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Economic Aspects of Addiction Control Policies

by **ALAN MAYNARD AND ANDREW JONES**

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This is a follow-up paper arising from a World Health Organisation meeting which was held in Disley (near Manchester) in England in September 1984. The original paper for that conference (Maynard (1984)) was revised as a result of comments perceived at the Disley meeting and circulated to participants in a revised form (Maynard (1986)). As a result of comments received at Disley and subsequently this paper has been written to provide the present overview of the economic aspects of addiction control policies.

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1. Introduction

The proceedings of the 1984 Disley meeting were based on a WHO document (ICP/MPN 501/504/2, 3117E, dated May 1st 1984) which indicated that the concern of the deliberations was "economic aspects of primary prevention outside the health sector" with regard to the "abuse" of tobacco, alcohol and psychoactive drugs. In particular the study was to:

- i) "compare the economics of the three abuse areas"
- ii) "identify the most important points for intervention"
- iii) "draw conclusions about the cost effectiveness of different intervention strategies".

The work at Disley indicated clearly that these were ambitious objectives given the poor epidemiological base in all countries and the absence of knowledge about the costs and benefits of substance abuse, let alone knowledge about the costs and benefits of alternative (non-health care) instruments which could be used to alter that abuse. (These issues were discussed initially in Maynard (1984) and (1986)).

Consequently this paper will seek to provide a framework for the discussion of policy objectives and the efficiency of alternative policy instruments. The paper sets out to show the contribution that economics can make to this process of policy formation.

Firstly, economics provides a conceptual framework which can be used to organise the abundance of material that is generated by the study of addictive goods and to help set the agenda for that study. The main organising principle in this paper is the distinction between the supply and demand for addictive goods.

Secondly, economics can provide information and evidence to improve the quality of decision-making. To take the example of tax policy; before advocating the use of taxation as an addiction control policy it is clearly important to have a reliable indication of how consumption will respond to a change in price, what proportion of a tax change will be borne by consumers and what by producers or their suppliers and employees, how employment and exports will be affected, and what effect the tax will have on the distribution of income. Economics can investigate all of these questions.

The paper has three main sections. The next section (2) concentrates on the supply of addictive goods and adopts the structure/conduct/performance approach to describe the alcohol, tobacco and illicit drugs industries. Section 3 begins by describing recent trends in consumption and goes on to survey econometric studies of the demand for addictive goods, paying particular attention to estimates of price and income elasticities. The fourth section reviews the extent of public sector involvement with addictive goods and shows how economic analysis may be applied to the question of taxation. It goes on to survey the research that has been done on the social costs of addiction and concludes with a discussion of the objectives and evaluations of addiction control policies.

In addition to these three main sections there is a bibliography, a glossary of relevant economic terms and, in section 5, a detailed proposal for the collection of data and the conduct of econometric studies on an international basis.

2. The Supply of Addictive Goods

2.1 Introduction

The standard approach to the economics of industries and firms is the structure/conduct/performance paradigm. This approach can be applied to all countries to elicit the nature of the suppliers of addictive goods. Broadly speaking structure refers to the environment in which production takes place, but within that definition it is useful to distinguish three levels of structure:

- i) The economic system; which usually corresponds to geo-political boundaries. For instance we might contrast a western industrialised economy with a sophisticated financial sector, advanced media of mass communication and a general "consumer culture" with a third world economy, perhaps dominated by cash crops, with low per capita purchasing power, poor communications and a large informal sector.
- ii) The industry; which will cross geo-political boundaries and is conventionally defined by the products it produces.
- iii) The firm; this is the basic unit of production which, in the case of the alcohol and tobacco, is likely to cross geo-political and industrial boundaries. The firm is conventionally defined by its ownership.

Conduct refers to the strategies and rules of behaviour adopted by firms. The standard assumption in much economic analysis is that the sole objective of capitalist enterprises is the maximisation of their profits. However this need not always be the case and many models exist which suggest additional or alternative objectives (eg. sales maximisation).

The term performance relates to how firms perform in terms of selected indicators such as profitability, employment and survival. The latter raises the question of entry and exit to and from the industry and mergers and takeovers within the industry. This introduces a feedback from firms' performance to the structure of the industry.

The structure, conduct and performance paradigm used in industrial economics is based on the premise that there is a two way link between structure and performance via conduct. The use of this paradigm for developing and analysing policies which may mitigate the costs arising from the use of addictive goods has not been developed extensively or systematically. However with such data it would be possible to model the impact of given prevention policies on profits, employment, conduct and the structure of the industry. Thus a question such as what would be the effects of a 10 per cent reduction in consumption could be investigated to determine which owners and employees would lose what profits and employment and to predict how these decision makers might behave, both economically and politically, as a result of these changes. Whilst such analysis is not presented below, some indications of the structure, conduct and performance of UK addiction industries are given.

2.2 Structure

2.2.1 Alcohol

Substantial data exist about the structure of the alcohol and tobacco industries and they show that both are highly concentrated. An imperfect but useful description, using largely secondary sources, of the international alcohol trade is provided by the controversial WHO report (WHO (1982)) written by Cavanagh and Clairmonte and later published

independently (Cavanagh and Clairmonte (1985)). This study together with Booth and Hartley (1987b) which concentrates on the UK, highlights both the oligopolistic nature of the market in alcohol and its integration and diversification.

In the UK six firms dominate the brewing sector: Bass Charrington, Allied Lyon, Scottish and Newcastle, Grand Metropolitan through their brewing subsidiary Watney Mann and Truman, Whitbreads and Courage which is now owned by Hanson Trust having previously belonged to the Imperial Group. Booth and Hartley (1987b) show that in 1982 Bass Charrington had the largest market share, as a percentage of volume sales, of 20 per cent, while Courage (then owned by Imperial) was lowest with 9 per cent. Together the six firms had 78.5 per cent of the market, indicating a highly concentrated industry.

However the high concentration of the brewing industry is a relatively modern phenomenon. Concentration did not increase markedly until the late 1950s. This absence of concentration was primarily due to problems in handling and distribution in the era before keg beer was widely available. In the 1950s and 1960s the industry experienced a merger boom the main motives of which were the establishment of retail network of tied houses and the exploitation of technological change which eased the distribution problems of the product.

The concentration of the brewing sector is also reflected in employment. In 1980 the five firm concentration ratio was 54 per cent (ie. the proportion of total employment attributable to the top five employers). Census of production data from 1983 shows that the seven largest establishments in the sector, with an average employment of 1657, employed

29 per cent of the total, and the 25 establishments which employed more than 500 workers accounted for 61 per cent of total employment.

By far the least concentrated section of the alcohol industry is wine manufacture. However the five major suppliers of wine to the UK, who account for around for 30 per cent of the off-trade sales, are all owned by the major brewers. This reflects the widespread horizontal integration of the market. Bass Charrington are major wine importers (Hedges and Baker) and, together with Whitbreads, own a soft drinks firm, Canada Dry. Allied Lyon own various wine interests (Grants of St James, Victoria Wines, Harveys Sherries), have major cider interests (Whiteways), and have interests in the spirits market (Teachers and Stewart and Sons). Whitbreads own Long John distilleries and have substantive interests in the small independent brewers. Watney Mann are owned by Grand Metropolitan, which earns a high proportion of its profit from wine sales, a leisure industries operation with substantial interests in hotels. Grand Metropolitan owns International Distillers and Croft (sherry), Morgan (rum) and J & B (whisky). Scottish and Newcastle own Mackinlay and McPherson (spirits). Courage breweries own a spirits firm (Saccone and Speed) and Guinness, through a now notorious take-over, own the Distillers company.

The retailing of wine is dominated by the brewers (Allied Lyon, Grand Metropolitan, Whitbreads and Bass Charrington) and by general retailers such as Sainsburys, Marks and Spencers and Associated Dairies (which own the supermarket chain ASDA). The spirits market is well penetrated by the brewers in addition to multi-nationals such as Seagrams, Hiram Walker and Lonrho.

Thus the market for alcohol in the UK is characterised by a few firms who dominate the market for beer (the market leader) and who have

substantive interests in wine and spirits. Furthermore these firms tend not only to produce and distribute their products but also to own outlets such as public houses and off-licence shops. The international links of the industry are also considerable. These characteristics are indicative of the substantial market power of these producers which enables them to affect public policy substantially.

As to the firms themselves, there is considerable evidence of economies of scale in the brewing industry (eg. see Booth and Hartley, (1987b)). A number of studies have been carried out to try and identify the "minimum efficient scale" (MES) for plants in the industry. This provides an indication of the extent of economies of scale. Pratten (1971) estimated the MES for the UK beer industry to be 3 per cent of the total UK market. Cockerill (1977) suggests that the MES takes a range of values and gives a figure of 5 per cent for 1982-83. The highest estimate comes from Scherer (1973) who suggests 9.2 per cent of the UK market.

2.2.2 Tobacco

The alcohol market is highly oligopolistic but its concentration characteristics are less than those associated with tobacco manufacture. The UK tobacco market is dominated by three major producers who together control over 90 per cent of the market. In 1984 the 3 firm concentration by volume was 91 per cent, while the top 4 firms accounted for 99 per cent of employment.

The market leader is the Imperial Group, now owned by the Hanson Trust, which in 1984 had a 44 per cent market share. Imperial Tobacco, which includes W.D. and H.O. Wills, markets brands that include Woodbine,

Embassy and John Player Special. Gallahers, who are owned by the US company American Brands, had a market share of 32 per cent in 1984. They market products such as Benson and Hedges, Silk Cut and Old Holborn. The third company, with 15 per cent of the market in 1984, is Rothmans International who market Rothmans, Peter Stuyvesant and Dunhill. Rothmans are part owned by the US producer Phillip Morris (who produce the Marlboro brand) and by Rembrandt. The Rembrandt Group is a South African company owned by the Anton Rupert family. A fourth UK based company, British American Tobacco trades abroad especially in the US, German and Brazilian markets.

The UK tobacco market is dominated by the three companies Imperial, Rothmans and American Brands. These companies trade worldwide sometimes in collaboration with the four other leading international companies R.J. Reynolds, British American Tobacco, Phillip Morris, the Loews Corporation and Gulf and Western. About 85 to 90 per cent of the leaf used by these tobacco producers is controlled by 6 international buyers (see U.N.C.T.A.D (1978, Chapter 4)). These companies are Universal Leaf, Transcontinental Leaf Tobacco Company, Debrill Brothers, the Export Leaf Tobacco Company (wholly owned by B.A.T.) and the Imperial subsidiaries, Kulenkampff and A.C. Monk. Thus not only are there few companies in the tobacco trade, eight companies dominate it worldwide, they are integrated vertically from the stage of production and purchase of the leaf, to its manufacture, and onwards to its retail sale.

Recent years have also seen considerable diversification of tobacco companies into a number of other sectors including distribution, engineering, financial services, foods, paper and packaging and printing and retailing. Many of the tobacco companies have interests in the alcohol industry. In the UK the best known example is Imperial's acquisition of

the Courage and John Smith breweries. In the US Phillip Morris owns Miller Beers and American Brands own Jim Beam Bourbon. Diversification outside the alcohol and tobacco markets include B.A.T.'s ownership of the cosmetic companies Yardley, Lenthéric, Mornay and Cyclax and the paper and packaging group Wiggins Teape, R.J. Reynolds ownership of Sea-Land and Del Monte and Imperial Group's extensive interests in the food industry (Ross, Golden Wonder, Smedley, HP, Buxted chickens and Young's seafoods).

As might be expected from the degree of concentration in the industry there is again evidence of considerable economies of scale in the tobacco industry although less research has been carried out than for alcohol. Bain (1956) estimated a minimum efficient scale of 5.5 per cent of the UK industry capacity. Whilst in a more recent study by Scherer (1973) the figure suggested is 21 per cent of the UK output, equivalent to a plant employing 2,275. The 1983 census of production shows that the top five establishments produced on average 15.4 per cent of the industries gross output. Each of the five is recorded as employing more than 2000 workers (Booth and Hartley (1987b)).

2.2.3 Illicit Drugs

The amount of published material about the structure, conduct and performance of the alcohol, tobacco and psychoactive drug industries is noticeable by its paucity. This is particularly true of illicit drugs which belong to an illegal sector in which drugs with varying characteristics are produced, traded and consumed in informal market places whose characteristics can be explored only partially, primarily due to a lack of data.

The marginal production costs of illicit drugs such as hashish and heroin tend to be very low. However in the illegal drug market street prices are in excess of marginal production costs because law enforcement agencies distort trade flows and generate distribution costs associated with the probability of arrest, the consequent costs to traffickers and the need to bribe enforcement officers.

Furthermore there is some evidence that the importation and distribution of illicit drugs in many countries is often controlled by organisations, such as the Mafia, which have monopoly characteristics. Such market power generates a capacity to collect rents above production costs: the hard drugs traffic is a form of social security for illegal organisations rather like the US Prohibition was a form of social security for the bootleggers earlier this century.

2.3 Conduct and Performance

The conduct of firms involves a variety of decisions including their choice of location, how many people to employ, how much to spend on advertising and so on. Once a firm's objectives and the structure of its industry have been specified, economic modelling can lead to the specification of a number of important concepts. These include the aggregate supply function, the profit function and factor demands such as the labour demand function. In principle all of these could be estimated, however the paucity of data means that few, if any, reliable econometric studies have been published.

However data do exist to describe trends in the alcohol and tobacco industries' performance, in particular their records on employment and profitability. These are shown in Table 1. Data from the UK Census of

Production shows that the number employed in alcohol manufacturing (brewing and malting, spirits distilling and compounding and the manufacture of British wines, cider and perry) almost halved between 1963 and 1983 (falling by 41 per cent). This fall was concentrated in the brewing sector where numbers fell by 54 per cent. In 1985 the Department of Employment's figure for employment in alcohol manufacture was 76,000, 1.4 per cent of total manufacturing employment while the census of production figure was 60,000. However the UK Brewers' Society have estimated a total employment in drink-related jobs of 750,000 (Thurman (1983)), but this figure includes related sectors such as clubs and restaurants as well as manufacturing. Table 1 also shows that the numbers employed in tobacco manufacturing in the UK dropped by around 31 per cent between 1963 and 1983, a figure which is a little less than the trend for manufacturing industry as a whole (which fell by 32 per cent between 1963 and 1982).

Table 1 also illustrates the trends in the overall profitability of the two industries. Such data are notoriously difficult to interpret, but the rate of return on assets in the brewing industry has remained fairly stable over the period starting at 16.8 per cent in 1960 rising to a peak of 22.7 per cent in 1978 and falling back to 17.5 per cent by 1983. The rate of return in the tobacco industry has shown a consistent upwards trend, peaking in 1982 after a rise of 93 per cent from 16.7 per cent to 32.3 per cent (despite the fall in UK tobacco consumption over the period). An interesting complement to this trend is the growth of tobacco exports. Column 3 of the table shows exports as a proportion of sales for the UK tobacco industry. These show a five-fold rise from 1.4 per cent in 1960 to 8.6 per cent in 1983, indicating that in response to a shrinking domestic market the UK industry has had to look abroad for its profits. At the same

Table 1 Employment, profitability and exports in the UK alcohol and tobacco industries (selected years)

Year	Numbers employed (thousands)		Rate of return on assets (%)		Tobacco exports as a percentage of sales
	Alcohol	Tobacco	Brewing	Tobacco	
1960			16.8	16.7	1.4
1963	107.8	43.3			
1965			14.9	16.2	1.6
1970	101.9	39.7	14.9	14.6	2.4
1975	97.3	39.8	16.8	16.8	4.3
1976	92.5	37.9	18.8	19.0	4.7
1977	92.9	37.7	21.1	21.8	5.1
1978	93.5	37.5	22.7	21.7	7.5
1979	88.3	37.3	21.3	25.9	8.8
1980	84.7	35.7	18.2	22.3	7.4
1981	76.6	33.3	17.6	30.5	7.8
1982	69.3	31.1	17.8	32.3	8.8
1983	63.6	29.8	17.5	27.1	8.6

Source: Employment - Godfrey (1986a)

Profitability and exports - Booth and Hartley (1987a)

time recent years have seen a dramatic growth in imported cigarettes (between 1979 and 1985 the growth was 294 per cent in terms of numbers of cigarettes). This has been attributed to the high specific tax in the UK relative to other European Community countries which has encouraged the importation of cheaper, low quality brands (see eg. Godfrey and Powell (1987)).

This section has concentrated on the production of addictive goods within the private sector. However in many countries some or all of the alcohol and tobacco markets are supplied by producers from within the state sector which may also control distribution. This offers particular scope for public policy, motivated by public health issues, to play a direct role in controlling production. For instance Osterberg (1983) notes that from the mid-1970s the Finnish state alcohol monopoly has attempted to regulate overall consumption on the basis of a perceived link between overall consumption and the prevalence of alcohol-related problems. To do this it has restricted availability and conducted educational campaigns.

3. The demand for addictive goods

3.1 Consumption Trends

This section deals with the trends in the consumption of alcohol, tobacco and illicit drugs since the beginning of the 1960s. All the data are for the UK, but the issues associated with their derivation are international. In Section 5 a table is set out indicating what data could be collected from each country to facilitate comprehensive analysis of a wider range of markets for addictive goods.

3.1.1 Alcohol

The data in Table 2 show the expenditure series for the UK consumption of alcoholic drinks over the period 1960-85. Total consumer expenditure measured at constant prices for alcoholic drink as a whole peaked in 1979 then declined until 1982 before it resumed its upward trend between 1983 and 1985. Within this overall pattern the time trends of beer and spirits are similar but that of wine shows a continuous proportionate growth over the whole period. The market shares of the three product groups have exhibited significant changes. Beer remains the dominant product, holding just less than 50 per cent of the market in 1985, but along with the spirits market it has exhibited a declining market share against wine and other alcohol products.

From an economic point of view an important indicator of consumers' behaviour is the share of alcohol in total expenditure. Using aggregate expenditure to calculate the overall expenditure share shows that alcoholic drinks have risen from 5.5 per cent in 1960 to 7.4 per cent in 1984. The disaggregated pattern is similar to that for market shares. Although it has shown considerable variation around the trend, particularly a marked

Table 2 Consumer Expenditure on Alcoholic Drinks and Tobacco at constant 1980 Prices : million

Year	Alcoholic Drink	Beer	Spirits	Wine, Cider & Perry
1960	4750	3409		1479
1961	5103	3601		1640
1962	5210	3672		1679
1963	5388	3705	1192	632
1964	5738	3876	1287	712
1965	5686	3907	1236	695
1966	5911	4032	1282	749
1967	6154	4165	1304	841
1968	6483	4301	1396	933
1969	6609	4558	1330	913
1970	7073	4718	1559	956
1971	7544	4941	1654	1105
1972	8122	5098	1883	1258
1973	9211	5394	2334	1522
1974	9435	5396	2495	1564
1975	9350	5567	2378	1459
1976	9448	5623	2325	1554
1977	9487	5467	2428	1618
1978	9930	5548	2616	1766
1979	10382	5588	2890	1904
1980	9954	5320	2720	1914
1981	9612	5000	2561	2051
1982	9370	4825	2427	2118
1983	9730	4914	2494	2322
1984	9983	4943	2525	2515
1985	10224	4934	2658	2632

Source: Central Statistical Office - National Income and Expenditure Accounts.

decline between the late 1950s and 1965, the share of beer in total expenditure has remained relatively stable, in 1984 it was 4.0 per cent. Spirits have shown even greater stability, in 1960 their share was 1.6 per cent while in 1984 it was 1.8 per cent. These trends for beer and spirits are in dramatic contrast to the growth of wine consumption in the consumer's budget. In 1960 wine formed only 0.6 per cent of total expenditure by 1984 it had risen to 1.6 per cent. It is this rise in the importance of wine consumption that explains most of the increased share of alcohol in consumers' expenditure.

Expenditure and budget shares are the most obvious way of examining trends in consumption from the economist's perspective. However, another way of describing market trends, of particular relevance to public health, is to translate the data into a series showing consumption in litres of pure alcohol per head of population (aged 15 or over). This series is shown in Table 3 and it can be seen that over the period per capita alcohol consumption increased by 60 per cent, peaking in 1980, declining until 1982, and rising since then. In terms of pure alcohol the market share of beer declined from 73 per cent in 1960 to 57 per cent in 1985, that of spirits rose from 17 to 22 per cent, that of wine from 7 to 17 per cent and cider from 3 to 5 per cent.

Thus the alcohol market in the UK has exhibited considerable growth and significant shifts in market shares during the period since the early 1960s. One factor contributing to these trends has been the movement of alcohol prices in relation to the price of other goods. Over the period 1963-1984 the retail price index (RPI) rose from 100 to 631.6 (Table 4). For the same period the beer index rose to 808.5, that for wine and cider to 501.5 and that for spirits to 465.0. A central argument of the economic theory of consumer behaviour is that consumption will be inversely related to the real price of the good in question. From these figures it is clear

Table 3 Consumption per capita of pure alcohol (in litres per head of population aged 15 and over) - Calendar Year date

Year	Beer	Spirits	Wine	Cider	Total
1960	4.4	1.0	0.4	0.17	6.0
1961	4.6	1.0	0.4	0.18	6.2
1962	4.6	1.0	0.4	0.16	6.3
1964	4.8	1.2	0.5	0.17	6.7
1965	4.8	1.1	0.5	0.17	6.6
1966	4.8	1.1	0.5	0.19	6.6
1967	4.9	1.1	0.5	0.22	6.7
1968	5.0	1.2	0.6	0.22	7.0
1969	5.2	1.1	0.6	0.25	7.1
1970	5.4	1.2	0.6	0.27	7.5
1971	5.6	1.3	0.7	0.27	7.9
1972	5.7	1.5	0.8	0.27	8.3
1973	5.9	1.8	1.0	0.29	9.0
1974	6.0	2.0	1.1	0.30	9.4
1975	6.1	1.9	1.0	0.34	9.3
1976	6.1	2.1	1.0	0.40	9.6
1977	6.0	1.8	1.0	0.37	9.2
1978	6.2	2.2	1.1	0.38	9.9
1979	6.2	2.4	1.2	0.39	10.2
1980	5.9	2.2	1.2	0.38	9.7
1981	5.6	2.1	1.3	0.41	9.4
1982	5.5	2.0	1.3	0.48	9.3
1983	5.5	2.0	1.4	0.54	9.4
1984	5.5	2.0	1.6	0.53	9.6

continued

Notes: These estimates assume average alcohol content as follows:

Beer	-	4% alcohol
Wine	-	12% alcohol
Spirits	-	40% alcohol
Cider	-	8% alcohol

Source: Annual Abstract of Statistics, The Brewers Society, UK Statistical Handbook.

Table 4 **Current Price Indices - 1963 = 100**

Year	Beer	Spirits	Wine and Cider	Tobacco	All Items
1963	100.0	100.0	100.0	100.0	100.0
1964	105.6	106.5	105.9	105.9	103.6
1965	116.6	114.3	111.9	116.8	108.7
1966	121.8	119.0	116.7	119.3	113.1
1967	126.7	121.5	116.0	119.3	116.0
1968	128.2	125.1	120.1	125.0	121.6
1969	136.2	131.3	133.2	135.8	128.3
1970	148.3	131.9	137.5	138.1	135.8
1971	159.5	136.3	141.7	140.8	147.5
1972	168.4	138.9	147.8	142.8	157.1
1973	173.1	144.6	158.7	144.6	170.1
1974	198.4	151.7	181.5	168.3	199.0
1975	248.0	189.8	225.7	216.9	246.3
1976	297.4	215.6	250.5	154.1	284.9
1977	344.5	241.4	272.0	312.3	327.3
1978	370.0	252.8	288.2	309.0	356.7
1979	423.3	279.8	330.2	338.1	404.7
1980	515.6	328.2	378.0	396.2	471.1
1981	615.0	373.0	419.1	488.8	525.3
1982	684.5	406.4	456.8	564.5	570.2
1983	746.5	431.4	473.2	602.5	600.9
1984	808.5	465.0	501.5	665.4	631.6
1985	881.4	488.4	525.4	723.4	659.1

Source: Central Statistical Office - National Income and Expenditure Accounts.

that the real price of beer in terms of the RPI has risen markedly over the period while the real prices of wine and cider, and spirits have fallen. These variations in the movements between the RPI and the products' prices are explained largely by tax changes, an issue that is explored in Section 4.

3.1.2 Tobacco

The consumption trends in the market for tobacco products are shown in Table 5. Real expenditure on tobacco peaked in the late 1970s and over the period 1960 to 1984 fell by nearly 22 per cent. Within this overall trend cigarette consumption, which dominates the market, also peaked in the mid 1970s and fell by 11 per cent over the period. This decline gained pace in the second part of the period with a fall of 25 per cent between 1975 and 1984.

This downward trend in the use of tobacco took place in a period of modest increases in income (purchasing power) and a falling real price, a pattern which would seem to contradict the economic theory of consumption. However in this respect it seems crucial to make the distinction between per capita and per smoker consumption. Figure 1 shows that the downward trend in per capita consumption of cigarettes is attributable to the falling participation rate (the proportion of smokers in the adult population), while the per smoker cigarette consumption pattern shows an upwards trend.

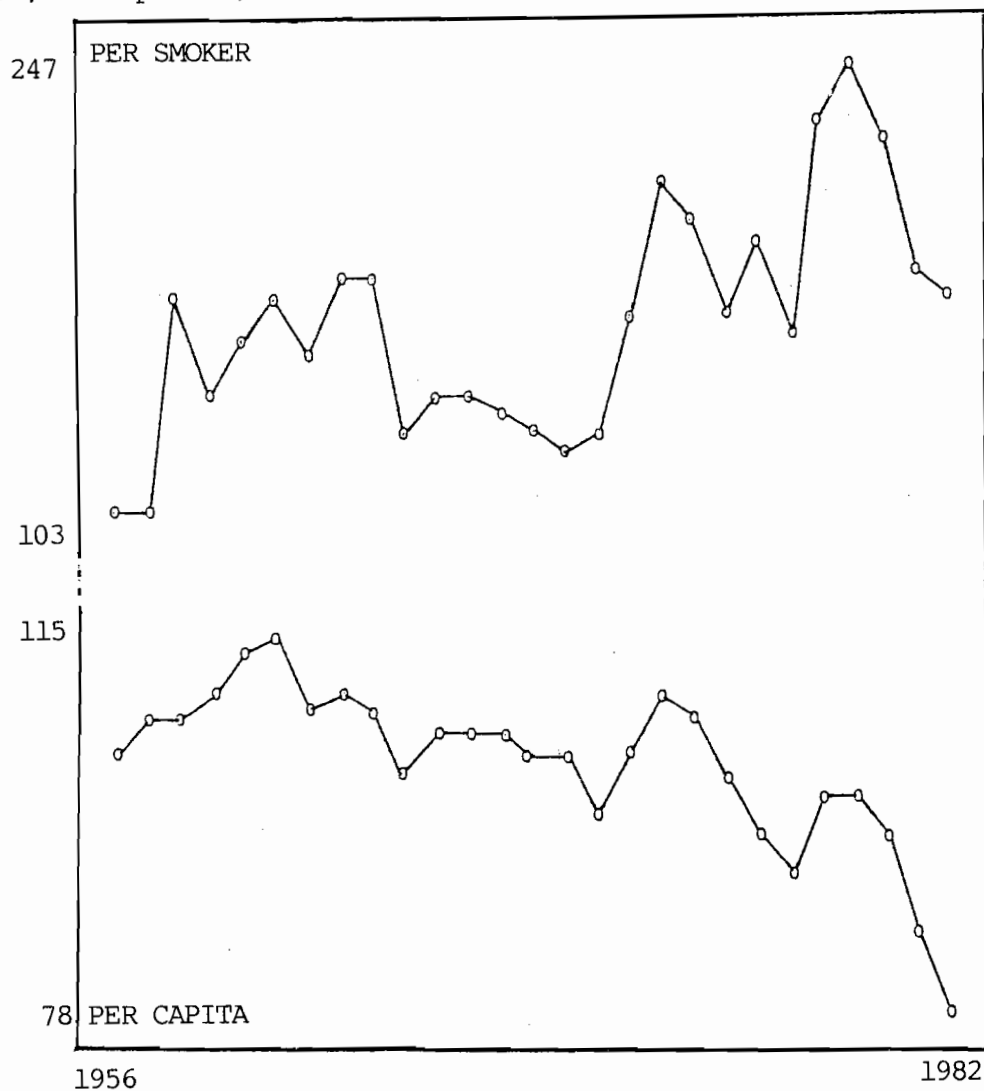
Table 5 Consumption Trends in Tobacco

Year	Expenditure (£ 1980 prices)	Cigarettes ('000 million)	Cigarettes (Mill.Kg)	Cigars and Cigarillos (Mill.Kg)	Pipe Tobacco (Mill.Kg)	Hand- rolling tobacco (Mill.Kg)
1960	5051	110.9	108.5	0.7	7.9	7.1
1965	4842	112.0	100.1	1.3	6.6	7.3
1970	4934	127.9	97.7	2.0	5.8	6.5
1975	4995	132.6	96.4	3.4	5.0	6.4
1976	4821	130.6	93.2	3.2	5.0	6.5
1977	4602	125.9	89.7	3.0	4.9	6.5
1978	4982	125.2	98.9	3.2	4.6	6.1
1979	4960	124.3	98.6	3.2	4.2	5.7
1980	4822	121.5	97.2	3.0	4.0	5.6
1981	4470	110.3	89.4	2.9	3.8	6.2
1982	4128	102.0	82.6	2.7	3.5	6.2
1983	4083	101.6	83.0	2.6	3.3	5.8
1984	3944	99.0	81.6	2.7	3.2	5.3
1985	3837	97.8	81.1	2.6	3.0	5.0

Source: Godfrey, Hardman and Maynard (1986), pp 288 and 293.

Figure 1 Trends in per capita and per smoker cigarette consumption, 1956-1982

(£ p.a., 1980 prices)



This distinction between participation and consumption is highlighted in section 3.2.3 below. The trend in participation appears, at least in part, to be the result of increasing public awareness of the health dangers of tobacco use, initiated by research findings in the UK and the USA in the early 1950s and disseminated and emphasised by subsequent reports (eg. of the Royal College of Physicians in the UK and the surgeon General in the US). Although this history has not been evaluated systematically to determine which policy instruments were the most cost effective, it is clear that "health education", however defined, produced significant results.

3.1.3 Illicit Drugs

Because it is illegal and hence informal or underground this market does not generate readily accessible data about prices, quantities and qualities. Indeed it is surprising, given the public concern about the use of products such as cocaine and heroin, to find that this concern is based largely on ignorance about the volume of traffic, its quality and price movements over time. Surveying the available data Wagstaff and Maynard (forthcoming 1987) concluded that the value of the UK heroin market was only some 3 to 6 per cent of the value of tobacco consumption. This estimate has to be treated with some caution and there are no available data for the size of the other illicit drug markets.

Not only are the volume data poor but the information about price and quality is also highly defective. There is some ad hoc monitoring of these attributes of the illicit drug markets by police and customs agencies, but no systematic sampling of the type that would produce data suitable for econometric analysis, or even descriptive analysis of trends in these markets.

3.2 Empirical studies of the demand for addictive goods

3.2.1 Applied demand analysis

The theoretical foundations of demand analysis are rooted in individual behaviour. The basic approach is to specify the individual's preferences and to argue that they will select a bundle of consumption goods according to those preferences subject to the financial constraint of their income and the prices of the goods. The specification of preferences can be given an explicit mathematical form and a number of attempts have been made to incorporate characteristics which are particularly relevant to addictive goods. These include the influence of addiction on behaviour and the interaction between hazardous consumption and health.

The main outcome of modelling consumer behaviour is a set of demand functions which relate consumption to prices, income and other factors such as advertising and health education. In practice most of the econometric studies of the demand for alcohol and tobacco have used aggregate expenditure data. This implies that the theoretical demand functions are aggregated over individuals or alternatively are treated as a representative individual. However there has recently been increasing use of individual and household survey data from sources such as the UK Family Expenditure Survey (see Atkinson et al, 1984a and 1984b).

Econometric models of demand consist of two components; the functional form of the equations (the deterministic component) and the assumptions made about the equation errors (the stochastic component). These components, and hence the appropriate estimation procedure, are determined normally by the type of data in use and by the underlying economic model. For instance the use of cross-section survey data which identifies smokers

and non-smokers and their socio-demographic characteristics allows the analyst to use models of discrete choice (eg. probit and logit). While time-series data on aggregate expenditure can be used to estimate single demand equations or alternatively systems of equations, exploiting the cross-equation restrictions implied by economic theory to improve the statistical efficiency of the estimation.

It should be emphasised that the assumptions made about functional form and stochastic structure of the model ought both to be tested using techniques that are commonly available in the econometrics literature. It is often assumed that the demand equation is linear in its parameters allowing the use of ordinary least squares estimation, this assumption can and should be tested. The majority of applied studies also assume that the error term on the estimating equation has a normal distribution with zero mean and a constant variance and is uncorrelated across observations. This assumption should also be tested as violations can bias or affect the efficiency of the estimated parameters.

Having specified, estimated, and tested a demand function which relates consumption to prices, income and other relevant factors some guidance is needed to interpret the results. A central concept in the interpretation of demand equations is the elasticity of demand. This measures the proportional response of consumption to a proportional change in a determinant of demand. For example the price elasticity of demand for beer is other things being equal, defined as

$$\text{Own-price elasticity of beer} = \frac{\% \text{ change in consumption of beer}}{\% \text{ change in price of beer}}$$

Similar definitions would apply for the income elasticity, the advertising elasticity and the cross-price elasticity of demand (the latter relates the consumption of one good, say beer, to the price of another, say wine). A beer price elasticity of -0.5 implies that a 10 per cent increase in the price of beer will reduce the consumption of beer by 5 per cent. The attraction of this concept is that the elasticity is independent of the units in which consumption, price, income and so on are measured.

Two notes of caution should be sounded for the interpretation of elasticities:

- (i) In general elasticities will vary according to the point on the demand function at which they are measured. Only under very special restrictions will demand functions lead to elasticities which are fixed numbers. However for convenience many of the empirical studies described below have adopted these restrictions which imply that the demand function is linear in the logarithms of the relevant variables. This point is of particular importance in cross-section studies of income elasticities which in general should be allowed to vary across the income distribution (see Ackinson et al, 1984a).
- (ii) Elasticities are defined in terms of infinitesimal changes and must therefore be used with care when dealing with proportionately large changes in the variables. If the price of cigarettes rises by 10 per cent econometric estimates of the price elasticity are likely to provide a reliable prediction of the effect on consumption. But if the price of cigarettes trebles over-night, the elasticity estimates will be a weak basis for forecasting effects on consumption.

Having set the scene the next three sections survey the empirical work that has been done on alcohol, tobacco and illicit drugs. This review is not exhaustive and concentrates on work that has been done in the UK (it

draws on Godfrey (1986b) and Godfrey and Maynard (1986)). Reviews of methods and results for other countries would provide a useful basis to inform national and international research in the future.

3.2.2 Alcohol

In Table 6 the results of four different UK studies of the demand for alcoholic drinks are set out. The data for price elasticities show considerable variation except in the case of beer where the estimates are small in all of the models. For example the Central Statistical Office (CSO) estimates (H.M. Treasury (1980) and private communication) indicate that a one per cent change in the price of beer will lead to a 0.2 per cent change in the quantity consumed. The Walsh and McGuinness results for spirits and wine are lower than those of Duffy and the CSO. The latter forecast changes in spirits and wine consumption following a one per cent increase in their prices of 1.3 and 1.1 per cent. The price elasticity of a good clearly has a central role to play when it comes to changes in the tax rate. In section 4 it is shown how these elasticities can be used to calculate tax revenues and in the analysis of tax reform.

The data in Table 6 also gives estimates of income elasticities. Again the Duffy and CSO estimates are higher. The CSO figures indicate that a one per cent increase in income will lead to increases in beer, spirits and wine consumption of 0.7, 2.5 and 1.8 per cent respectively. The dispersion of these estimates and of the price elasticities is a cause for some concern, as is the fact that the estimates are derived from data that is at least seven years old. Work underway at York using more recent data is seeking to explore the causes of the variations in the estimates and their stability over time (see Godfrey (1986b)).

There has been considerable debate about the size and statistical significance of the advertising elasticity. The managers of both the

Table 6 Estimates of elasticities in alcohol

(a) Price elasticities

Study Authors	Time Period	Elasticity Estimates		
		Beer	Spirits	Wine
Walsh	1955-1975 (quarterly)	Vol. -0.13	-0.47	-0.28
		Exp. -0.26	-0.45	-0.38
McGuinness	1956-1979 (annual)	-0.30	-0.38	-0.17
Duffy	1963-1978 (quarterly)	N.A.	-0.8 to -1.0	-0.7 to -1.0
Central Statistical Office (CSO)		-0.2	-1.3	-1.3

(b) Income elasticities

		Beer	Spirits	Wine
Walsh	Exp.	0.13	1.20	0.51
	Vol.	0.12	0.99	0.49
McGuinness		0.13	1.54	1.11
Duffy		0.8 to 1.1	1.6	2.2 to 2.5
CSO		0.7	2.5	2.6

Source: Godfrey (1986b), table 2, text and table 3. The C.S.O. data is for wines with under 15% alcohol content and was supplied (personal communication) by H.M. Customs and Excise.

alcohol and tobacco industries have argued that advertising does not increase the overall size of the market but merely affects the market share of their brands. Duffy (1982) found a significant but low advertising elasticity for beer consumption of 0.07. In his wine equation there was no evidence that advertising affected demand and the results for spirits were mixed and insignificant. Walsh's (1982) estimate of the beer advertising elasticity was also low (0.1) and his other results, together with those of McGuinness (1980), do not suggest that advertising has much effect on the level of alcohol consumption.

However there are at least two reasons why further research work on the effects of advertising is needed. Firstly, the results mentioned above are aggregated and little is known about the effects of advertising on particular social class, age and gender groups. For example it is possible that the advertising industry targets its efforts on the young so as to influence life cycle preferences. Secondly, the definition of advertising used in the studies is narrow, including only expenditure in the media. Both alcohol and tobacco companies sponsor art and sports events and this enables them to deliver certain "messages" about their products to consumers. Indeed advertising in its widest sense might include "role models" provided by celebrities and other public figures. While the former could be incorporated into econometric models if data were made available by the industries, the latter is more difficult to model.

Another possible influence on the consumption of alcohol is ease of access. The number of licenses, used as a proxy for access, was found to be significant in the work of McGuinness and Walsh. The latter also found significant effects in the spirits and wine equations. Work is underway to extend these results in a variety of ways (Godfrey (1986b)).

3.2.3 Tobacco

Table 7 sets out estimates for the price and income elasticities of tobacco from a number of UK studies. With the exception of McGuinness and Cowling (1975) the price elasticities are all fairly similar, indicating that the demand is inelastic. The income elasticities are again low with the CSO estimate the highest but still inelastic.

In general tobacco consumption appears to be much less responsive to income and price charges than is alcohol consumption. However the variations in the results is significant and related, no doubt, to variations in the data sets (quarterly and annual for differing periods), the choice of explanatory variables (eg. using volume or expenditure as the dependent variable), and the general approach to modelling demand.

Section 3.1.2 indicated that in terms of trends in cigarette consumption it is crucial to distinguish between participation and consumption. In Jones (1987) the two decisions are modelled separately and the resulting equations are estimated using annual data. The results of the study confirm that participation and consumption do react differently to price and income. They also show the important role of addiction and in particular the cost of adjustment associated with withdrawal effects. The model suggests that per smoker demand is highly price inelastic (with estimates of -0.15 and -0.18).

The distinction between participation and consumption is of particular interest when household survey data are available. Sources such as the Family Expenditure Survey (FES) and General Household Survey (GHS) allow

Table 7 Estimates of elasticities for tobacco

(a) Price elasticities

Study Authors	Time Period	Elasticity Estimates	
McGuinness & Cowling	1957-1968 (quarterly)	s.r. l.r.	-0.99 -1.05
Witt & Pass	1955-1975 (annual)		-0.32
Metra	1958-1978 (quarterly)	s.r. l.r.	-0.34 to 0.54 -0.42 to 0.54
Radfar	1965-1980 (quarterly)	s.r. l.r.	-0.23 -0.39
Central Statistical Office (CSO)			-0.50

(b) Income Elasticities

McGuinness & Cowling	s.r. l.r.	0.31 0.33
Witt & Pass		0.13
Metra		N.A.
Radfar	s.r. l.r.	0.12 0.19
CSO		0.6

Source: Godfrey (1986b), table 1 and text.

individual or household consumption to be identified and the non-participants to be separated from the participants. This kind of information has been exploited by Atkinson et al (1984a) in their study of tobacco expenditure data in the FES and there is great potential for further work in this area.

For time series studies, the estimates of advertising elasticity for tobacco indicate a very low value like those for alcohol. Radfar's (1985) estimate was 0.09 to 0.15 whilst that of Witt and Pass (1981) was 0.07 and the McGuinness and Cowling (1975) results suggest an elasticity of 0.09. Thus it seems that a 10 per cent increase in advertising is unlikely to increase tobacco consumption by more than 1 to 1.5 per cent. (For a critical review of these studies see Godfrey (1986c)).

Health education variables, usually in the form of dummies, have been introduced into the models of the demand for tobacco. Witt and Pass concluded that cigarette consumption is affected by health education events such as the publications of the reports of the Royal College of Physicians (1962, 1964 and 1971) and that consumption is reduced by 3 to 7 per cent in the first and subsequent year after the campaign. Radfar and McGuinness and Cowling incorporated health education effects in terms countervailing the effects of advertising. They found the effects were significant but reduced the (already small) advertising elasticities by only small amounts. The evidence in Jones (1987) suggests that the effect of health scares is predominantly through reduced participation, no effect was apparent on per smoker cigarette consumption.

3.2.4 Illicit Drugs

Although there have been some attempts to estimate the price elasticity of demand for drugs in the USA (see Brown and Silverman (1974) and Silverman and Spruill (1978) who produce a heroin price elasticity estimate of -0.25), no work appears to have been done elsewhere. Similarly there has been little work investigating the links between, eg. heroin consumption and crime (the exception are Silverman and Spruill who estimate that increased enforcement which induces a 50 per cent increase in prices will generate a 14 per cent increase in total property crime).

Before econometric techniques can be used to investigate the characteristics of the market for illicit drugs it is necessary to persuade enforcement agencies to collect systematic data about the prices, quantities and qualities of these substances and the effects of enforcement efforts on market attributes (eg. crime). Such data need to be assembled using careful sampling and trial techniques. Unfortunately such evaluative techniques, although commonplace in medical care, are rarely used by control and enforcement agencies. However, as indicated in a review of the literature and proposals for new research (Wagstaff and Maynard (forthcoming, 1987)) the scope for such work is considerable.

3.3 Discussion

The econometric studies surveyed in this section, in particular the results in tables 6 and 7, indicate gaps in the existing knowledge. Using different data sets (many of which are now quite dated), different models and different variables researchers have, not surprisingly, produced a wide range of estimates. It would be useful, as indicated by Godfrey (1986) who is now pursuing this avenue of research, to estimate a number of models

using a common data set and then to apply statistical diagnostics to evaluate the adequacy and reliability of the various results. As Godfrey notes, recent changes in the relative prices of alcoholic beverages and the sharp fall in the consumption of tobacco may have introduced increased variability into the data enhancing the usefulness of statistical testing procedures.

Such models could throw light on many but not all aspects of policy. While insights can be generated into the effects of small changes in price, income and advertising on the consumption of alcohol and tobacco in particular, the effects of health education and access are more difficult to identify. However the scope for the extension of existing work seems considerable, particularly the analysis of price, income and advertising effects on different age, gender and social groups (eg. see Townsend (1983), and Atkinson et al (1984a) and (1984b)).

Finally, a considerable body of research has grown up in the economics literature which treats "health" as a commodity for which individuals have an explicit demand. A number of authors have extended these models to allow for interactions between the demand for health and for hazardous goods such as alcohol and tobacco (eg. Cropper (1977), Ippolito (1981) and Ginestal (1986)). These models have considerable potential for empirical application and may generate some important new insights, particularly if they are linked to models of habits and addiction.

4. Public Policy and Addictive Goods

4.1 The role of the public sector

The markets for alcohol and tobacco are tightly regulated by governments who tend to exhibit some schizophrenia in their attitudes towards appropriate policies. This stems from the products' capacity to damage the health and welfare of their citizens whilst generating significant tax revenues, employment and exports; a trade-off between health and wealth. In the case of alcohol consumption the CPRS (1979) noted that, in the UK, "The Government has a vested interest in this consumption. It annually yields revenue of some 2,000m. The exports and jobs that the industry provides are important to the economy.

In 1985 the tax yield from alcohol had grown to 5,972m forming 13.9 per cent of total taxes on expenditure and 4.6 per cent of total government current account receipts (see eg. Godfrey and Powell (1987)). The ratio of alcohol exports to imports in 1985 was 1.5 to 1 (although this balance of trade has declined over recent years with the growth of wine imports and the decline of whisky exports). Total employment in the alcohol manufacturing industries in 1985 was 60,000 (compared with 88,300 in 1979).

Similar characteristics are evident in the UK government's relationships with the tobacco industry. In 1985 the tax yield from tobacco was 5,247m, 12.2 per cent of total expenditure taxes and 4.0 per cent of total current account receipts. The ratio of exports to imports was 1.2 to 1. In 1983 total employment in tobacco manufacturing was 29,800.

There are inevitable trade-offs to be made between the wealth of the community and its health. Nowhere is this more evident than with regard to addictive goods whose consumption results in the premature death and increased morbidity for thousands of people each year. The nature of the constraints and relationships in tax revenue policy are outlined here as are the attempt to determine the costs associated with the use of tobacco and alcohol. The use of econometric techniques outlined in section 3 in relation to price and income effects are more likely to be useful in the formulation of trade and tax revenue policies than prevention policy. As indicated towards the end of the section the application of such techniques to analyse use - policy - harm links is perhaps more productive in terms of investigating whether consumption (use) can be influenced by policy (e.g. a tax hike) to reduce harm (e.g. mortality from liver cirrhosis). The range of policies that can be manipulated to affect harm is wide (e.g. licencing, education, advertising, road traffic laws, and risk assessment) and the relative influences of these factors requires careful investigation if cost effective prevention policies are to be identified.

4.2 Economic analysis of the public sector: taxation

Section 3 has shown that the empirical understanding of the economics of the alcohol and tobacco markets has been developed to a greater extent for the "demand side". Considerable effort has gone in to providing reliable estimates of price and income elasticities, and it is for this reason that taxation is used here to illustrate the applied economics of public sector involvement with addictive goods.

A major practical concern for the policy maker is the impact of changes in alcohol or tobacco duties on the revenue derived from the taxes. A crude approach would be to multiply the change in the tax rate by current

consumption, however this is inadequate as it overlooks behavioural responses to the tax change on the part of producers and consumers. By using estimated price and income elasticities it is possible to make forecasts of the revenue effects which allow for these behavioural responses.

In making these forecasts a number of assumptions have to be made. Foremost among these is whether to concentrate on a "partial equilibrium" model, which is confined to the first-round impact of the tax change on the market in question, or to use a "general equilibrium" model, which allows for the repercussions of the tax change throughout the economy.

A second question is the incidence of the tax between producers and consumers. In the UK the official forecasts of tax revenue (H.M. Treasury (1980) and subsequent revisions) assume that alcohol and tobacco taxes are fully "shifted" to the consumer, implying that the aggregate supply of the goods are perfectly price elastic. There is some evidence that this is not the case.

Finally a set of elasticity estimates have to be selected. To illustrate the sensitivity of revenue forecasts to these assumptions a number of calculations have been carried out using 1982 levels of prices, tax rates and consumption to examine the revenue implications of a 10 per cent increase in the duty on cigarettes. In the absence of any behavioural responses to the tax change the predicted increase in revenue is 497m (at 1982 prices, this figure is simply calculated by multiplying the change in duty by the basic level of consumption). In a partial equilibrium model with full forward shifting and using the CSO elasticity estimates the figure drops to £304m. While using estimates based on a model with

addiction effects from Jones (1987) gives an intermediate figure of £418m. These results are sensitive to the full shifting assumption. If supply is assumed to be less than perfectly elastic (using an empirical estimate of 0.8) the predicted revenue drops to £342m with the addiction model and £195m with the CSO parameters.

The contribution of economics to the analysis of taxation is not confined to the positive issue of predicting changes in revenue. A large and theoretically sophisticated literature has grown up around the normative issues of optimal taxation and tax reform. Despite the complexity of this literature, a number of important insights can be gained with a simple application of the results.

The elasticity of the revenue from a specific tax such as alcohol or tobacco duty is given by

$$ER = 1 - \frac{t}{p} E_p$$

where t/p is the ratio of the tax to the goods' selling price and E_p is the price elasticity of the good. In their theory of tax reform Ahmad and Stern (1984) write ER as $1/\lambda$ where λ is interpreted as "the marginal cost in terms of consumer surplus of raising an extra pound in tax revenue".

Under a number of strong conditions the reform rule for an efficient tax policy would be to switch taxation, at the margin, from goods with a high marginal cost λ to those with a lower λ . It should be emphasised that this reform rule ignores:

- i) distributional judgements
- ii) cross-price effects

- iii) market structure ie. less than full shifting
- iv) externalities (third party costs and benefits).

However it does highlight a "standard notion that tax as a proportion of price should be inversely related to the elasticity of demand," (Ahmad and Stern (1984)).

Using elasticities derived from their cross-section studies, Atkinson et al (1984b) propose a value of λ for alcohol taxation of 1.56 and for tobacco of 1.52. They argue that "the proximity of these numbers might suggest that the government has got the balance broadly correct". However this overlooks the widely differing levels of the tax/price ratio for the different groups of alcoholic drinks. To illustrate this point table 8 shows values for λ calculated using some of the elasticity estimates surveyed in section 3 for alcoholic drinks (the tax/price ratios used in these calculations are taken from the national income and expenditure statistics).

The interpretation of these data is that a value of λ of say 1.5 implies that the marginal cost, in terms of consumer welfare, of an extra £1 of revenue is £1.50. Bearing in mind the restrictions outlined above, a crude application of the Ahmad and Stern reform rule suggests that, within the alcoholic drinks sector, taxes should be shifted from spirits to other forms of alcohol. A process that seems to be happening in practice.

The theory of tax reform discussed here is concerned purely with private costs and benefits. It makes no allowance for third party costs of externalities. In the case of addictive substances, externalities are often proposed as a major argument for "preventive taxation". This issue

Table 8 Price elasticities and marginal costs of taxation

	Price Elasticity	1982	1983	1984	1985
H.M. Treasury (1980)					
Spirits	-1.6	6.01	4.88	4.88	4.43
Wine, cider and perry	-1.1	1.58	1.64	1.54	1.53
Beer	-0.2	1.08	1.08	1.08	1.08
Duffy (1985)					
Spirits	-0.85	1.79	1.73	1.73	1.70
Wine, cider and perry	-0.75	1.34	1.36	1.32	1.31
Beer	-0.36	1.15	1.15	1.15	1.15
McGuinness (1983)					
Spirits	-0.38	1.25	1.23	1.23	1.23
Wine, cider and perry	-0.17	1.06	1.06	1.06	1.06
Beer	-0.30	1.12	1.12	1.12	1.12

is taken up in the following section which deals with the social costs of addiction. However, before considering the link between externalities and tax, it is worth noting that quite different pressures for tax harmonisation have arisen out of UK membership of the European Community. The European Commission argued that UK taxes favoured beer relative to wine and in 1983 they achieved a court ruling that beer and wine should be treated as like products and taxed according to their alcoholic strength per volume. This pressure from the EEC has brought the ratio of the tax on a pint of beer down from around 5:1 to around the community average of 3:1 (Godfrey and Powell (1985)). It is clear that a criterion for tax reform based on the alcoholic strength of the beverages may lead to quite a different outcome from the criteria suggested by the economic theories of tax reform and optimal taxation which are based on individual welfare.

4.3 Social Costs

One factor which may influence public policy towards addictive goods is the health status of citizens. In 1984 the UK Chancellor of the Exchequer used this argument for the first time in putting up tobacco taxes by a rate in excess of the RPI. Arguments such as this tend to be couched in terms of harm or the total social costs to society. This section surveys the attempts that have been made to identify the social costs of drug abuse.

4.3.1 Alcohol

The epidemiological knowledge which forms the basis of any attempt to quantify the costs to society associated with the use of alcohol is inadequate (McDonnell and Maynad, 1985a). As a consequence any estimates

of the total social costs associated with the use of alcohol are incomplete and qualitatively poor. A "guesstimate" of the UK social costs of alcohol use is given in table 9. The social cost of alcohol in 1983-4 was approximately £1600 million and approximately £2 billion in 1987 (Maynard, Hardman and Whelan (1987)).

Not only are these data poor, even "simple" indicators like alcohol related mortality are difficult to establish. Using published data McDonnell and Maynard (1985c) estimated that the number of alcohol related deaths in 1983 was between 5,000 and 7,800. The range of these estimates is illustrative of the poor quality of the basic epidemiological data. It was also calculated that these deaths generated between 115,980 and 185,384 premature life years lost.

However these data are believed to be serious under-estimates of mortality in the UK associated with alcohol use. This belief is based partly on the findings of the Malmo study which involved the re-analysis of mortality among middle aged men, using longitudinal survey techniques. This work indicated that official Swedish mortality data under-estimated true alcohol related mortality by a factor of between 6 and 8 (see eg. Petersson et al (1982)).

Using such findings it has been argued (British Medical Journal (1986) and Royal College of Psychiatrists (1986)) that the likely annual alcohol associated mortality level in the UK may be as high as 25,000. A report of

Table 9 Total resource costs of alcohol misuse in England and Wales (1983 prices)

	£m
(1) The Social Cost to Industry	
a. Sickness absence	723.55
b. Housework services	48.60
c. Unemployment	166.74
d. Premature death	653.31
 (2) The Social Cost to the National Health Service	
a. Psychiatric hospitals, in-patient costs (alcoholic psychosis, alcohol dependence syndrome, non-dependent abuse of alcohol)	19.89
b. Non-psychiatric hospitals, in-patient costs (alcoholic psychosis, alcohol dependence syndrome, alcoholic cirrhosis and liver disease)	8.04
c. Other alcohol related diseases in-patient costs	82.09
d. GP visits	2.1
 (3) Society's Response to Alcohol Related Problems	
a. Expenditure by National Alcohol Bodies	0.33
b. Research	0.60
 (4) The Social Cost of Material Damage	
a. Road traffic accidents (Damage)	104.01
 (5) The Social Cost of Criminal Activities	
a. Police involvement in traffic offences (excluding road traffic accidents)	4.90
b. Police involvement in road traffic accidents (includes judiciary and insurance administration)	14.53
c. Drink-related court cases	18.14
 TOTAL (including unemployment and premature death)	1026.78
TOTAL (excluding unemployment and premature death)	1846.83

Source: Maynard, Hardman and Whelan (1987).

the Royal College of General Practitioners even suggests that alcohol related premature mortality may be as high as 40,000 per year. These and other guestimates (eg. see Maynard (1986)) cannot be substantiated by scientific fact at present because the requisite scientific research has not been carried out in Britain or elsewhere (with the exception of Sweden). So, while it is known that existing data may under-estimate alcohol related mortality, it is not known by how much these data are inadequate measures of this aspect of "damage".

4.3.2 Tobacco

There is no published estimate of the social costs associated with the use of tobacco in the UK. A Department of Health estimate has been made, showing inter alia a NHS tobacco related cost of 155 million in 1981 (Finsberg (1982)) but this has yet to be published. The authors of a recently published study by the UK Office of Technology Assessment (cited in Inglehart (1986)) estimated that the costs to US industry (in terms of lost production) of tobacco associated illness was \$43 billion. This represents (as noted by Inglehart) an industrial loss equivalent to \$1.45 for each pack of cigarettes sold in the USA.

The latest report of the Royal College of Physicians (1983) estimated that the annual tobacco related mortality rate was at least 100,000. In other words they estimate that 15 to 20 per cent of all British deaths are tobacco related.

In addition to the users of tobacco dying and having reduced quality of life during their declining years, the use of tobacco imposes health consequences on non-users. The exact effects of passive smoking on third parties is an area of intensive research and initial UK estimates put the

passive smoking death rate at about 300 per annum. More research is needed to clarify these effects (see eg. US Surgeon General (1984, Ch. 7)).

4.3.3 Illicit drugs

There are no accurate mortality data associated with the use of illicit drugs. The best guess is that in 1984, 235 deaths resulted from the use of such substances (British Medical Journal (1986)). There are no social cost estimates available.

4.3.4 Discussion

The paradox is that in terms of these incomplete social cost and mortality measures the most damaging to health of the products is tobacco. In the UK tobacco is associated with the deaths of over 100,000 people each year; alcohol is associated with 5,000 to 7,800 (and probably many more) and drugs with less than 300 deaths per year. Why is it that those products which cause so much more social damage are not assigned the priority of the problems arising from the use of illicit drugs?

To illuminate these areas both nationally and internationally it is necessary to acquire better data. A tentative listing of such data is set out in section 5.

A note of caution should be sounded. If public policy is to be influenced by a concern for social costs, care should be taken to clarify the nature of those costs. From the Paretian perspective the individual is sovereign and, to put it crudely, should be free to decide how to depreciate his/her human capital stock and when to die (Littlechild and Wiseman (1986)). The liberal neo-classical economist would argue that,

provided the use of tobacco generates only private costs, only a paternalist can advocate the infringement of individual liberty by addiction control policies.

This rather 'fundamentalist' viewpoint needs to be qualified in a number of ways. Firstly it is based on the individual having access to the same information as policy-makers on the effects of their behaviour. Secondly it ignores the influence of addiction and the diminished responsibility that it can entail. Related to this is the fact that in the majority of cases these habits are acquired during adolescence, a period when individuals are open to particularly powerful peer group pressures. The sovereignty of the adult smoker, for instance, may be severely curtailed by the burden of an addiction inherited from their earlier years. Many adult smokers express a desire to quit the habit, and this may bring into question the normative significance of the economists' dictum that true preferences are only revealed in observed behaviour (see eg. Wright (1987)).

These issues aside, it is clear that alcohol, tobacco and illicit drugs do impose third party costs, or externalities, ranging from injuries and deaths in motor accidents caused by drunken driving to drug related theft and violent crime. However care should be taken to distinguish policies aimed at reducing externalities from those based on paternalism.

4.4 The appropriate policy-mix

What are the objectives of addiction policy? Some health promotion/education agencies seem to advocate the removal of all the social costs associated with these consumption activities. However, efficient

policy formation must look at the costs and benefits at the margin, emphasising changes in the costs of policy formation and execution and the resulting change in benefits.

Considerable research is going into the measurement of these benefits in terms of the generation of additional years of life and the quality of those years (quality adjusted life years or QALYs). One priority for research is to identify the costs of alternative ways of producing desired outcomes (QALYs). The pursuit of efficiency is not concerned with minimising the costs of policy formation and execution, if it was the "efficient" policy would be to do nothing. Neither is efficient policy formation concerned with maximising benefits (eg. QALYs, reduced mortality or social costs) regardless of the costs in terms of designing and implementing policies and their consequences for the "losing" industries (ie. reduced employment and incomes). Given the existence of scarcity it is essential to identify the cheapest way of generating QALYs and spending limited budgets on the best QALY-acquiring activities. Benefits and costs have to be traded off at the margin and the efficient policy is unlikely to lead to the removal of all the costs associated with the use of addictive substances.

This emphasis on selectivity and the benefits of policies, measured in terms of life years saved, highlights the importance of targeting policies at certain groups who are particularly "at risk". The potential gain, in terms of QALYs, will be particularly large if addiction related deaths can be prevented among young people. In this context it is interesting to look at recent work in the USA which involves econometric analysis of youth alcohol abuse and motor accident mortality (eg. see Saffer and Grossman (1982) and Grossman and Coate (1985)). These authors evaluate an increase in the legal minimum drinking age and increased alcohol taxation as means

of reducing accident mortality. They conclude that a uniform drinking age of 21 in all US states would reduce deaths amongst 18 to 20 year olds by 7 per cent. More strikingly they predict that a policy which offset the erosion in the real federal beer tax that has occurred since the 1950s and that taxed the alcohol in beer at the same rate as spirits would reduce deaths amongst 18 to 20 year olds by 34 per cent and amongst 21 to 24 year olds by 52 per cent (Grossman and Coate (1985)).

Two of these authors have also been involved in similar work on the influence of taxation and regulation on teenage smoking in the United States (Lewitt, Coate and Grossman (1981), Lewitt and Coate (1982)). They conclude that teenagers are more responsive to price effects than adults and that "price has its greatest effect on young males and that it operates primarily on the decision to smoke rather than via adjustments in the quantity of cigarettes smoked" (Lewitt and Coate (1982)).

To summarise, efficient policy formation should be informed by cost and benefit information. It is commonplace for the costs of efficient addiction policies to be underplayed and for policy to be formulated largely in terms of benefits (reduced mortality, lower social costs and increased QALYs). Furthermore these benefit estimates tend to be crude, measuring totals rather than margins. Thus the economic basis of policy formation is incomplete and inadequate. Social cost estimates, such as those in table 9, whilst illuminating some aspects of the policy problems, are largely irrelevant for the purposes of formulating efficient prevention policies. Such policies need to be informed by data about the costs and benefits at the margin. The next section introduces a call for improved and internationally comparable data-sets to help meet this need.

5. Data requirements and the "research box"

In order to assist the development of reliable econometric studies of the demand and supply of addictive goods it would be useful to compare methods and results across countries. In particular the collection and analysis of the data set out in table 10 would enable policy makers and economists to identify the strengths and weaknesses of existing estimates and to set about improving any deficiencies. For those intending to carry out their own empirical analysis of the demand for addictive goods, table 11 sets out an agenda for the research methodology and the presentation of results. It is hoped that this will encourage consistency of data sets and econometric approach and will allow reliable international comparisons to be made.

At present the extent of economic analysis in the markets for addictive substances is limited but it is beginning to develop in a substantive fashion. The scope for "gains from trade" across international boundaries seem potentially large in terms of developing methods of analysis and providing inputs into the process of policy formation. However, progress of this type will not take place unless basic data sources (economic and epidemiological) are improved. (a succinct and insightful review of some European data is provided by Powell (1987)).

An essential ingredient into the process of improving data and using it to inform policy decision making is the generation of information such as that outlined in tables 10 and 11. If such basic and essential facets of policy formation are not addressed systematically it is likely that the present increase in analysis of the markets for addictive goods will develop less efficiently than it otherwise might. At worst the current stirring of policy reform could come to nought.

Table 10 Data Requirements for International Comparison

Data to be collected on a quarterly basis where possible.

(a) Alcohol: a data series from 1960 to 1986 for all alcohol in total and beer, wine, spirits and other alcoholic products separately.

Expenditure at current and constant prices.	Annual estimate of social costs, emphasising gaps.
Litres of pure alcohol, per capita aged 15 years and over.	Mortality associated with alcohol use.
Price indices.	
Factor price indices (eg. labour and raw materials).	Advertising Expenditure (total and by age groups)
	Tax Revenues

(b) Tobacco: a data series from 1960 to 1986 for:

Expenditure at current and constant prices.	Annual estimate of social costs, emphasising gaps.
Cigarettes (numbers).	
Cigarettes (Kg.mn)	Mortality associated with the use of tobacco (including passive smoking effects).
Other tobacco products (Kg.mn)	
Price indices.	
Factor price indices	Proportion of smokers in the population (broken down by age, social class, region, etc).
Tax revenue	
Advertising expenditure (total and by age groups)	

(c) Illicit drugs: for each drug a data series from 1970 for:

Real expenditure.	Annual estimate of social costs.
Quantity (Kg.mn).	Mortality associated with the use of illicit drugs.
No. of users and frequency.	
Quality.	
Price indices.	
Expenditure (and volume) data on enforcement (Police and Customs).	

Table 11 The "research box": an outline for applied demand analysis

(1) For each study the following information would be set down:

(a) Methods

- i) functional form of equation estimates (eg. log-log)
- ii) time period (indicate whether quarterly or yearly data used)
- iii) estimation technique (OLS, 2SLS, etc)

(b) Results

- i) which estimates were statistically valid?
- ii) what elasticity estimates were generated (giving their standard errors if possible)?

(2) These data would be collected for all demand equations (alcohol, tobacco and illicit drugs) in which any or all of the following variables were included:

- i) price
- ii) income
- iii) advertising
- iv) access (eg. number of outlets, number of licenses and hours)
- v) health education

(These data might be for aggregate markets (eg. tobacco, beer, spirits and wine) or for subsets thereof (eg. teenage beer or tobacco consumption).

For guidance on the statistical testing of demand models see Godfrey (1986b).

6. Executive Summary

The purpose of this paper, which is an output of a WHO meeting in Disley, UK in 1984, is to provide an economic framework for the discussion of policy objectives and for the analysis of the efficiency of alternative policy instruments used to regulate the market for addictive substances (in particular alcohol, tobacco and illicit drugs).

The next section of the paper (2) analyses the supply of addictive goods and examines the structure, conduct and performance of the three industries. Using UK evidence, it shows that patterns of ownership, employment, trade (imports and exports) and integration continually change and are amenable to economic analysis.

In section 3 the recent trends in the consumption of addictive substances are described prior to a survey of econometric techniques and results about the demand for alcohol, tobacco and illicit drugs. Attention is paid to price and income elasticities of demand in particular.

The nature and extent of Government regulation of these markets is the subject of section 4. The objectives of taxation policy and the relation to estimates of social cost to policy formation are discussed. It is shown that the evolution of consumption (eg. of alcohol) - harm (eg. road traffic accident deaths), and the appraisal of alternative policy instruments (eg. minimum drinking ages and alcohol taxation policies) in terms of their effects on use and harm is an area in which econometric techniques can be used productively to illustrate the nature of policy options (Although much work is still needed to investigate the links between use and harm). The conclusion of this section is that efficient policy formation should be informed by cost and benefit (outcome) information.

These three main sections are drawn together in section 5 which sets out a detailed proposal for the collection of data and the conduct of econometric research on an international level. Such data collection and its analysis which enable policy makers to learn more about the costs and benefits of their own policies as well as those of their neighbours rather than live in virtual ignorance of costs and outcomes as they do now.

The paper concludes with a glossary of economic terms and a bibliography.

The scope for the use of economic analysis to investigate the supply and demand for addictive substances is considerable. Such analysis can illuminate the policy debate with estimates of the costs and benefits (outcomes) of competing policies which can be used to regulate the use of alcohol, tobacco and illicit drugs.

Appendix: Glossary of economic terms

Ad valorem tax

A tax charged as a percentage of the market value of a commodity. As opposed to a unit tax which is charged at a fixed rate per unit and is independent of the price of the good.

Cost effectiveness

Evaluation of options on the basis of the resources required to achieve a given end. In principle the term only applies to alternative means of generating a identical outcome, however it is often misused in practice.

Cost benefit analysis

Evaluation of options which have different outcomes on the basis of their costs and benefits, at the margin.

Deadweight loss

The loss in efficiency (measured in terms of consumer and producer surplus) associated with the imposition of a tax.

Demand function

Defines a relationship between the quantity of a good that consumers plan to consume and the determinants of demand such as prices and income.

Elasticity

This concept is discussed at length in section 3. The price elasticity of demand is the ratio of the percentage change in quantity demanded as a result of a price change to the percentage change in price.

Externality

A cost or benefit borne by a third party.

Pareto improvement

A change which makes no individual worse-off and at least one individual better-off.

Pareto optimum

A situation in which there are no potential Pareto improvements (no potential changes which satisfy the definition of a Pareto improvement given above).

QALY

A quality-adjusted life year, a measure of benefits which combines the effects of policies and therapies on the length of life (additional life years) and their quality.

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