Mooney, 2000) a group which typically has lower income. Thus comparison of smoking rates across income classes may be comparing people at very different points of their life.[6] It may also be the case that some of the regressivity of tobacco taxation will be offset by the fact that higher-income individuals may be less sensitive to tax changes than others. Evidence for the US indicates that demand elasticities for lower income groups may be up to four times greater than for high income groups (see Evans et al., 1999). Unfortunately the evidence presented in Madden (1993) and Conniffe (1995) is based on aggregate time-series data so it is not possible to confirm if this is also true for Ireland.

In terms of simplicity, cigarette taxes are an attractive source of revenue. There are relatively few producers so collection of excise duties is reasonably straightforward.

Thus using the principles of optimal taxation, it appears that there is a reasonable case for a relatively high tax on tobacco. However, it is unlikely that optimal tax theory on its own would justify current rates of taxation (for example see Madden, 1995, who calculates marginal social costs of indirect taxes for Ireland). Thus we must look elsewhere for justification of very high taxes on tobacco. This is where the idea of the tax on tobacco correcting the negative externalities associated with tobacco consumption comes in.

In general for most goods it is the case that private and social costs/benefits of consumption are equal. For some goods however, it may be the case that the social costs/benefits of consumption differ from the private costs/benefits. For example, it can be argued that the social benefit of education outweighs the private benefit, since there are benefits to society in having a well-educated population in addition to the private benefits which education confers. And similarly it can be argued that the social costs of tobacco consumption exceed the private costs. The precise nature and magnitude of these costs will be discussed below but the implication is that since individuals will consume up to the point where private costs and benefits are equal at the margin, then, in the absence of any intervention, the privately optimal level of consumption will exceed the socially optimal level. Thus a tax which equates private and social costs will lead to the socially optimal level of consumption.

Depending upon the magnitude of the external costs the above approach provides a justification for taxation on tobacco above and beyond what would be merited by conventional optimal tax theory. The crucial information necessary to determine what this tax should be is, of course, the magnitude of the external costs. Once these are known then the tax is set so that social costs and benefits are equalised at the margin, giving us the socially optimal level of consumption.

Before trying to estimate what these external costs are, we should point out, as indicated in the introduction, that the approach taken here is different from that which a public health specialist might take. The normative economic approach implies that the socially optimal level of consumption will be positive (unless external costs are so high that the

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[6] See Congressional Budget Office (1990)

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tax would lead to zero consumption). Once external costs have been taken account of and the appropriate tax imposed, then well-informed rational consumers who are aware of the costs and benefits of smoking can make their decisions on whether and how much to smoke.

A public health specialist, on the other hand, might argue that the socially optimal level of tobacco consumption is zero, given the adverse health consequences of smoking. Presumably lying behind this position is a view that either (a) consumers are not fully informed of the costs and benefits of smoking or (b) the addictive nature of tobacco implies that rational decision-making is not possible in this context, or possibly a combination of (a) and (b). There may well be some truth in these arguments, but we will postpone a detailed discussion of these issues until section 5.

It is interesting to note that if such a view is also held by policy-makers then the logically consistent policy to adopt would be a ban on tobacco consumption and its inclusion along with such drugs as heroin and cocaine as an illegal substance. Clearly there would be immense practical difficulties involved in such a move (some of which are discussed in section 6) so from a pragmatic point of view it does not make sense to ban tobacco. On the basis of published documents such as the Mooney report *Towards a Tobacco Free Society* and the recent health strategy it appears that the long-term desired outcome in Ireland is zero consumption, but that this should arise because of voluntary decisions by consumers (influenced of course by various measures including taxation) rather than compulsion.

The approach we will take in the next section of the paper is to try and come up with an estimate of external costs and see what level of taxation these would imply. In section 5 we will then address issues relating to consumer rationality, in particular the extent to which consumers fully take into account the internal costs of smoking and the implications this has for tax levels.

4. What are the External Costs of Smoking?

In this section we list and try to give some estimate of the magnitude of external costs associated with smoking. In particular we take the approach outlined in Evans et al.(1999) for the US and apply it to Ireland for the year 2000. It is probably impossible to obtain an exact figure for external costs. What follows is an attempt to get some idea of the range and magnitude of the principal external costs and compare them with actual tax collected. Occasionally in the absence of the relevant information for Ireland we are forced to use data from other countries and then apply them to Ireland.

Before going through the external costs, it is probably best to outline precisely what we mean by internal and external costs, in other words what we are and, by implication, are not including. The link between smoking and future health problems is by now very well documented (see Chaloupka and Warner, 1999). However, if the principle of consumer sovereignty is applied then the costs associated with these health problems are not a matter of public policy, unless the costs imposed are external rather than borne privately

by the smoker. A rational person who weighs up all the costs and benefits of his actions should be free to smoke as long as he is fully informed about the consequences of his choice and does not impose costs upon others. We return to the question of rationality and how the costs and benefits of smoking are weighed up by the smoker below, but we concentrate for the moment on external costs.

Marginal Health Expenditure Incurred by Smokers

Given the impact of smoking upon health it seems clear at first glance that smokers will incur substantial health care costs arising from their smoking. To the extent that these health care costs are not fully borne by the smoker then they are external. This has been labelled by Warner et al (1995) as the "user fee" argument for high cigarette taxes. Since smokers use more of society's health resources than they pay for, the balance should be made up via a user's fee i.e. a high tax on cigarettes. Quite how much of the incremental health spending arising from smoking is borne by smokers will depend upon the extent to which health insurers are able to observe the smoking behaviour of customers and set insurance premiums and policies accordingly. Of course if smokers do not have, or choose not to use, private health insurance then no such adjustment will be made. Even where private schemes quote different rates for smokers and non-smokers significant moral hazard may remain, especially if little care is taken to verify customer's reports.

However, it can be argued that it is *net* healthcare costs associated with smoking which are relevant here not the gross costs. Smokers die younger, so there will be savings in social security payments. There may also be savings on other forms of long-term care, since smokers are less likely to reach those ages where such costs are typically highest. Following this approach a number of influential studies in the US have concluded that smokers "pay their way" and that the external costs are less than the tax imposed (note these arguments might apply even more strongly to Europe where taxes are well above those applying in the US).[7] Thus lifetime healthcare costs of smokers may be no greater, or may even be less, than non-smokers. Lightwood et al. (2000) in a review of a large number of studies conclude that the net costs of smoking are small but positive while Warner (2000) states that: "Smoking may well impose a financial burden on health care budgets, but its net impact is likely modest".

The results from these papers sit uncomfortably with calls for higher tobacco taxes since they suggest that current taxes may be well above their optimal level. There are some criticisms which can be levelled at them, however. In the balance sheet of costs and benefits drawn up in these studies the cost savings arising from the premature death of smokers are considered as a "benefit". Many people find such an approach ethically objectionable. They argue that if such deaths are regarded as a financial benefit, without attributing any positive value to life or good health per se, then society should never engage in activities which prolong life beyond workers' productive years.

The core of this criticism is the failure of this type of cost-benefit analysis to attribute a value to life per se. What seems to be crucial here is whose lives should be valued. If

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[7] See for example Manning et al. (1991), Gravelle and Zimmerman (1994) and Viscusi (1995).

smokers knowingly and rationally engage in activities which will shorten their lives, then why should society put any value on the years of life lost by these smokers, any more than the lives of people who, say, knowingly engage in a hazardous sport should be valued.[8]   The position taken in this paper is that in terms of assessing the costs of smoking, the value of life lost by smokers arising from their smoking will be regarded as an internal cost, but the value of life lost by non-smokers arising from smoking will be regarded as an external cost and thus of relevance in assessing the appropriate tax.

On this basis then, the net financial burden which smokers impose on the public sector, *arising from their own ill-health,* appears to be small and we will adopt the working assumption that such costs are zero.

Thus in the next section we concentrate on the costs which smokers impose on non-smokers in terms of the health and well-being of non-smokers. Table 2 summarises such costs while table 3 gives the data sources used.

Environmental Tobacco Smoke (ETS) or "Passive Smoking"

In assessing the external costs of ETS a crucial assumption which must be made concerns the economic unit adopted. Much public policy analysis assumes that the relevant unit is the family. This implies that the effect of smoking upon spouses and other family members, including the effect of maternal smoking on infants, is by assumption not an external cost. Whether the relevant unit should be the family or the individual is a complex issue to resolve. While a spouse might make a fully informed decision to live with a smoker and accept the associated risks, it may be that different criteria should apply to infants and children. The empirical relevance is not clear either. In the US the Environmental Protection Agency (EPA) calculated that over 70 per cent of exposure to ETS occurs outside the home (EPA, 1992). In the calculations to follow we include external costs both inside and outside the family.

The first external costs we examine are the costs of passive smoking in terms of increased risk (for the non-smoker) of dying from the following diseases: lung cancer, coronary heart disease (CHD) and stroke.[9] We calculate the number of deaths of non-smokers from these diseases which can be attributable to passive smoking as follows (using CHD as an example):

Data from the Central Statistics Office (CSO) reveal that in 2000 there were 6629 deaths from CHD in Ireland (see "Deaths from Principal Causes" in the Vital Statistics section of the CSO website http://www.cso.ie/principalstats/princstat.html).   Of these 6629 deaths a certain percentage would have happened to non-smokers. We follow Woodward

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[8] Below we will examine the implications of dropping the crucial assumption of full information and the extent to which smokers discount the cost to themselves of smoking.
[9] We confine ourselves to these three diseases since as reported in Woodward and Laugsen (2001) there is insufficient epidemiological data on the effect of passive smoking on conditions such as chronic obstructive pulmonary disease even though it seems plausible that such an effect should exist. Thus the figures here can be regarded as conservative estimates of the external costs of smoking.

and Laugsen (2000) who assume that 50% of deaths from CHD are non-smokers. The next step is to establish the relative risk ratio (RR) for those non-smokers who died of CHD. Non-smokers will have a baseline risk of suffering from CHD but exposure to passive smoking will increase this risk. We use an estimated RR for non-smokers for CHD of 1.3 i.e. compared to non-exposure to passive smoking, there is a 30% higher probability of suffering from CHD for those non-smokers who are exposed to passive smoke. This figure of 1.3 is obtained from a meta-analysis by Law et al (1997) and is consistent with the figures quoted in Mooney (2000).

The next stage is to obtain a figure for exposure to passive smoking for non-smokers. Following the introduction of the Smoke-Free Environments Act in New Zealand in 1990 which banned smoking in many workplaces the Ministry of Health in New Zealand estimated an exposure rate of 13.5% in 1996. They also estimated an exposure rate of 14.1% for home. Given that the overall smoking rate in New Zealand in 1996 was reported as 25% this suggests that for every 1% of the population smoking there is an exposure for non-smokers of about 0.5-0.6%. If we apply the same exposure to the overall smoking rate for Ireland for 2000 (31%) we arrive at an exposure rate of around 17%. Given that the relevant legislation applying in Ireland in 2000 appears to have been less stringent than that applying in New Zealand an exposure rate of 17% seems reasonably conservative.[10]

Given the RR and the exposure rate, E, we now calculate the population attributable risk (PAR) i.e. that proportion of deaths from CHD of non-smokers which is attributable to the risk in question, passive smoking. This is calculated via the established relationship

$$PAR = \frac{E(RR-1)}{1+E(RR-1)} \ .$$

For the case of CHD we calculate a PAR of just under 0.05, indicating that about 5% of deaths of non-smokers from CHD is attributable to passive smoking i.e. about 164.

We now have to evaluate the costs of these deaths. We take the approach of aggregating willingness-to-pay figures to arrive at a value of a statistical life (VoSL). This approach can be illustrated via the following simple example. Suppose in a population of 1000 people there is a risk of death of 0.005. Now assume a policy is introduced which reduces the risk of death by 0.001 to 0.004, and every person is asked to state their willingness-to-pay (WTP) for the introduction of this policy. If the average figure per person is €2000 then the aggregate WTP is €2m. The change in risk from 0.005 to 0.004 will on average save one life (1000x0.001). Thus the value of the statistical life (VoSL) is €2m. Note that people are not being asked what they would pay to stay alive. Instead

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[10] A Voluntary Code on Smoking in the Workplace was developed by the Health and Promotion Unit of the Department of Health and Children with the support of a variety of bodies including both employers and trade union groups. This was initiated in 1994 and advocated a consensual approach to smoking control policies.

the individual is being asked how much they are willing to pay for a small reduction in the probability of death and this figure is then aggregated.[11]

There is a considerable range of calculated VoSL. In their survey Pearce et al (1998) suggest a figure of €3.03m for under-65s and €2.18m for over-65s and then update them to 2000 prices. However the proceedings of a European Commission workshop on recommended values for the value of preventing a fatality in environmental cost benefit analysis suggest figures in the €1.4m-€2m range depending upon the age of the possible mortality victims (see http://europa.eu.int/comm/environment/enveco/others/value_of_life.htm). It seems that the best approach to take here is to use a range based on the two of these studies giving a range of €2m-€3.25m for infants and children and €1.4m-€2.7m for older victims.

Thus overall we have an estimated external cost of €230m-€458m arising from the effects of passive smoking on CHD for non-smokers. As we see from Table 2, we estimate external costs of €326m-€650m for stroke and about €8m-€17m for lung cancer. The figure for lung cancer may appear surprisingly low but this is accounted for by the fact that (a) the RR is comparatively low at around 1.24 and (b) only about 8% of those people dying from lung cancer are calculated to be non-smokers. The reverse is the case with stroke, where the RR is quite high at over 1.8 and nearly two thirds of deaths from stroke are estimated to be non-smokers.[12]

One element of ETS which is proving to be a larger contributor to external costs than previously thought is maternal smoking. The costs of smoking on infants and children arise owing to an increased probability of a low birth weight, an increased risk of sudden infant death syndrome (SIDS) or "cot death" and an increased probability of infant mortality and foetal loss.[13] Smoking has been identified as the single largest modifiable risk factor for low birth weight (Shiono and Behrman, 1995). Abery and Laffoy (2000) estimate that maternal smoking during pregnancy reduces birthweight by an average of 200 grams and doubles the chance of an infant having a low birth weight. Low birth-weight infants have greater risks of developmental and health problems than other infants, with higher rates of cerebral palsy and other forms of brain injury. There are also higher rates of deafness, blindness, epilepsy, chronic lung disease and mortality. By school age they are more likely to suffer from learning disabilities, attention disorders and developmental impairments compared to normal birth-weight infants.[14] Thus the external costs associated with low birth-weight comprise higher medical expenditures, infant mortality and the future impact of lower educational achievement on earnings.

In terms of fatalities, we estimate that about 56 deaths owing to SIDS, other infant mortality and late-term fetal loss may be attributed to maternal smoking. The RR for SIDS and the exposure rate for all cases were obtained from the study by McDonnell et al

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[11] For a review of different methods of valuing a statistical life see Pearce et al (1998).

[12] The source of the relevant RR and E for these diseases are outlined in the table in the appendix.

[13] McDonnell et al. (2002) show that maternal smoking is associated with a fourfold increase in risk factor for SIDS in Ireland.

[14] See Chaikind and Corman (1998).

(2002) while the RR for non-SIDS infant death and late-term fetal loss were taken from Di Franza and Lew (1995). Applying the range of VoSL figure outlined above for infants and children we obtain external costs of €112m-€182m.

In terms of other costs associated with low birth-weight babies we have used data from Connolly et al (1989). They carried out a detailed study of the cost of neonatal and intensive care in the Rotunda hospital in 1986 arriving at an average cost of around €1250. These figures were then updated to 2000 using the hospital cost index of Walsh (this index is calculated by Walsh using data from the Central Statistics Office). Finally, in order to ascertain the external cost owing to smoking we must calculate the *marginal cost* of low birth-weight babies. This data is unavailable for Ireland but we apply the ratio of average to marginal cost for the US, which is available from the HCUP Nationwide Inpatient Sample. We estimate the extra medical cost of low birth-weight babies which is attributable to smoking to be around €20m.

Finally, we estimate external costs owing to deaths arising from fire. The Irish Fire Services list 43 deaths arising from fire in 2000. Using data from the publication *Fire in the United States* published by the US Fire Administration Department we calculate a RR of the presence of a smoker for fire of about 2.7. Using the smoking rate for 2000 as our measure of exposure we obtain a PAR of 0.34, suggesting that 15 deaths from fire in 2000 may be attributable to smoking, giving an external costs of €25m-€42m.

We also include some estimates of hospital costs arising from a number of illnesses where ETS has been assessed as a contributory factor. These are asthma, bronchitis, pneumonia, pleurisy and middle ear disease (all for children) and circulatory diseases. Data for the number of hospital cases were obtained from *Activity in Acute Public Hospital in Ireland 1990-99* based on data from the Hospital In-Patient Enquiry. The data on costs were obtained from the audit carried out on the Irish Health System by Deloitte and Touche (2001). The total hospital costs attributed to ETS for these diseases is estimated at around €10m for 2000.

We now turn to review evidence concerning the effect of smoking on output and productivity.

Smoking and Productivity

Smoking can affect output and productivity in a number of ways. Once again we must be careful to distinguish between internal and external costs, since it is the latter which are of concern from a public policy perspective. Thus if a self-employed person loses a week's work owing to a smoking-related illness, that is a cost borne by the smoker and once again assuming the smoker to be well-informed about the health risks of smoking, it is a cost they have knowingly and willingly borne. The same argument applies to salaried workers who smoke and who bear the costs of their absenteeism or lower productivity.

A recent study which may be of some relevance to Ireland given the similar size of economy and similar smoking rates is that by Parrot et al (2000) who estimate the cost of employee smoking in the workplace in Scotland in 1998. They look at two principal costs, excess absenteeism caused by smoking and lost productivity owing to smoking breaks for workers. They estimate the former to be around £40m and the latter to range from £288m-£450m depending upon assumptions regarding how many establishments offer smoking breaks and how long these smoking breaks last. If we apply these figures to Ireland for 2000 and assume they represent the same fraction of GDP we obtain a figure for excess absenteeism of €66m and a range of productivity losses of €480m-€750m.

The US Center for Disease Control and Prevention estimate annual productivity losses of $1760 per smoker for the US for the 1995-1999 period (CDC, 2002). A conservative application of such a figure to Ireland for 2000 would lead to estimated productivity losses in the region of €800m (this is assuming a smoking rate of 30 per cent for Irish workers, a loss per worker of €1500 and using the estimated labour force of just under 1.8m).

These are substantial sums but they suffer from the drawback that, unlike the case with some of the health effects listed above, there does not appear to be the same wealth of studies from which to draw comparison and derive confidence over the reliability of the figures. Nevertheless, even taking a conservative range from these numbers a loss of €500m does not seem unreasonable.

There is another potential source of productivity loss arising from maternal smoking. Hay (1991) estimates external costs for the US of $87bn due to reduced economic activity of children whose mother smoked during pregnancy. He claims that evidence shows that children whose mother smoked are four months behind other children in test scores at age 6. He likens this to a one third drop in years of education, which at a 6 per cent rate of return, implies a 2 per cent drop in economic value.

There are two points of controversy here. First is the extent to which maternal smoking influences childhood development and secondly whether being four months behind in test scores is equivalent to losing one third of a year's education. Dealing with the first issue, there is evidence of a relationship between maternal smoking and childhood development, usually acting via the role of smoking in low birthweight (see Scott et al, 2001 and Corman and Chaikind, 1998). Corman and Chaikind state that "…low birthweight children are more likely to repeat a grade, have poor school performance, or enroll in special education than their normal birthweight peers". Currie and Hyson (1999) using data from the UK National Child Development Survey (NCDS) find that low birthweight has significant effects on educational achievement and employment but only limited effect on wages. They also find that the results are overall more pronounced for females. For example, females with low birthweight will on average pass 0.64 fewer O-levels.

The second issue is finding some sort of metric for the poorer performance of low birthweight children. It is not always clear how to relate a lower test score at age 6 with passing on average 0.64 fewer O-levels. Suppose we accept the Hay estimate that low birthweight children lose 2 per cent economic value. Assume that a worker starts working at age 20 and works for 45 years until retiring at age 65. Also assume that the starting wage is €15,000 p.a. and that earnings grow at 3 per p.a. With a 5 per cent discount rate the present value of earnings is about €440,000. 2 per cent of this is about €8800 per worker and we have estimated that smoking accounted for 648 low birthweight babies in 2000. This gives a cost attributable to smoking of around €5.7m.

Total External Costs and Tax Revenue

On the basis of the figures above we have estimated a range of external costs of tobacco consumption for Ireland in 2000 of €1237m-€1886m. What degree of external costs per packet of cigarettes does this imply?

Data from the national accounts indicate that in 2000 €1869m was spent on cigarettes. Given that the average cost per pack of 20 was €4.81, this implies that just over 388m packs of cigarettes were sold in 2000 (note that the number of packs *consumed* is likely to be higher owing to smuggling, which we return to below). Given the range of external costs estimated here this implies external costs of about €3.18-€4.85 per pack. The actual tax per pack of cigarettes in 2000 was €3.77, towards the lower end but still comfortably within our estimated range of costs.

Does this imply that the Department of Finance have got it right and that cigarette taxes in Ireland are very near their "optimal" levels? Clearly this depends upon the reliability of the external costs quoted above. The most important assumptions in these costings were (a) the use of the individual rather than the family as the relevant unit (b) the figure used for the VoSL and (c) the estimate of lost productivity.

Regarding assumption (a), as indicated above, it is not clear how much ETS exposure occurs within compared to outside the home. It can also be argued that a distinction should be made between adults and children, in that children have little choice re their exposure to ETS, while an adult in all probability makes the decision to live with a smoker voluntarily. Recent economic research has questioned the practice of using the family as the unit of analysis and has criticized the unitary household model (for example see Bourginon and Chiaporri, 1992). In summary, as indicated above, the choice of family or individual is in many ways a value judgement. The contention here is that in the case of children exposed to ETS the individual is the correct choice. The case of adult exposure within the home is not as clearcut.

The second crucial assumption here concerns the VoSL. Here we have presented a range of values based on surveys of the literature carried out by the European Commission. It is interesting to note that the range used here is well below that quoted in Evans et al. (1999). There are other reasons to suggest that the range presented here is conservative. The studies quoted here chiefly rely on VoSLs estimated from WTP studies i.e. studies

indicating people's willingness to pay to avoid a small increase in risk. A related concept is people's willingness-to-accept (WTA) a small increase in risk. For infinitesimally small changes in risk these figures should be the same. For non-infinitesimal changes WTA is usually found to exceed WTP. Whether WTP or WTA is the relevant measure to use depends upon the issues of "property rights" i.e. if non-smokers have the right to clean air then the relevant concept is how much they are willing to accept for an increase in risk associated with smoky air. On the other hand if smokers have the right to smoke then the relevant concept is how much non-smokers should be willing to pay for a reduction in risk associated with cleaner air. Once again it is arguable that value judgements are in operation here, but the view of this author is that WTA is more appropriate here and this reinforces the case that the range of VoSL chosen is conservative.

A further point here concerns the VoSL of other people i.e. your relatives and friends will place a value on a reduction in risk to you and likewise you will value a reduction in risk to your family and friends. The literature in this area is quite sparse but Pearce (1998) indicates that a premium of up to 40 per cent could be added to obtain the social value of a statistical life. Once again this is clearly a complex issue and also is affected by the degree to which decisions are made on an individual or family basis. We will make no adjustments to the VoSL used here but note that the inclusion of such effects would clearly lead to a fairly significant upward revision in estimated external costs.

Finally, the estimate for productivity losses arising from smoking suffers from the problem that there are relatively few studies to call upon. Nevertheless, the figure of €500m chosen appears to be well towards the lower end of possible values.

Taken together, this limited degree of sensitivity analysis indicates that the range of external costs estimated here are fairly conservative. In terms of tax policy, this implies that while current tax levels are probably near enough to the optimal level, the balance of evidence would indicate that if they are to be changed it should be upward.

But Would Higher Taxes Reduce Smoking?

It was believed at one time that cigarette smoking and other addictive behaviour was not rational and so not suitable for conventional economic analysis. There is now however a substantial body of literature to testify that the demand for cigarettes clearly responds to changes in prices and other factors (see the comprehensive review by Chaloupka and Warner, 1999). Early studies of cigarette demand employed aggregate time-series data and produced estimates the price elasticity of demand in the region of –0.4. One disadvantage of these studies was that they were unable to distinguish between the elasticity of cigarette demand conditional upon smoking and the elasticity of participation. Later studies used individual level data which can consider separately the effect of price on the probability of smoking and on average consumption of smokers. Studies which have examined smoking initiation in a discrete choice framework have typically estimated elasticities of participation with respect to tax in the region of –0.5 to –1.0 with an apparent inverse relationship between age and smoking elasticity.

In terms of evidence for Ireland a variety of models of tobacco consumption have been estimated mostly using aggregate time-series data dating from O'Riordan (1969) to Madden (1993).[15] These studies have produced broadly comparable results with a median estimate for the price elasticity of tobacco in the region of –0.5, which is in line with results from elsewhere in the world. As noted above, the use of aggregate time-series data precludes distinguishing between the effect of price on the probability of smoking and on the demand for cigarettes conditional on smoking. Conniffe (1995) remedies this to some extent by combining analysis of aggregate time-series data with data on the proportion of the total population who are smokers. He found that the proportion of the population smoking is unaffected by price (or income) but exhibits a downward trend related to health concerns. Consumption by smokers does not exhibit such a downward trend but appears to have a significant price elasticity of around –0.3.

As far as we are aware, the only study for Ireland which examines cigarette price or tax elasticity using individual level data is Madden (2002). This study applies duration analysis to a sample of Irish women to investigate the degree to which tax delays the period before starting smoking. The estimates suggest that higher taxes do delay the period before starting, with estimated elasticities of 1.0 but the results are sensitive to various aspects of model specification and so cannot be regarded as entirely robust. Overall, however, the limited range of Irish studies are still in line with international evidence indicating that consumption is price sensitive.

Thus Irish smokers appear to be rational in terms of their response to tax and price increases. The analysis above has also assumed that smokers themselves are fully informed, rational and consistent in their preferences and hence it is only external costs which should be relevant in terms of taxation levels. In the next section we examine the effect of relaxing this assumption.

5. Do Smokers Take Full Account of Internal Costs?

So far we have assumed that the rationale for intervention in tobacco consumption, in the form of higher taxes, is that smokers do not take account of the external costs of their smoking. The analysis above indicates that such external costs may be substantial, but they are likely to be dwarfed by the *internal* costs of smoking. If smokers are fully informed and have rational, consistent preferences, then such internal costs are not relevant from a public policy perspective. However, if consumers are not fully informed and/or if their preferences are not rational and consistent then perhaps there is a role for public policy in terms of correcting for (some of) the internal costs of smoking.

Dealing with the question of information first of all, concerns over the potentially adverse effects of cigarette smoking have been expressed since the early part of the twentieth century. By 1930 statistical correlations between cancer and smoking had been established but the breakthrough in terms of public consciousness can probably be dated to 1952 and the publication of an article entitled "Cancer by the Carton" by the *Reader's*

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[15] The exception was O'Riordan (1969) who used data from the Tobacco Research Council.

Digest magazine. In 1964 the US Surgeon General released a report titled "Smoking and Health" which concluded that cigarette smoking was causally related to lung cancer in men and that the data for women, although less extensive, pointed in the same direction. Since then smoking has been implicated as a risk factor for an extensive range of other diseases. In addition, since the early 1970s it is obligatory for cigarette packs in Ireland to carry health warnings. TV and radio advertising have also been banned since 1969 and 1978 respectively and there have been numerous other health campaigns discouraging people from starting to smoke and encouraging smokers to quit. It seems clear that such campaigns played a major role in reducing the smoking rate from over 50 per cent to just over 30 per cent. Given this barrage of information, surely the population at large is fully informed of the health consequences of smoking?

While it is true that there may be reasonably widespread knowledge of the health effects of tobacco, there are two key features of smoking which must be taken into account. First is the fact that nicotine is addictive and second that the onset of nicotine addiction takes place primarily during childhood or, at the least, early adulthood.[16] Whether or not addicted adults can be regarded as rational is a matter for debate (see Becker and Murphy, 1988), but the case for guiding children's decisions regarding cigarette consumption seems fairly compelling. In terms of information, once again there are widespread and ongoing programmes to educate children regarding the ill-effects of smoking but it is argued that such programmes have shown limited effectiveness (see Warner et al, 1995). If these attempts to correct the problem at source are meeting with only partial success, then maybe high taxes can be justified as a second best solution. This particular justification for tobacco taxes would be all the more persuasive if children are believed to be especially sensitive to price increases. Unfortunately, the evidence here is not clearcut. While the conventional wisdom has been for a number of years that children are more price-sensitive, recent work by DeCicca et al (2002) has challenged this.

As well as the question of information and rationality, there is also the question of the degree to which preferences are consistent. This can have a crucial bearing on attempts to quit smoking and may have radical implications for the extent to which smokers take full account of the internal costs of smoking. Since smoking (for a smoker) involves an immediate pleasure which has a health consequence in the future, the degree to which smokers trade-off current pleasures and future costs is a key element of the decision to start/quit smoking. The standard approach in economics has been to assume that agents are time-consistent in their preferences applying what Frederick et al (2002) call the discounted utility (DU) model. Thus utility at future periods is discounted at a constant rate.

However, there is substantial evidence that agents apply a *higher* discount rate to events in the very near future and are thus far more present orientated than the standard DU model would predict. This will give rise to time-inconsistency of preferences. Thus say in September I decide that I will quit smoking on January 1st. Since January 1st is a

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[16] Madden (2002) shows that for a sample of Irish women the risk of starting smoking peaks at around 17-18 and then again at 21.

number of months away I will probably be indifferent between quitting on January 1st or January 2nd. When December 31st comes around however, since I place a high weight on immediate pleasure I will certainly not be indifferent between quitting on January 1st or January 2nd. Thus the decision to quit will be postponed until January 2nd and then on January 2nd I will postpone it until January 3rd and so on.[17] Thus my preferences are time-inconsistent in the sense that I do not follow through my original resolve of quitting. As Gruber (2001) points out, unrealised intentions to quit are a common feature of stated smoker preferences. The use of self-control devices (such as making bets with friends) are also indirect evidence of time-inconsistency (note that these are not to be confused with quitting aids such as nicotine patches).

So what relevance does this have for tobacco taxation? If time-inconsistency of preferences is admitted then even for rational, forward-looking consumers there is an optimal positive tax even in the absence of interpersonal externalities (i.e. the type outlined in the last section). Government tax policy is effectively acting as the self-control device which time-inconsistent agents need to help them control their habits. Thus cigarette taxes are correcting not just the external costs associated with smoking but also part of the internal costs.

The implications for tobacco taxation are potentially enormous. For example Gruber and Koszegi (2001) estimate the internal costs of smoking a packet of cigarettes to be \$30, compared with the range of external costs which we have estimated at €3.18-€4.85. If even 10 per cent of these internal costs were to be corrected then this implies a doubling of current tax levels.

Is such a huge increase in taxation warranted or indeed is it practical? In the next section we discuss the practicality of significant increases in taxation in the context of potential for smuggling. But in the meantime before making such radical suggestions it is useful to look at the source of the "market failure" which such a tax increase is trying to correct. The literature on time-inconsistent preferences differentiates between sophisticates and naifs. The former are those who are aware of their self-control problems. Consequently they are likely to employ self-control devices in attempting to quit smoking or may be more likely not to start smoking since they are aware of the difficulty they would face in attempting to subsequently quit. The latter are unaware of their self-control problem and assume each period that they will be able to carry through their desire to quit.[18]

Since the problem here is one of self-control the first-best solution to the problem would seem to be to provide self-control mechanisms for both the sophisticates and the naifs and in addition provide incentives for the naifs to use such self-control devices. There have been few, if any, policy initiatives which specifically address the self-control issue. This is an avenue which might be worthy or exploration before turning to the second best

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[17] The phenomenon of applying a higher discount rate to near events can be captured by hyperbolic discounting as opposed to exponential discounting which is assumed in the DU model.

[18] In certain circumstances sophisticates may be *more* likely to start smoking, precisely because they correctly forecast their future self-control problems and see little point in delaying the inevitable! See O'Donoghue and Rabin (2000).

solution of higher taxes, especially given the scale of tax increases required to correct internalities.

A recurrent theme of the discussion in this section and the last section is the need for tobacco tax policy to be aware of the potential for smuggling and tax evasion should there be substantial tax increases. We discuss this in more detail in the next section.

6. Other Practical Issues

Specific or ad valorem taxes

In a perfectly competitive market for a homogenous good the choice between specific and *ad valorem* taxation is irrelevant since any specific tax can be replaced by its *ad valorem* equivalent with no effect on price, consumption or revenue. In many countries tobacco is clearly not a homogenous good with cheap domestic brands coexisting with expensive imported brands. In this scenario a specific tax will reduce relative price differences between low and high price brands, while an ad valorem tax will not. Optimal tax considerations would thus seem to favour an ad valorem tax given a competitive market with quality differences.

However in Ireland there is no cheap domestic brand corresponding to those in Southern Europe (we will return to the competitiveness of the market below). Furthermore, if taxes are being set so as to correct external costs then, assuming that cigarettes of different quality cause the same health damage, a specific tax is favoured.

In the case of an uncompetitive market, ad valorem taxes appear to lead to lower consumer prices and higher tax revenues (see Skeath and Trandel, 1994). Evidence for the EU also indicates greater shifting of specific as opposed to ad valorem taxes (see Delipalla and O'Donnell, 2001). Thus when the tobacco industry is not perfectly competitive (as is surely the case in Ireland) the preference for specific versus ad valorem taxation may well boil down to whether governments take a public health or revenue maximising approach.

Finally, it is worth noting that in the same way that ad valorem taxation creates incentives for firms to lower prices, it also creates incentives for a lowering of product quality. If this serves to reduce the glamour of smoking then the public health implications may be positive since fewer younger people may be encouraged to start smoking. On the other hand it also implies that quality changes in cigarettes which may be health-enhancing, such as coal filters which reduce the degree of tar in tobacco are less likely to be adopted.

Smuggling

The data presented in table 1 showed the great variation in cigarette prices across Europe. Such price variation presents obvious opportunities for smuggling and tax evasion. Economic theory suggests that the incentive for such activities will be influenced by price/tax differentials. The degree to which cigarette taxes can be increased may be

limited by the tax/price regime in a bordering jurisdiction since excessive tax increases may lead to both legitimate and illegitimate trade diversion. This could ultimately lead to a reduction in tax revenue.[19]

The precise nature of the smuggling involved can vary. Bootlegging is the legal purchase of cigarettes in one country but their consumption and resale in another, whereas smuggling involves cigarettes being sold without the payment of taxes or duties, even in the country of their origin. In one of the most celebrated examples of smuggling in response to tax increases, higher tobacco taxes in Canada led to Canadian cigarettes being exported tax-free to the United States and then smuggled back into Canada. Such smuggling ultimately led to a federal tax reduction in Canada of $5 per carton, followed by provincial tax reductions of up to $10 per carton.

It is also appears that cigarette smuggling is growing in Ireland. The most recent report of the Revenue Commissioners reports a 68 per cent increase in seizures of cigarettes to 161.2m in 2001 compared to 2000. This may reflect an improvement in detection rates but almost certainly also indicates increased underlying activity, although there is some evidence that at least some seizures represent cigarettes which were ultimately intended for the UK market (see Revenue Commissioners, 2002).

Merriman et al (2000) list three ways in which smuggling limits the use of high taxes. First, there is a limit on the maximum revenue which can be raised from cigarette taxes since higher taxes lead to greater smuggling. Secondly, attempts to control smuggling will absorb law enforcement resources. Finally, the presence of smuggling may lead to opportunities for corruption which will in turn undermine the legitimacy of existing law enforcement authorities.

As mentioned above, economic theory suggests that the level of smuggling is linked to the level of taxes. However, the empirical evidence is mixed. Joosens and Raw (1998) show an inverse correlation between the price of cigarettes and the level of smuggling in the European Union, with high price countries such as Norway, the UK and Ireland having estimated smuggling levels of 2 per cent, 1.5 per cent and 4 per cent respectively (all figures are for 1997). On the other hand low-price countries such as Spain and Austria had smuggling levels of 15 per cent.[20] The evidence reviewed for North America in Merriman et al (2000) supports the notion that smuggling responds to tax increases in the expected way, but econometric evidence for a worldwide cross section of countries finds no relationship between the degree of smuggling and price. In a separate exercise Merriman et al also estimate cigarette demand for 23 countries in Europe explicitly including measures taking account of bootlegging. They find that the grater the incentives for illegal importation, the lower were recorded sales while the greater were the incentives for illegal exportation the higher were recorded sales, in line with

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[19] This phenomenon is by no means unknown in Ireland. In the mid-1980s there appears to have been widespread smuggling of alcohol in response to price differentials between the Republic and Northern Ireland, so much so that excise duties on spirits in the Republic were reduced. See FitzGerald et al (1988).
[20] These figures are for 1997. There is evidence that since then the situation in the UK has worsened considerably. See the Treasury Committee's Second Report on HM Customs and Excise (2000).

economic theory. However, they also estimated that bootlegged cigarettes accounted for only about 3 per cent of consumption in a typical European country and that moderate tax increases would still lead to higher revenue.

A report from the UK Treasury also distinguishes between bootlegging and smuggling. They acknowledge that what they call "white van trade" or bootlegging will be price responsive and that cuts in excise duties on tobacco would reduce such trade. However, they also claim that the bulk of smuggling involves large scale movement of containers and such trade is unlikely to respond to tax or price increases (see Treasury Committee's Second Report on HM Customs and Excise, 2000)

The overall conclusion from the somewhat confusing evidence on bootlegging and smuggling is that the former will respond to price and tax incentives. However, it is the latter, which mainly involves the freight trade with smuggling in large containers, which may constitute by far the greater proportion of illegal trade in cigarettes. While such smuggling clearly has implications for governments in terms of lost revenue, it is not clear how price sensitive it is. Thus tax increases may have relatively little impact on such large-scale smuggling.

7. **Conclusion**

This paper has examined aspects of tobacco taxation in Ireland. It shows that on a comparative basis Ireland has a relatively high tax rate and even higher retail price. It also shows that after declining in real terms for most of the 1970s tobacco prices increased during the early 1980s, levelled off in the late 1980s and increased again during the 1990s.

The central part of the paper examined the external costs which can be attributed to tobacco. Data from a variety of sources were used to derive a range of estimated external costs. The range estimated was not inconsistent with current tax rates, though perhaps on the low side, suggesting that there is still scope for further tax increases.

The paper then discussed the issue of whether consumers fully take account of *internal* costs when deciding to smoke, in particular focussing on the issue of self-control. It noted that the tax implications here could be quite enormous but suggested that attempts be directed first towards tackling the self-control problem at source.

Finally, the paper discussed a couple of practical issues concerning the choice between the type of tax to be imposed upon tobacco and the relevance of smuggling. With regard to smuggling the tentative conclusion was that the bulk of smuggling was unlikely to be responsive to changes in tax and price.

Table 2: External Costs of Smoking for 2000 (€m)

Condition	Cases	RR attributed to smoking	Exposure	PAR	Cases Attributed to Smoking	MC/Case	Cost Attributed to Smoking
Mortality							
Heart Disease	3315	1.30	0.17	0.5	164	1.4-2.8	229.6-458.4
Stroke	1758	1.88	0.17	0.13	233	1.4-2.8	326.2-651.2
Lung Cancer	123	1.24	0.20	0.04	6	1.4-2.8	8.4-16.8
SID	49	4.00	0.27	0.45	22	2.0-3.3	44-71.5
Infant Death (non SID)	287	1.20	0.27	0.05	15	2.0-3.3	30-48.8
Late-term Fetal Death	363	1.20	0.28	0.05	19	2.0-3.3	38-61.8
Fire	43	2.67	0.31	0.34	15	1.4-2.8	25.5-41.9
Morbidity							
Asthma	6036	1.30	0.43	0.12	695	0.0027	1.87
Pneumonia, Pleurisy	2203	1.50	0.43	0.18	393	0.0027	1.06
Middle Ear	6813	1.30	0.43	0.12	785	0.0027	2.11
Circulatory	32364	1.3	0.17	0.05	1602	0.003	4.97
Low Birth-Weight	2216	2.29	0.28	0.26	588	0.028	16.61
Very Low Birth-Weight	496	1.49	0.28	0.12	60	0.052	3.11
Other							
Absenteeism, Productivity							500
Lost Earnings					648	0.007	5.7
Total							**1237-1886**

Table 3: Data Source for Table 2

Factor	Number of Cases	Relative Risk	Smoking Fraction	Cost
Low-weight	ISIDA's Sudden Infant Death Register, 2000	Evans et al. (1999)	McDonnell et al (2002)	Total cost for low weight obtained by updating figures of Connolly et al. (1989) by medical inflation index of Walsh. Marginal cost obtained by assuming same ratio of MC to AC as in HCUP Nationwide Inpatient Sample (2000).
Very Low Weight	See above	See above	See above	See above
SID	ISIDA's Sudden Infant Death Register, 2000	McDonnell et al. (2002)	McDonnell et al. (2002)	VOSL updated from Pearce (1998)
Non SID	ISIDA's Sudden Infant Death Register, 2000	DiFranza and Lew (1995)	McDonnell et al. (2002)	VOSL updated from Pearce (1998)
Fetal Death	Table B11, *Health Statistics 1999*. Rate for 1995 applied to birth figures for 2000.	DiFranza and Lew (1995)	McDonnell et al. (2002)	VOSL updated from Pearce (1998)
Lung Cancer	"Death from Principal Causes", Central Statistics Office	Hackshaw et al. (1997)	Figures for New Zealand from Woodward and Laugsen (2000) applied to Irish smoking rate	VOSL updated from Pearce (1998)
Heart Disease	"Death from Principal Causes", Central Statistics Office	Law et al. (1997)	Figures for New Zealand from Woodward and Laugsen (2000) applied to Irish smoking rate	VOSL updated from Pearce (1998)
Stroke	"Death from Principal Causes", Central Statistics Office	Bonita et al. (1999)	Figures for New Zealand from Woodward and Laugsen (2000) applied to Irish smoking rate	VOSL updated from Pearce(1998)
Accidental Fire	www.irishfireservices.com	RR derived from PAR of 0.24 and smoking rate of 0.19 in *Fire in the United States*, US Fire Admin.	Mooney (2000), figure for 1999.	VOSL updated from Pearce (1998)

Asthma (0-17)	Cases from *Activity in Acute Public Hospitals in Ireland 1990-1999* (1999 figure used)	Average of rates for 0-6 and 6-15 in Cook and Strachan (1999)	Figures for New Zealand from Woodward and Laugsen (2000) applied to Irish smoking rate	Deloitte and Touche (2001)
Pneumonia and Pleurisy (0-17)	Cases from *Activity in Acute Public Hospitals in Ireland 1990-1999* (1999 figure used)	Cook and Strachan (1999)	Figures for New Zealand from Woodward and Laugsen (2000) applied to Irish smoking rate	Deloitte and Touche (2001)
Middle Ear Disease	Cases from *Activity in Acute Public Hospitals in Ireland 1990-1999* (1999 figure used)	Cook and Strachan (1999)	Figures for New Zealand from Woodward and Laugsen (2000) applied to Irish smoking rate	Deloitte and Touche (2001)
Circulatory	Cases from *Activity in Acute Public Hospitals in Ireland 1990-1999* (1999 figure used)	Law et al (1997)	Figures for New Zealand from Woodward and Laugsen (2000) applied to Irish smoking rate	Deloitte and Touche (2001)

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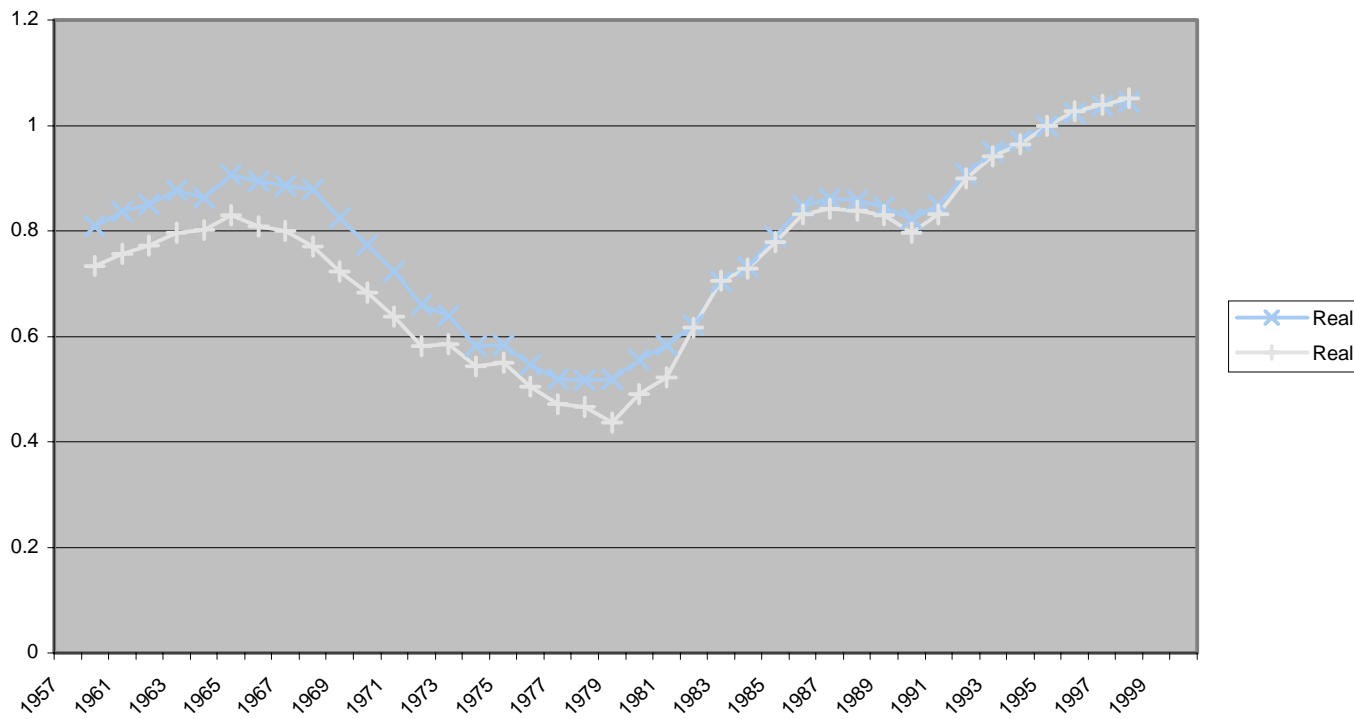
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