ECONOMIC ASPECTS OF THE ILLICIT DRUG MARKET AND DRUG ENFORCEMENT POLICIES IN THE UNITED KINGDOM

HOME OFFICE RESEARCH STUDY 95

HOME OFFICE RESEARCH STUDY NO. 95

Economic Aspects of the Illicit Drug Market and Drug Enforcement Policies in the United Kingdom

by Adam Wagstaff and Alan Maynard

A HOME OFFICE
RESEARCH AND PLANNING UNIT
REPORT

LONDON: HER MAJESTY'S STATIONERY OFFICE

First published 1988

ISBN 0 11 340883 8

HOME OFFICE RESEARCH STUDIES

'Home Office Research Studies' comprise reports on research undertaken in the Home Office to assist in the exercise of its administrative functions, and for the information of the judicature, the services for which the Home Secretary has responsibility (direct or indirect) and the general public.

On the last pages of this report are listed titles already published in this series, in the preceding series *Studies in the Causes of Delinquency and the Treatment of Offenders,* and in the series of *Research and Planning Unit Papers.*

Foreword

In 1985 Professor Alan Maynard and Dr Adam Wagstaff were commissioned to review the international economics literature on the cost-effectiveness of law enforcement strategies aimed at reducing the misuse of controlled drugs; examine the economic characteristics of the illicit drug markets in the United Kingdom; explore the costs and benefits of the drug enforcement work of HM Customs and Excise and the police; and make recommendations for further research.

Their report does not aim to provide an up-to-date assessment of the drugs problem as it affects the UK. Most of the initial work on this project was done in the second half of 1985. This work broke new ground, and the need subsequently to check data and explore further the implications of some of the techniques used has extended further the time lag already inherent in much published data in this area.

This is nevertheless an important and innovative study which should be of great interest to all those concerned with drugs policy and its implementation. For policy makers its chief significance lies in its examination of the ways in which the different levels of drugs enforcement are capable of evaluation. The authors make clear that the report, because of the limitations of the data available, does not itself constitute such an evaluation. But it does make a notable contribution to "value for money" analysis. Examples are the way in which the report explores the scope for, and methods of, quantifying outputs and assigning input costs for drugs enforcement. Professor Maynard and Dr Wagstaff have also constructed a number of different cost-effectiveness indices, and the report discusses their interpretation.

The report ends with recommendations for better information and further research. A number of improvements in data on seizures, prices, purity levels and addict notifications have already been implemented, or are in hand. Several current research projects have been influenced by Professor Maynard's and Dr Wagstaff's findings, and we intend that future research projects should progressively respond to other recommendations in the report. Professor Maynard's and Dr Wagstaff's work has also been taken into account in the monitoring and evaluation of the Government's drugs strategy which is co-ordinated by the Ministerial Group on the Misuse of Drugs.

MARY TUCK

Acknowledgements

A number of people have helped us during the course of writing this report. In particular, we would like to thank the following:

C. Andrew, HM Customs and Excise; J. P. Bensley, Cleveland Constabulary; R. F. Broome, Avon and Somerset Constabulary; D. Browne, Freelance journalist; Sir Lawrence Byford, HM Chief Inspector of Constabulary; M. Campbell, United States Drugs Enforcement Administration; M. Clark, National Co-ordinator of Regional Crime Squads; D. Crockley, Metropolitan Police Drug Squad; H. D. Davies, South Wales Constabulary; D. A. Davis, HM Customs and Excise; J. D. Dibley, Sussex Police; D. Graham, Cheshire Constabulary; R. Hartnoll, Drugs Indicators Project; C. V. Hewett, National Drugs Intelligence Unit; J. Hopley, Staff Officer to National Co-ordinator of Regional Crime Squads; H. Hunter, Arthur Young and Associates; The Institute for the Study of Drug Dependence; B. Irving, Police Foundation; D. S. Jones, Hertfordshire Constabulary; R. Lees, Greater Manchester Police; W. MacLaurin, National Drugs Intelligence Unit; T. Meffen, West Midlands Police; J. Mott, Home Office; R. Newcombe, University of Liverpool; P. O'Neil, Laboratory of the Government Chemist; R. G. L. Osborne, Drugs Intelligence Laboratory, Central Research Establishment; R. Penrose, Metropolitan Police Drugs Squad; B. D. K. Price, Cumbria Constabulary; D. G. Purkiss, Sussex Police; B- J. Reynolds, National Drugs Intelligence Unit; H. F. C. Reynolds, Gloucestershire Constabulary; J. A. Rigby, HM Customs and Excise; J. Sharpies, Avon and Somerset Constabulary; G. Sims, Avon and Somerset Constabulary; H. B. Spear, Home Office; K. Vardy, West Midlands Police; D. Wilkinson, Cheshire Constabulary; D. J. Williams, Hertfordshire Constabulary; D. Wilmot, West Yorkshire Metropolitan Police; C. Woolf, Home Office.

ADAM WAGSTAFF and ALAN MAYNARD

Contents

1 Introduction and Summary

1.1 Introduction

Current trends in illicit drug use in the UK are a source of considerable concern. The Government's concern was reflected in a speech to the London Diplomatic Association in 1983 by the then Home Secretary, Leon Brittan. "Drug abuse", he commented, "is a disease from which no country and no section of modern society seems immune. Stamping it out will be slow and painful. It requires co-operation between Governments, law enforcement agencies, professionals, schools and families. The rewards are great if we succeed — and the price of ultimate failure unthinkable" (Home Office, 1985a, page 3). The Home Affairs Committee has used even stronger language. In their Interim Report on the Misuse of Hard Drugs (Home Affairs Committee, 1985a) the Committee described the prospect of South American cocaine exporters targeting their supplies on the British market as "the most serious peacetime threat to our national well-being" (Home Affairs Committee, 1985a, page Hi).

The Government's response to the apparent growth in drug misuse has been to increase its expenditure on anti-drug measures. These include law enforcement (HM Customs and Excise and the police), treatment, rehabilitation and prevention, as well as assistance to producer countries for law enforcement and crop-substitution programmes (both directly and through the United Nations) (see Home Office, 1985a). The Home Affairs Committee (1985) recommended that Government expenditure on drug control measures be increased yet further. They urged that there be intensified law enforcement against drug traffickers, stiffer penalties for traffickers of 'hard' drugs and seizure of their assets. It also urged the Government to consider use of the armed forces for surveillance operations against illicit importers.

None of these recommendations is based on any firm evidence that their adoption would represent an efficient deployment of resources. Nor indeed is there any firm evidence that the particular 'mix' of enforcement (and non-enforcement) measures in the current strategy for tackling drug misuse represents the best possible mix, in the sense that it yields the largest possible benefits in terms of reductions in illicit drug consumption. That the best mix may not have been found has been suggested in various quarters (see e.g. Stimson, 1985).

The fundamental problem facing the Government in its deliberation on drug control measures is the paucity of information on the subject. The current debate

is characterised more by rhetoric than hard facts. Nowhere is this more true than in discussions of the 'size of the problem'. Delegates to a 1984 British Medical Association Conference suggested that drug misuse had become so widespread that it was no longer 'an epidemic' but rather 'a plague' (Hansard, 13.7.1984). The facts suggest otherwise. In 1982 there were 142 deaths associated with controlled drug misuse (Office of Population Censuses and Statistics, 1983). In the same year an estimated 5,000 deaths resulted from alcohol misuse (McDonnell and Maynard, 1985) and at least 100,000 persons died prematurely from cigarette smoking (Royal College of Physicians, 1983).

The debate concerning the wisdom of current djug enforcement policies has also been characterised more by alarmist rhetoric than hard facts. The trade union representing uniformed Customs Officers has argued that ''the present level of customs controls in the United Kingdom can no longer be regarded as effective" (Society of Civil and Public Servants, 1985, page 1) and that the policy of reducing the numbers of uniformed officers has been "the height of irresponsibility by this Government" *(The Times*, 16.4.1985). The use and interpretation of figures quoted by the trade union in support of its claim for additional staff are, however, viewed by the Board of Customs and Excise as highly misleading (cf. Home Affairs Committee, 1985b).

1.2 Objectives and structure of the report

The objectives of this report are:

(i) to establish what is known about the economic 'parameters' of the UK illicit drug market prices, quality (purity) and consumption. The report focuses on the markets for heroin, cocaine and cannabis and investigates how these markets have evolved since 1979;

(ii) to review the literature on the economics of drug enforcement;

(iii) to undertake some preliminary economic analysis of drug enforcement policies in the UK; and

(iv) to make suggestions for future research.

The report is organised as follows. Chapter 2 discusses the 'welfare economic' foundations of drug enforcement policies. It introduces the idea of 'external costs' of illicit drug consumption—costs imposed by drug misusers on third parties such as health care costs, lost productivity and distress to others—and outlines the various factors to be borne in mind when evaluating alternative means of government intervention designed to reduce these costs. It emphasises the distinction between the problem of ensuring that drug enforcement agencies operate in a cost-effective fashion and the problem of determining the efficient scale of operation of each enforcement agency at the various levels of the market. The type of question considered in the discussion on cost-effectiveness is: ought HM Customs to be devoting a greater share of its budget to intelligence work and

less to the employment of static controls at airports and ports? The type of question considered in the discussion on the efficient scale of activity is: ought more of the Government's drug enforcement expenditure be devoted to enforcement at the import level of the market and less on enforcement at the retail level?

Chapter 3 provides a review of the literature on the economics of drug enforcement. It begins with the theoretical literature. Much of this has been orientated towards the issue of whether supply-side enforcement (measures aimed at drug traffickers, rather than users) has any beneficial effect on illicit drug consumption. It also discusses the idea of the effects of enforcement aimed at one market 'spilling over' into other markets: enforcement aimed at heroin dealers, for example, may have repercussions for the cocaine market. Chapter 3 also reviews the few studies that have been undertaken aiming to estimate the effects of alternative enforcement measures on illicit drug consumption. Influential amongst these is the report by Polich *et at.* (1984), which concluded that in the United States even large increases in drug enforcement expenditure—at any level of the market — would be unlikely to reduce consumption of cocaine and marijuana by any significant amount.

Chapter 4 examines what is known about the economic parameters of the UK illicit drugs markets. It presents data on prices, purity and—in the case of heroin—consumption for the years 1979-84. It also discusses the limitations of the existing data.

Chapter 5 presents a preliminary economic analysis of the drug enforcement activities of HM Customs and Excise. It presents data on manpower and expenditure for the years 1979-85, much of which has not previously been published. Chapter 5 also discusses the various possible measures of 'output' of HM Customs and Excise drug enforcement work and how these might be used to analyse cost-effectiveness. The chapter goes on to consider the effects of Customs drug enforcement activities on the 'final output' of drug enforcement policies — reductions in illicit drug consumption.

Chapter 6 presents a similar analysis to that undertaken in Chapter 5 for the police. It presents data on manpower and expenditure on drug enforcement by the police and discusses the various possible measures of the 'output' and how these might be used to examine the cost-effectiveness of their work. The chapter then goes on to consider the effects of police drug enforcement work on illicit drug consumption and the effects of changes in the law relating to length of prison sentences for drug traffickers and seizure of their assets on the retail prices of illicit drugs.

The final chapter—Chapter 7—presents a list of suggestions for future research, as well as a list of data requirements for this research.

1.3 Summary of tbe report

The welfare economics of drug enforcement policies

The economic rationale for government intervention in the illicit drug market appears to be that drug misuse imposes costs on non-users, in the form of distress to others, health care costs, drug-related crime and lost production. These costs are known as 'external' costs in economic theory. The mere existence of such external costs does not, however, ensure that society as a whole stands to gain from their elimination. Reducing illicit drug consumption through law enforcement and prevention programmes is *itself* a costly exercise and these costs need to be compared to the benefits such programmes yield in terms of reduction in the external costs of drug misuse.

The planning problem facing the Government is to allocate its 'anti-drugs' budget in such a way that the benefits from the anti-drugs programme as a whole—defined in terms of reductions in illicit drug consumption—are as large as possible. This problem can be broken down into two stages: (i) the problem of ensuring that the enforcement agencies operate in a cost-effective manner at each scale of operation, and (ii) the problem of determining the efficient scale of operation for each of the various agencies. An example of the type of question considered under (i) is: ought HM Customs be devoting more of its budget to intelligence work and less to static controls at ports and airports? This is a question of cost-effectiveness. An example of the type of question considered under (ii) is: ought the Government to be devoting more of its budget to enforcement at the import level of the market and less to enforcement at the wholesale level? This is a question of the efficient scale of activity of enforcement agencies and concerns the appropriate level of expenditure on HM Customs and the police drug squads.

An investigation of the issues of cost-effectiveness and efficient scale of activity requires estimates of the relationship between the enforcement agencies' inputs and outputs. Inputs include manpower and equipment. Two types of output can be distinguished: a final output (defined in terms of reductions in illicit drug consumption) and an intermediate output (number of seizures, amount of drugs seized, arrests of traffickers etc.). The size of an enforcement agency's intermediate output depends on its own activities and on external factors affecting the size of the drugs market (conditions in producer countries etc.), The size of its final output will depend on its own activities, but also on many other factors, including the activities of other agencies in the criminal justice system, notably the courts and prisons. Because of this it may be more satisfactory to use measures of intermediate output when investigating the issue of cost-effectiveness.

The economics literature on drug enforcement policies

Much of the economics literature on enforcement policies is of a theoretical nature. Early studies argued that 'supply-side' enforcement measures (measures

aimed at traffickers) were likely to be futile, since the demand for illicit drugs (especially addictive drugs) is likely to be unresponsive to price changes. It was argued further that such measures may be counter-productive because they will tend to result in increased expenditure on drugs and therefore higher drug-related crime (addicts engaging in theft to support their 'habit'). The early literature concluded that demand-side measures (arrests of users, education etc.) would be more likely to reduce illicit drug consumption and would have the added advantage of reducing—rather than increasing—the level of drug-related crime.

This conclusion has recently been challenged on the grounds that the demand for illicit drugs may not be so insensitive to price changes as was previously thought. One reason is that users of certain drugs, such as heroin, tend (or are at least able) to switch to other drugs as the price of heroin (or whatever) rises. The existence of substitutes means that the demand for some drugs may not actually be so 'price-inelastic' (i.e. unresponsive to price changes). Other writers suggest that demand may be 'price-elastic' at least over some price ranges. At low prices some of the market demand will be from occasional users, whose use may be expected to drop (or even cease) as the price rises. Thus, even if addicts' demand is price-inelastic at low prices, the market demand need not be. At high prices addicts' demand may be price-elastic, since as prices become very high, they will find it harder and harder to fund their 'habit'. They may be more likely to be detected when engaging in theft and therefore more likely to be removed from the community. They may also be more likely to enter treatment programmes voluntarily as finding money for illicit supplies of drugs becomes more difficult. The upshot of all this is that supply-side law enforcement may, after all, have a role to play.

Some writers have suggested that price increases and price reductions may have asymmetrical effects on the demand for drugs. When prices are falling, new users may develop a 'habit', which they cannot 'kick' when prices rise again. The implication of this is that it will be harder for the enforcement agencies to reduce consumption through supply-side enforcement measures than one might conclude merely from an examination of the responsiveness of demand to price reductions. Another complication is the possibility of spillover effects of enforcement into other drug markets. If, say, heroin and cocaine are substitutes for one another, intensified supply-side enforcement in the heroin market could increase both the level of consumption of cocaine and its price. There is a danger, therefore, that intensified supply-side enforcement in one drug market merely results in the problem being shifted into another market.

It has been suggested in the literature that measures aimed at importers are likely to yield larger net benefits than measures aimed at street-level dealers, since the quantity exchanged per transaction is higher at the import level than elsewhere. The situation is in fact rather more complicated than this. First, because the price structure of the illicit market tends to be steeply graduated, a seizure of one kilo at import level is likely to have a smaller effect on retail

price than a one-kilo seizure at wholesale or retail level. Tending to offset this, however, is the fact that drugs such as heroin and cocaine tend to be 'cut' (diluted) as they pass along the distribution chain. As a result, a one-kilo seizure of reputed heroin and cocaine at street level tends to contain far less of the pure substance than one kilo seized at import level. The effect of 'cutting' points, therefore, towards seizures at import level as having the biggest impact on retail prices. There is, however, a third complication, namely that the probability of detection may vary from one level of the market to the next. To the extent that the number of transactions per kilo is higher at street level, the probability of detection will also tend to be higher (Rottenburg, 1968). Whether or not the risks of detection are in practice higher will also depend on the extent of enforcement activity at the two levels of the market. Because all these factors tend to work in opposite directions, it is impossible to say *a priori* whether law enforcement aimed at import level (or indeed distribution level) yields higher or lower net benefits than enforcement aimed at street level.

Econometric studies of United States drug markets suggest that the price elasticity of demand for heroin is low but above zero in absolute size. One study estimated the price elasticity of heroin at -0.25: this implies that a 10% increase in price would result in a 2.5% reduction in demand. The econometric studies to date do not, however, indicate anything about the effects of enforcement measures. The only full-scale model of an illicit drugs market in which enforcement measures are analysed is in the Systems Analysis tradition. As a result, the forecasts produced are derived from assumptions about the effectiveness of enforcement measures rather than estimates. Many of the model's assumptions are also of questionable validity. The only reliable empirical study of the effects of enforcement measures is the study of the United States drug market by Polich *et al.* (1984), who concluded that even large increases in expenditure on law enforcement, at any level of the market, would leave cocaine and marijuana consumption in that country relatively unchanged.

Trends in the UK illicit drug market

Of the three major illicit drug markets, the heroin market has been the most studied in the UK. It appears to be relatively specialised, with five distinct levels—importer, distributor, wholesaler, retailer and non-dealing user. There appears, however, to be some overlap. In particular, some importers appear to undertake their own distribution, supplying directly to the wholesaler ('ounce dealer'). Little is known about the organisation of the cocaine and cannabis markets, though the latter is thought to be well-organised and competitive. The composition of the heroin market—in terms of 'market shares' of different types of heroin—appears to have changed over the last six years, with Turkish, Iranian and Southeast Asian heroin accounting for increasingly less of the market and heroin from the Indian sub-continent increasing its market share. There is some evidence that Southeast Asian heroin may be re-establishing its market share.

The purity of heroin and cocaine at all levels of the market tended to increase over the years 1980-83. This trend has now apparently been reversed, with purity at import level falling somewhat over the last two or three years and purity at retail level falling dramatically. The degree to which heroin and cocaine is 'cut' (diluted) as it passes along the distribution chain seems, therefore, to be increasing.

Data on prices show that the retail prices of heroin and cocaine in 1985 were roughly the same as they were in 1980. In real terms, therefore, the prices of heroin and cocaine fell between 1980 and 1985. Because, however, the purity of heroin and cocaine at street level tended to increase over the period 1980-83, the inflation-ad justed price per pure gram rose over this period. The recent downwards trend in purity levels at retail level means that the opposite has been true of the period since 1983. Both the current and inflation-adjusted retail price of cannabis resin rose over the period 1980-85. The retail price of herbal cannabis, by contrast, fell in real terms, although it rose in current price terms.

Estimates by the Drug Indicator Project put illicit heroin consumption in the UK in 1982 at between 1,200 kg and 1,900 kg of street-level (diluted) heroin. Using their methodology, illicit heroin consumption in 1984 is estimated in this report at between 2,330 kg and 3,820 kg. The estimates suggest that heroin consumption grew at an average annual rate of 10% over the period 1974-81 and at 21% over the period 1982-84. Total expenditure on illicit heroin in 1984 is estimated at between £112m and £238m. This is equivalent to between 3% and 6% of total expenditure on tobacco in 1984. However, all these figures—and particularly those relating to trends in heroin consumption — should be treated with caution, since they are based on a number of assumptions about the number of heroin misusers, their average daily doses etc. which—with existing data—cannot be verified.

Cannabis consumption has recently been estimated at around 500 tonnes per annum. This estimate, however, ought to be viewed with scepticism. No estimates of cocaine consumption have been attempted.

The costs and benefits of HM Customs and Excise drug enforcement activities

The number of full-time equivalent (FTE) HM Customs staff working exclusively on drug enforcement work has increased steadily since 1979. In 1985 there were 841 FTE staff employed exclusively on drug enforcement. The number of 'preventive' staff—whose work includes drug detection—declined steadily over the period 1979-84, but showed an increase in 1985. Drug-specific expenditure increased in real terms at an average annual rate of 9.0% over the period 1979-85. During 1983-85 it has grown slightly faster (9.6% p.a.) and is currently £23.6 m (1985 prices).

The last three years have also seen a redeployment of manpower in the Investigation Division away from intelligence work directed at cannabis

importers towards work directed at heroin and cocaine importers. In 1986 it was planned that 55% of the Investigation Division's expenditure on drug enforcement work will be directed at the heroin market (44% in 1985) and that 15% will be directed at cocaine importers (13% in 1985). In real terms expenditure by the Investigation Division on the cannabis market has remained roughly constant at around £3.6 m {1985 prices), whilst expenditure on the heroin and cocaine markets have shown upward trends.

In analysing their 'output', we have assumed that HM Customs operate exclusively at the import level of the market. We therefore ignore those instances where Customs operate with other enforcement agencies, notably the police. For performance evaluation purposes five possible measures of intermediate output are examined: (i) numbers convicted for drug smuggling, (ii) length of prison sentence for drug smugglers, (iii) the quantity of drugs seized, (iv) the numbers of seizures, and (v) the interception rate (an indicator of the risks facing importers and couriers). Each is argued to suffer from limitations, with (i), (iii) and (iv) being biased in favour of Customs (in the sense that factors external to Customs over the last five years will have tended to increase the indicators automatically), and (v) being biased against Customs. The interception rate for heroin (the proportion of heroin shipments seized by Customs) for 1984 is estimated at between 9% and 19% and appears to have increased over the last five years. A cost-effectiveness index (CEI) based on the interception rate and two alternative measures of expenditure on drug enforcement suggest that the cost-effectiveness of Customs drug enforcement work probably increased over 1980-82, and possibly thereafter as well.

Using the same methodology as that used by Polich *et al.* (1984), we estimate that a doubling of the interception rate from 15% to 30% would probably result in an increase in the retail price of heroin of somewhere between 9% and 26%. Without better knowledge of the structure of the heroin market at each level and importers' pricing policies, it is impossible to be more precise. Indeed, it is possible that the true figure may lie outside this estimated range.

The costs and benefits of police drug enforcement activities

In 1984 there were 256 FTE police officers involved in drug enforcement work in regional crime squads in England and Wales and a total of 596 in the force drug squads. At both levels the manpower deployment is increasing rapidly: the 1985 figure for drug squads was 713, a 20% increase on the 1984 figure. A rough estimate suggests that another 60 FTE police officers may have been employed in drug enforcement at the uniform and CID level. Total expenditure by the police on drug enforcement in 1984 was probably in the region of £21.7 m (1984 prices).

In analysing the 'output' of the police in the drug enforcement field we have assumed that they operate below the import level of the market. We therefore ignore those instances where the police co-operate with other enforcement

agencies, notably HM Customs. For performance evaluation purposes six possible measures of intermediate output are examined: (i) conviction for drug offences, (ii) length of prison sentence awarded for the offences, (iii) the quantity of drugs seized, (iv) the number of seizures, (v) the police seizure rate, and (vi) the risks facing drug dealers. Each is argued to suffer from limitations, with (i), (iii) and (iv) being biased in favour of the police, and (v) and (vi) being biased against the police. The police seizure rate for heroin for 1984 is estimated at between 1.3% and 3.1% and appears to have increased over the last five years. The risks facing dealers are difficult to estimate with any degree of precision, but the estimates obtained suggest that they too may have risen. The risk of imprisonment for supply-related heroin offences is estimated to have been between 8% and 11 % in 1984 and the risk of being proceeded against for supply-related offences at between 15% and 22%.

Two cost-effectiveness indices (CEIs) have been constructed, but are based on indicators of output which are likely to be biased in favour of the police (seizures and convictions). Thus, the fact that both tended to fall — the cost per seizure fell from £1,092 in 1974 to £808 in 1984 (1984 prices)—is not necessarily indicative of an increase in efficiency on the part of the police.

A doubling in the police seizure rate in the heroin market from 2.5% to 5.0% is estimated to result in a rise in the retail price of between 1.4% and 24%. The upper estimate indicates the effect on retail price if drug distributors/ wholesalers doubled their mark-up in response to a doubling in their risks. The effects of stiffer sentences and asset sequestration on retail prices are estimated to be small. An increase in the average prison sentence for heroin traffickers from 5 years to 20 years is estimated to result in a rise in the retail price of heroin of between 9% and 15%. This stems in part from the effects of 'time preference'—a tendency to value future costs at less than present costs. The introduction of sequestration of assets is estimated to result in a rise in the retail price of heroin of only 5%.

Any attempts to compare the effects on the retail price of heroin of increased efforts at the import level of the market or at the wholesale/distribution level requires that certain assumptions be made. If, for example, both the importers and the distributors/wholesalers of heroin increased their prices by doubling their mark-ups when the appropriate enforcement agency doubled their seizure rates, Customs may well have to seize more than 1 kg of heroin for every kg seized by the police in order to produce the same effect on the retail price. However, whether this is in fact the case depends crucially upon the assumption that both importers and distributors/wholesalers have sufficient market power to double their mark-ups following intensified enforcement. In practice, this is most unlikely to be the case. It seems highly likely that importers enjoy considerably more monopoly power than dealers lower down the distribution chain. If this is the case, they will be in a better position to increase their mark-ups than distributors at the lower levels of the market. If, for example, importers

were able to double their mark-ups but lower level distributors were unable to do *so* because of competition, the police may well have to seize more than I kg for every kg seized by Customs in order to produce the same effect on the retail price.

In the absence of better information on the market structure at each level of the market and dealers' pricing policies it is impossible to indicate what the real position is likely to be. What is obvious, however, is that it is necessary to look further than the quantities being seized when trying to evaluate the relative cost-effectiveness of alternative drug enforcement strategies. In particular, it is necessary to look at both the price structure of the market and the degree of monopoly at each level of the market.

It is important to emphasise that all of the estimates derived in this report are based on an underlying data base which is woefully inadequate for the task in hand. Where possible we have tried to overcome this by adopting over-generous assumptions *so* as to ensure that our results will be over-estimates, rather than under-estimates. This is true, for example, of our estimates of the effects of intensified enforcement. At other times we have adopted a range of assumptions, so that our estimates are in the form of a minimum and maximum estimate. This is true, for example, of our heroin consumption estimates for a given year. There are occasions, however, where we have investigated trends in variables, but have had little guidance as to how the reliability of our assumptions may have changed one year to the next. Our estimates of trends in heroin consumption are a case in point here: we cannot exclude the possibility that the estimated rise in heroin consumption reflects a failure on our part to take into account changes in, for example, the average daily dose or the average frequency of use. The research proposals at the end of the report—Chapter 7—are drawn up with these data limitations in mind.

2 The Welfare Economic Foundations of Drug Enforcement Policies

2.1 Introduction

The government's concern over the apparent increase in drug misuse in the UK stems from its belief that drug abuse imposes heavy costs on society. These costs are argued to include distress to drug users' parents and friends, the costs associated with treatment and rehabilitation centres and lost output (Home Office, 1985a). In an effort to reduce these costs the government has developed a strategy for tackling drug misuse that embraces both law enforcement and non-law enforcement measures. The former include the use of HM Customs to intercept unlawful shipments of controlled drugs and the use of police regional crime squads to disrupt the domestic distribution network. The primary non-law enforcement measure aimed at reducing drug consumption is the government's prevention strategy (Home Office, 1984).

For some the issue of drug enforcement is straightforward. Drug misuse imposes a heavy burden on the rest of society and therefore measures should be taken to eliminate it. The costs incurred in eliminating drug trafficking are costs that society must be prepared to pay. If drug misuse is increasing, then drug enforcement efforts must be intensified. These efforts should incorporate a broad range of enforcement measures: they should include measures aimed at importers as well as measures aimed at domestic dealers; they should include measures aimed at the user as well as measures aimed at the supplier; they should include measures aimed at heroin as well as measures aimed at cannabis; and so on.

The issue of drug enforcement is, however, rather less straightforward. Any resources committed to drug enforcement measures cannot be used for other purposes. The real (or 'opportunity') cost of a drug enforcement programme is what society has to forgo in order to find sufficient resources to fund the programme. It is important, therefore, to consider what benefits are obtained as a result of drug enforcement measures. These benefits will be in the form of reductions in the 'social' costs of drug misuse. Clearly, though, it is important to ensure that the costs incurred to obtain these benefits are not in excess of the benefits themselves.

It is also important to examine the costs and benefits associated with alternative drug enforcement measures. The question is, therefore, what 'mix' of measures gives society the greatest benefit? If some measures are extremely costly and yield only small benefits, it may be that it is not in society's best interest to employ a 'broad range* of measures.

These considerations point to the need for a theoretical framework for thinking about the economics of drug enforcement policies. This framework should include the 'social' costs of drug misuse, but also the costs of drug enforcement policies. This chapter sets out such a framework. Much of what follows may be unfamiliar to non-economists. It is, however, an important background to the subsequent discussion.

The chapter begins with a discussion of the economic theory of external costs (costs falling on third parties) and discusses the costs and benefits of government intervention to correct for external costs (Section 2.2). It then goes on to examine instances in which the social costs of drug consumption may exceed the private costs and discusses the problems of valuing private costs and benefits and external costs of drug consumption (Section 2.3). Section 2.3 also discusses the problems of operationalising the welfare economic approach to government intervention in the drug market and concludes that, in view of the informational limitations, the government may have little choice but to gear policy towards attaining some predetermined target level of consumption. The problem then becomes one of selecting the mix of anti-drug strategies which brings drug consumption as close to its target level as is possible within the constraints imposed by a fixed budget.

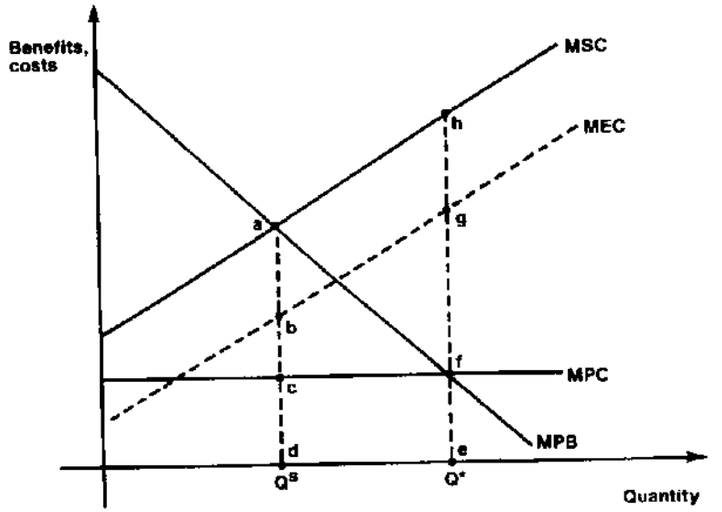
The remainder of the chapter is devoted to the problems of solving this more limited problem. Section 2.4 discusses the problems of measuring the costs and outcomes of government anti-drug measures, whilst Section 2.5 outlines the rules to be followed if the government's anti-drug budget is to be spent most effectively. A summary of the chapter is contained in Section 2.6.

2.2 The theory of external costs and governmental intervention

The government's concern over drug misuse appears to derive from a belief that drug abuse imposes heavy costs on society at large (cf. Home Office, 1985a, page 5). These costs are argued to include the distress and anxiety caused to parents of drug users and non-users alike, the lost production associated with premature death, and sickness absence and so on. In Section 2.3 we enquire more closely into the nature of these costs and how they ought to be incorporated into an analysis of government drug control measures. Suffice to say at present that there are good grounds for believing that drug abuse in the UK does indeed involve the imposition of costs on third parties (i.e. non-users).

Such costs are termed 'external' costs and have, since Pigou, been a major element in the economic analysis of 'market failure' and government

Figure 2.1
Private and external costs and benefits of illicit drug consumption



intervention. In the drugs field it has been recognised for some time that the existence of external costs may provide a rationale for some type of government intervention (cf. Culyer, 1973; Littlechild and Wiseman, 1984).

Divergence of private and social costs

A useful starting point for the discussion is Fig. 2.1. The vertical axis measures costs and benefits, the horizontal axis quantity of drugs consumed. The downward-sloping curve labelled MPB indicates the marginal private (and social) benefit at each level of consumption. By 'marginal benefit' is meant the benefit resulting from a small (e.g, one unit) increase in consumption. The curve slopes downwards on the assumption that drug users value the first unit of consumption more highly than the second, but the second more highly than the third, and so on.

It should be noted that in economics text books it is sometimes asserted that in the case of addictive drugs this standard assumption of economic theory fails to hold. Instead it is argued that the addict, craving for more the more he consumes, has a rising MPB schedule for drugs. As Culyer (1973) has emphasised, this conclusion is erroneous and derives from a muddled view of the time dimension in consumer theory. The notion of demand in consumer theory is not one of sequential purchases through time, which is the implication of the assertion, but rather one about purchases during a specific period of time. The individual's MPB curve thus indicates what the individual's marginal

valuation would be if he consumed some particular quantity of the drug in the period in question. The phenomenon of addiction, by contrast, refers to a dependency relationship between consumption during different periods of time.

The horizontal line in Fig. 2.1 labelled MPC indicates the marginal costs of drug consumption to drug users (i.e. marginal private costs). For simplicity they are assumed to be constant—i.e. the cost per unit is the same regardless of the level of consumption. The dotted upward-sloping curve labelled MEC indicates the marginal external costs of drug consumption—i.e. costs falling on third parties. These are assumed to be rising, so that the external costs associated with a unit increase *in* consumption rise as consumption rises. (The conclusion is similar if they are assumed to be constant.) TheTjold upward-sloping curve labelled MSC indicates marginal social costs—the sum of private and external costs.

In the absence of any government intervention, drug users will expand consumption to the point at which marginal private costs equal marginal private benefits, Q*. Users would not consume beyond Q*, because for each of the subsequent units of consumption the benefits are smaller than the (private) costs.

At point Q*, however, marginal social costs exceed marginal social benefits, so that society as a whole would be better off if drug consumption were reduced. In Fig. 2.1 the socially optimal level of drug consumption is $Q^{!}$: here marginal social benefits equal marginal social costs. In moving from Q* to Q^{s} drug users lose an amount equal to the area acf; the rest of society, however, gains an amount equal to the area bdeg, which is equal to the area acfh. Society as a whole (i.e. third parties and drug users) gains an amount equal to the area acfh—acf, which is the area ahf. The question is, therefore, how can drug consumption be cut back to the 'optimal' level, Q^{s}?

Before considering this two points are worth noting:

(1) Despite the existence of external costs, the socially optimal level of drug consumption is greater than zero. In this particular case, therefore, outright prohibition of drug consumption would not be optimal. Fig. 2.2 illustrates the case where the socially optimal level of drug consumption is zero. The private optimum is at Q*, but the MSC and MPB curves do not intersect anywhere in the diagram, so that zero consumption is the socially efficient level. Thus if the social costs are sufficiently large relative to the private benefits, outright prohibition may be optimal.

(2) The mere existence of external costs does not automatically ensure that the private optimum is greater than the social optimum. It is required, in addition, that the external costs be 'Pareto-relevant', i.e. the external cost must be a marginal external cost at the private optimum. Fig. 2.3 illustrates the case where this is not true. Here the marginal external costs only start occurring from point Q^{c} onwards. The MSC curve is therefore kinked and is indicated by the bold line. The private and social optima coincide, since—despite the existence of external costs—they are not Pareto-relevant.

Figure 2.2
External costs of illicit drug consumption giving rise to socially optimal level of consumption equal to zero

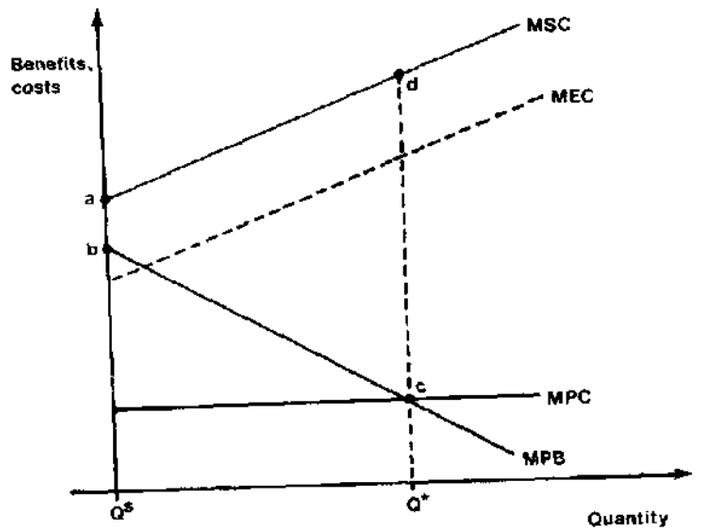
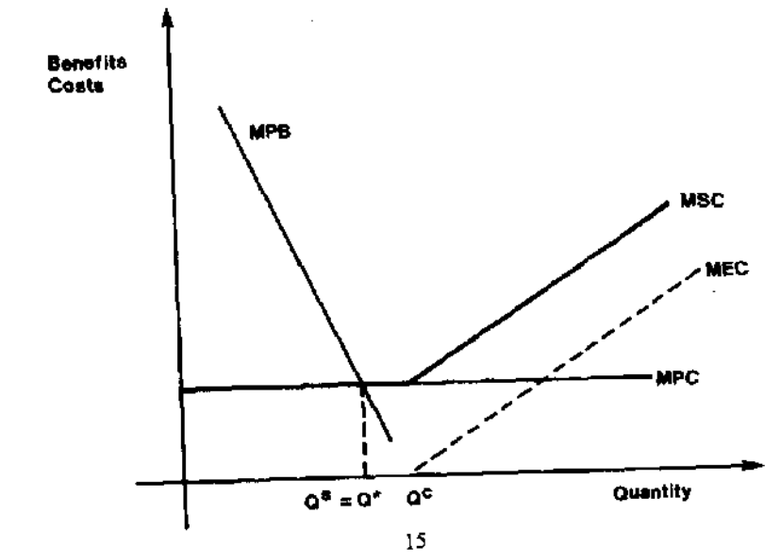


Figure 2.3
External costs of illicit drug consumption but no government intervention warranted



Government intervention

A variety of steps may be taken by the Government in order to reduce the size of the external costs, and so bring the level of consumption down to its socially efficient level. Of most interest in the present context are (1) the use of taxes and (2) the imposition of a legal upper limit:

(1) The traditional Pigovian solution would be to impose a purchase tax on the commodity in question, thereby raising the cost of drugs to drug users. If the tax were chosen so as to equal the distance ac in Fig. 2.1, the effect would be to move the MPC curve up by the same amount, so that private optimum and the social optimum would then coincide. Inspection of Fig. 2.1 reveals that the distance ac is equal to the distance be, which is simply the value of the external cost at the social optimum.

(2) Another possibility would be to impose a legal upper limit on drug consumption. In Fig. 2.1, for example, an upper limit of Q^s would be imposed with those violating the law being subject to penalties. In Fig. 2.2 the upper limit would be zero units of consumption.

Problems in government intervention

Much of the discussion in the literature on externalities and government intervention overlooks the costs associated with intervention, notably information costs, adjustment costs and enforcement costs (cf. Rowley, 1974). It was implicitly assumed above that all the relevant curves above are known to the government. In reality, there is confusion over what the relevant costs and benefits are and how they ought to be measured (Section 2.3). Even when these issues are resolved, however, the estimation of such curves would itself be a costly exercise. It was also implicitly assumed that there would be no transaction costs involved in the collection of taxes in a legalised drugs market. Clearly, such costs exist. Finally, it was implicitly assumed that enforcement of the legal limit involves no costs. In the event it is clear that enforcement in the drugs field is far from costless.

The recognition of the existence of costs associated with the reduction of external costs has several implications:

(1) The mere existence of a Pareto-relevant external cost (in the sense defined above) does not automatically mean that government intervention is desirable. If, for example, the costs of intervention in Fig. 2.1 were in excess of the area ahf (the maximum society stands to gain by moving from Q* to Q^p) society would be better off staying at Q*.

(2) The choice between alternative strategies for reducing Pareto-relevant external costs must be based, primarily at least, on an assessment of the relative cost-effectiveness of the alternative strategies in terms of their ability to reduce costs. In many situations it will be sufficient to compare the cost-effectiveness of alternative strategies in terms of their ability to reduce

quantity consumed (or produced). In the case of drugs, however, the situation is more complicated, since the external costs will themselves depend on the strategy selected. This is because the drug-related crime component of the external costs of drug misuse depends not only on the level of consumption, but also on the price of drugs (and hence expenditure). In Chapter 3 it will be seen that in some circumstances drug enforcement measures may increase expenditure on drugs even when drug consumption falls (Section 3.2.2). More generally, the marginal external cost associated with any particular level of drug consumption—i.e. the position of the MEC curve in Fig. 2.1 —will depend on the intensity of drug enforcement activity. Thus intensified drug enforcement activity will in itself result in a new social optimum, with a different optimum for each level of drug enforcement.

2.3 The external costs of drug misuse and their implications for drug control policies

In the previous section it was seen that in markets where consumption imposes external costs on third parties, there may be a case for government intervention. The optimal level and type of intervention will depend on (1) the private costs and benefits and external costs associated with drug consumption and (2) the costs associated with reducing any external costs.

The external costs of drug abuse

A reading of the Government's 'Tackling Drug Misuse' (Home Office, 1985a) and Culyer (1973) suggests the following list of consequences of drug use where there may be a divergence between private and social costs:

(a) health care costs associated with treatment and rehabilitation;

(b) costs associated with drug-related crime (petty theft etc. by addicts to fund their habits);

(c) distress to users' families and friends;

(d) forgone production resulting from premature deaths of addicts and reduced productivity;

(e) drug enforcement costs.

Item (e)—drug enforcement costs—can be dealt with quickly in the light of the discussion in section 2.2. Enforcement costs are properly viewed as costs of reducing external costs and are not external costs in themselves.

Whether or not in the case of item (a)—health care costs—there is any divergence of private and social costs depends on the institutional framework, (cf. Atkinson and Meade, 1974). There would be no divergence in a health care system where individuals paid for all their treatment in full. Divergence may, however, arise in a health care system such as the NHS, where payments are

through general taxation. In the British context it is reasonable, therefore, to regard medical costs as an external cost not taken into account by the drug user in his private decisions.

The implication of this is that the health care costs associated with treatment and rehabilitation of drug users are external costs and not costs associated with reducing the size of the externalities associated with drug abuse. In this sense it is wrong to view treatment and rehabilitation as measures for reducing drug-related externalities.

In contrast to the case of smoking, drug-related illness is relatively easily diagnosed. As a result, the government can, in an NHS-type setting, determine the level of health care expenditure on treatment of drug-related illness. In this sense, the magnitude of the health care-related external costs of drug abuse is itself largely under the control of policy-makers. The government may decide, for example, to allow the health care-related external costs of drug abuse to rise (by increasing the NHS budget for treatment of drug-related conditions) in order to reduce one or more of the other external costs of drug abuse (eg. drug-related crime, distress to families and friends etc.).

Similar considerations apply in the case of (d). A drug user accepting the risks of illness who becomes sick but receives no compensation for loss of earnings resulting from sickness absence or job loss would bear the full social cost and there would be no divergence between private and social costs. If, however, sickness benefit or social security is paid, private costs will tend to fall short of the social costs. The divergence between private and social costs is greater the greater the level of compensation to the drug user in the event of sickness. Premature death can be treated in much the same way. If an individual takes the decision to become a drug user, thereby reducing his life expectancy, then he imposes costs on others which are not taken into account privately, or alternatively he provides benefits to others (e.g. by saving the payment of pensions to which he would have been entitled, had he lived).

In the case of item (b), the size of the social costs depends on whether one discounts the gains to the offender. If one takes the view that offenders' gains ought to be disregarded (Stigler, 1970), the social cost of drug-related property crime is equal to the market value of the goods stolen. Even if offenders' gains are counted, there is still a net social loss since stolen goods cannot be sold at full value (Lind and Lipsky, 1971). The costs of 'solving' drug-related crime are—like drug enforcement costs—properly treated as a cost of reducing the size of external costs: they are not a component of the external costs of drug abuse.

Costs associated with distress to drug users' families—item (c) above—are, however, properly treated as external costs. Such costs may arise though the nuisance and anxiety generally which drug users cause their families and friends, or through the distress caused by the impaired health and/or premature death

of drug users. External costs may also arise through the anxiety caused by drug users to parents of young people who are not on drugs, but whose proximity to drug users may be thought to make their use in the future more likely—the so-called 'transmission effect' externality (Culyer, 1973).

Placing a money value on the distress and anxiety of parents of drug users and non-users is clearly extremely difficult. If society is viewed as a collection of individuals, the relevant valuations are those individuals make themselves. These valuations are reflected on what individuals would be willing to pay to reduce their anxiety levels by a given amount and might be successfully solicited by a carefully-constructed questionnaire or experiment (cf. e.g. Jones-Lee *et al.* 1985).

Ignorance of health risks and addiction

Much of the discussion so far is relevant to a whole variety of health-related behaviour. It could apply, for example, to motorcycle enthusiasts. Atkinson and Meade (1974) suggest that there are two aspects of consumption of commodities such as cigarettes (and dangerous drugs) which might make one want to revise the valuations above:

(i) ignorance of health risks;

(ii) the addictive nature of such commodities.

If drug users are unaware of the health risks of drug use, then one cannot argue that they have taken into account the private costs of sickness and premature death. In terms of Fig. 2.1 this means that the individual's perception of the costs he bears (i.e. MPC) will be incorrect, so that his true cost curve is higher than MPC and therefore the true social cost curve is higher than MSC.

In the case of sickness absence, for example, the individual's private costs are zero when health risks are known, since the possibility of sickness absence resulting from drug consumption has already been taken into account in his calculations. The external costs are equal to any sickness benefit paid, so that social costs are equal to the sickness benefit (zero plus sickness benefit). When the health risks are not known, the private costs in the event of sickness absence are equal to lost earnings less sickness benefit, since the possibility of sickness absence was not taken into account. The external costs are the same, so that the social costs are equal to lost earnings (i.e. earnings less sickness benefit plus sickness benefit). Thus whether the social costs of drug-related sickness absence are to be measured in terms of forgone earnings or sickness benefit depends on whether one believes that drug users are aware of the health risks involved.

The issue of addiction in the context of the welfare economics of government intervention is more problematic and has tended either to be dismissed as being of questionable relevance—e.g. in the case of smoking by Littlechild and Wiseman (1984)—or ignored—e.g. in the case of drugs by Culyer (1973). Atkinson and Meade (1974) suggest a somewhat extreme definition of addiction, namely that addiction means that no direct benefit is derived from consumption.

Thus any resources devoted to the production and distribution of drugs yield no benefit to drug users and their cost should therefore be added to the private and external costs to arrive at the total social costs of drug use.

This is an extreme definition and one that does not capture what are generally argued to be the twin characteristics of addiction, namely tolerance and withdrawal symptoms (see e.g. Ashton and Stepnery, 1982). Whilst some progress has been made in incorporating these characteristics into the economic theory of consumer behaviour (see e.g. Jones, 1986), their implications for the welfare economics of government intervention in the illicit drug market, and the data requirements in terms of costs and benefits of drug abuse have yet to be ascertained (cf. Godfrey and Powell, 1986).

External costs of drug misuse and drug control policies

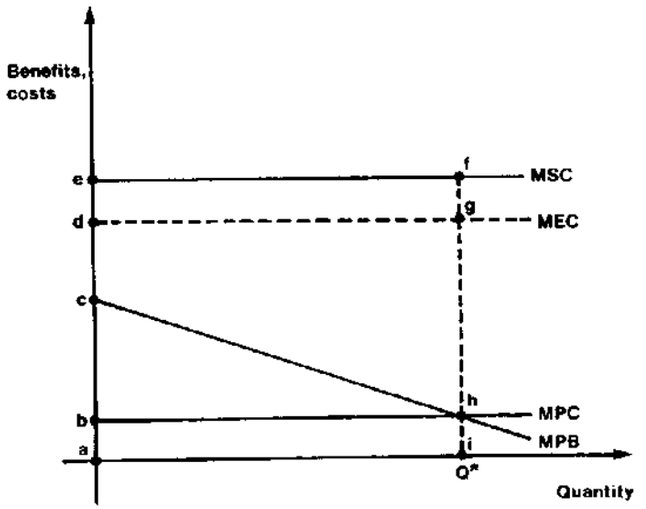
The discussion above suggested various aspects of drug misuse where there may be a divergence of private and social costs. It also indicated the appropriate valuations to be placed on the various external and private costs: these were seen to depend on whether users were considered to be aware of the health risks. The phenomenon of addiction will almost certainly lead to further revisions of the valuation system, depending on the definition of addiction adopted.

Once it has been decided what are private costs and what are external costs and how they and private benefits are to be valued, one can—in principle, at least—proceed to estimate private benefits, private costs and external costs for different levels of drug consumption. This would allow one to plot each of the schedules in Fig. 2.1 and thereby determine what the socially optimal level of drug consumption would be in the absence of any costs associated with government intervention. One could then go on to estimate the costs associated with each of the various intervention strategies and choose the optimal level and type of intervention.

All this, however, assumes a great deal of information, much of which would be costly to obtain and some of which, notably the costs of anxiety and distress to parents, would be extremely difficult to estimate. In view of this it might be considered not unreasonable to direct drug control policies towards the attainment of some predetermined target level of consumption. This practice is not uncommon in other areas where external costs are present—pollution, for example (cf. Burrows, 1974).

The danger of adopting this approach is that there is no assurance that the costs of attaining the particular target will be smaller than the benefits society gains as a result of it being attained. Suppose, for example, that in Fig. 2.2, the government set a target of zero consumption. If no estimate is made of the social gains of reducing consumption from Q* to zero (the area abed), there is no assurance that the costs of attaining the target of zero consumption will be smaller than the benefits associated with the reduction. Clearly, though, if one has the information to estimate the area abed, there is no reason why one should want to adopt the target approach in the first place.

Figure 2.4
The relevance of measures of the 'social costs of drug misuse' for public policy



In order to ensure that society does not spend more attaining a target level of drug consumption than it stands to gain from attaining it, it may be useful to undertake a 'social costs of drug abuse* study, along the lines of a 'social costs of alcohol' study or a 'social costs of smoking' study (e.g. McDonnell and Maynard, 1985). A study undertaken by the Research Triangle Institute estimated the 'costs of drug abuse' in the United States at $59.7 billion in 1983, half of which derived from the lost output associated with drug abuse (Mullen, 1984). Figures such as these are often presented in terms of the benefits society stands to gain by eliminating—in this case—drug abuse (cf. Weisbrod, 1961). Such calculations have been described by Feldstein (1963) as "irrelevant to the actual problems of public policy" (Feldstein, 1963, page 129), since the figures obtained from such calculations are not a benefit estimate of any real programme.

Estimates of the 'social costs of drug misuse' may, however, be useful in the following situation. Consider Fig. 2.4 above. This is similar to Fig. 2.3, except that the marginal external costs of drug abuse are assumed to be constant. In this case—as in Fig. 2.3—the 'socially efficient* level of drug consumption is zero, so that it would be 'Pareto efficient' for society to adopt a target of zero consumption.

The loss to drug users of reducing their consumption from Q*—the private optimum—to zero is given by the area bch. The gains to third parties, i.e. non-users, is equal to adgi, which is equal to befh. The net gain is equal to befh minus bch, which is equal to efhe. Thus, if the costs of attaining the target

level of zero consumption are in excess of the area efhc, society would lose more than it gains by attaining the target.

A 'social costs of drug misuse[1] study would—or ought to—estimate the area adgi, which is equal to the area efhb. This area represents the total external costs to society associated with the privately optimal level of drug consumption. (In practice, studies often estimate social—rather than external—costs, and the estimates are always based on actual levels of consumption, rather than those which would obtain in the absence of any government intervention.) Clearly, if the costs of attaining the target level of consumption exceed the area efhb, then *a fortiori* they must exceed efhc—the benefits society gains by attaining its target level of drug consumption. This conclusion would be reinforced if the marginal external costs were rising and the MPB curve lay everywhere below the MSC curve (i.e. the situation portrayed in Fig. 2.2).

This approach is likely to be of greatest value when the MPB curve lies everywhere below the MSC curve, so that the socially efficient level of consumption is zero. If the socially efficient level of drug consumption is greater than zero, there is no assurance that movement to the target level will be associated with net gains to society even before costs of intervention are taken into account.

2.4 Costs and benefits of drug control policies

In the previous section it was concluded that, in view of the information requirements involved in the pursuit of an optimal drug control policy, there may be little alternative but no direct policy measures towards the attainment of some policy-determined target level of drug consumption. The British Government's policy can be interpreted in this light with a target level of consumption of zero. The planning problem facing the government, therefore, is to ensure that its anti-drugs budget is spent in such a way as to ensure that the level of drug consumption comes as close to this target as possible—i.e. is as small as possible. The benefits of the programme are therefore defined in terms of reductions in drug consumption. To ensure that its budget is being allocated to the various sub-programmes as effectively as possible, the government needs to know the costs and benefits associated with each of these sub-programmes and how these costs and benefits change as the sub-programmes are expanded and contracted. This section discusses the problems of defining, measuring and valuing the costs and benefits of drug control policies, focusing in particular on drug enforcement measures.

What are the relevant costs and benefits?

Like other organisations, the various agencies engaged in the Government's anti-drug programme can be viewed as production units, in the sense that they use inputs to produce an output via a production process. In the case of drug enforcement agencies it is useful to distinguish between intermediate output and the final output (cf. Lind and Lipsky, 1971). This is illustrated in Fig. 2.5.

Figure 2.5
Drug enforcement agencies' production function

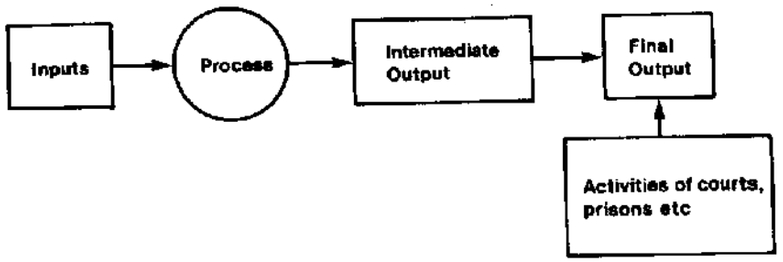


Table 2.1
Inputs, process and outputs of drug enforcement agencies

Item	*Description*
1. Inputs	Man-hours, equipment and premises
2. Process	Activities of drug enforcement agencies—intelligence gathering by Customs, NDIU, Regional Crime Squads and other agencies, deployment of static controls etc.
3. Outputs	Intermediate: arrests and convictions of drug dealers and users; Final: reductions in drug consumption

Examples of inputs, processes and outputs of drug enforcement agencies are listed in Table 2.1.

Thus, for example, Customs use inputs such as manpower and equipment in the process of intelligence gathering and deployment of static controls, thereby producing an intermediate output defined in terms of drug seizures and arrests and convictions of drug smugglers. The final output, however, is defined in terms of reductions in drug consumption. The impact of arrests and convictions on drug consumption will depend on the manpower and equipment used by other agencies in the criminal justice system, notably courts and prisons. Increases in the number of arrests are unlikely to result in reduced consumption levels unless the dealers detected are punished, thereby producing a deterrent effect. It is this deterrent effect which causes the retail price to rise, since importers and dealers perceive higher risks of being punished and therefore charge more to retailers to compensate (see Section 3.2).

The arrest of 10% of heroin traffickers will have a greater deterrent effect and therefore a greater impact on drug consumption if the courts deal with the cases quickly and if the prisons have the space to enable courts to pass normal-length sentences. If the courts are so busy that cases take a long time to be dealt with or if the prisons are operating at full capacity so that prison sentences are shorter than would otherwise be, the deterrent effects associated with the arrest of the

10% of traffickers would be smaller than would otherwise be. It should also be noted that responding to any capacity problem in prisons by making it easier for non-drug offenders to get early release on parole would have costs associated with it (i.e. reduced deterrent effects for non-drug crimes) and these would have to be *offset* against the benefits resulting from incarceration of the drug traffickers.

The costs of drug control measures stem from the agencies' use of inputs, such as manpower and equipment. Use of these resources means that they cannot be used in other activities at the same time and therefore involves a sacrifice of the benefits that would have been obtained if they had been employed in the most valued alternative use. This is the notion of opportunity cost—cost equals opportunities forgone.

Drug control measures also involve costs other than those associated with the use of manpower and equipment by the agencies concerned. They involve, for example, the use of government-owned land and buildings by law enforcement agencies and health education organisations for which no rent is paid but which nonetheless have alternative uses. The use of such land and buildings therefore entails an opportunity cost. Drug control policies also involve costs which fall on private individuals and which are not associated with money outlays by drug control agencies. Examples include the time costs borne by passengers subjected to spot checks by Customs at airports and the time costs borne by those wrongfully arrested by enforcement agencies in connection with alleged drugs offences.

Measurement of costs and benefits

The next stage of the economic appraisal of drug control policies is to measure the costs and benefits associated with each drug control measure.

The use of inputs such as manpower, heating, lighting and other such inputs can, in principle, be measured relatively easily. These then need to be converted into money values. As indicated above, the cost of a particular resource is the value of the benefit which would be derived from using it in its best alternative use. This value is related to the resource's market price in that in order for an individual to secure the resources for his own use, he has to compete with other potential users; as a result he will only obtain the required resources if he is prepared to pay at least what others were willing to pay for the use of them. Thus what an individual ends up paying will be a reflection of the resource's value in its best alternative use.

If market prices are to reflect the 'true' value of commodities it has to be assumed that (i) consumers and producers know what they are doing, (ii) markets are free of monopolistic and monopsonistic elements, (Hi) prices are not seriously 'distorted' by taxes and subsidies, (iv) there are no benefits accruing to or costs falling on (non-participating) third parties as the result of market transactions, and (v) individuals are able to buy and sell goods freely at their market prices.

If any of (i) to (v) do not hold (if, for example, some workers in a market are not able to work at the going wage rate—i.e. are involuntarily unemployed), market prices will not reflect true social valuations of inputs. In the case of a market where some workers are unemployed, the market wage rate will overstate the true opportunity cost of time of those workers in employment. One has to be careful, therefore, before equating market prices with the real value of a resource. Further discussion of this problem is to be found in, amongst others, Drummond (1980), and — at a more advanced level—in Sugden and Williams (1978).

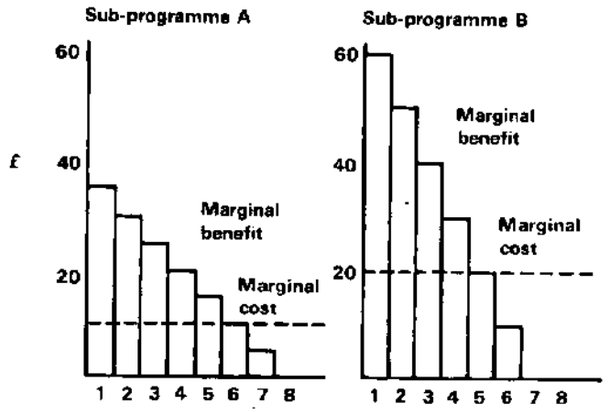
The measurement of the benefits of drug enforcement measures is less straightforward. The literature on the subject is discussed in Chapter 3.

Differential timing of costs and benefits

The discussion above applies to a static situation where costs and benefits occur only in the current period. It is more likely to be the case that the costs and benefits of a particular drug control measures are spread over several years rather than just one year. A prevention programme carried out in 1986, for example, would hopefully yield benefits (in terms of reduced drug consumption) not only in 1986 but in future years too. Indeed, such benefits might not begin to accrue until 1987 or later. The costs of the programme, however, are incurred in 1986.

Since individuals typically prefer £100 today to £100 tomorrow, one needs to take into account any differential timing between the costs and benefits associated with drugs control measures. That individuals do prefer £100 today to £100 tomorrow is clear from their behaviour. When lending money people typically demand a premium (i.e. interest), even in situations where there is no risk involved, the reason being that when an individual lends money, he has to postpone some of his own spending until the time when his money is returned. The fact that he charges interest makes it clear that he prefers not to do so. The premium is his compensation for the postponement of his spending and Us existence is due to the individual's positive rate of time preference. In terms of drug control policies, society would prefer a policy measure costing £100 giving benefits of £100 value this year (and none subsequently) to a policy measure costing £100 giving benefits of £100 value next year (and none this year). The commonest way of taking time preference into account is to discount costs and benefits arising in the future to equivalent present values. If the rate of the time preference (or the discount rate) is 10%, the present value of £110 in one year's time is £100. This is because, with a rate of time preference of 10%, lenders are indifferent (at the margin) between £100 and £110 in one year's time. To convert £110 into a present value when the discount rate is 10%, one multiplies £110 by 1/(1+0.1). More generally, to convert a sum accruing in n years time to a present value, one multiplies the sum by $1/(1 + r)^n$, where r is the discount rate.

Figure 2.6
Marginal benefits and costs of sub-programmes A and B



2.5 Securing maximum benefits from a given budget: basic principles

Section 2.3 suggested that, in view of informational limitations, the Government may have little option but to set a target level of drug consumption (zero) and direct drug control policy measures towards attaining the target. Choice of the 'mix' of policy measures will depend on the costs and benefits of each and how these costs and benefits change as these sub-programmes are expanded and contracted. The previous section discussed problems of measuring the costs and outcomes associated with the various drug control measures. This section discusses bow, given this information, one can select the best mix of measures in the sense that, with a fixed budget, the Government can come as close as possible to attaining the target level of consumption.

The problem—one of seeking to achieve the maximum benefit from a given budget—can be broken down into two stages.

The first concerns the cost-effectiveness of input choices. Economic efficiency requires that inputs be employed in each sub-programme in such a way as to minimise production costs at each level of output. This does not mean operating at the level of output at which costs are minimised, but producing at the lowest possible cost whatever level of output may be chosen as the best one (cf. Williams, 1967). In order to ensure that costs are minimised at each level of output, it will be necessary for the producer to adjust the mix of inputs (man-hours, equipment etc.) until costs are minimised for a given output level. Economic theory indicates that this will be achieved when—for each input—the ratio of the price of the input to its marginal product is the same. The term

Table 2.2
Marginal benefits and costs of two sub-programmes

Sub-programme A

Unit	*Marginal costs* £	*Total costs* £	*Marginal benefits* £	*Total benefits* £	*Net benefits* £
1st	10	10	35	35	25
2nd	10	20	30	65	45
3rd	10	30	25	90	60
4th	10	40	20	110	70
5th	10	50	15	125	75
6th	10	60	10	135	75
7th	10	70	5	140	70
8th	10	80	0	140	60

Sub-programme B

Unit	*Marginal costs* £	*Total costs* £	*Marginal benefits* £	*Total benefits* £	*Net benefits* £
1st	20	20	60	60	40
2nd	20	40	50	110	70
3rd	20	60	40	150	40
4th	20	80	30	180	100
5th	20	100	20	200	100
6th	20	120	10	210	90
7th	20	140	0	210	70
8th	20	160	0	210	50

marginal product is used to indicate the amount by which output increases following a small increase in the input in question, holding all other inputs constant. This rule has a straightforward interpretation: it means that if one input costs twice as much as another, then optimal input use requires that the first input be twice as productive (at the margin) as the second.

The second problem concerns the optimal scale of activity for each of the budget's sub-programmes. This requires a comparison of each of the sub-programme's benefits and (minimised) costs at each level of output. The rule to be followed states that the point at which the maximum benefit is achieved from a given budget is where—for each sub-programme—the ratio of the marginal benefit to marginal cost is the same.

The rule that the ratio of marginal benefits to marginal costs ought to be equalised across programmes can be illustrated with the following example taken from Mooney *et al*, (1980). Here there are 2 sub-programmes, A and B, with benefits and costs as in Table 2.2. The same data are illustrated in Fig. 2.6.

Table 2.3
Combinations of sub-programmes with budget constraint

Sub-programme A		*Sub-programme B*		*Total programme (A + B)*	
Units	*Benefit* £	*Units*	*Benefit* £	*Total benefit* £	*Total cost* £
8	140	1	60	200	100
6	135	2	110	245	100
4	110	3	150	260	100
2	65	4	180	245	100
0	0	5	200	200	100

One other rule of optimal resource allocation which should be noted in passing is that no programme should be expanded beyond the point at which marginal benefit equals marginal cost. Thus in sub-programme A the most that ought to be produced is 6 units. This is because the 7th and 8th units each provide a smaller benefit than it costs to produce. Similarly, the maximum number of units which ought ever to be produced by sub-programme B is 5. The reason for this is that any expansion of output in sub-programme A beyond 6 units results in a reduction in net benefits (benefits minus costs), and likewise any expansion of sub-programme B's output beyond 5 units results in a reduction in net benefits.

With a budget constraint it may not be possible to expand the outputs of both sub-programmes to these levels. Suppose, for example, the total budget available is only £100. Clearly, operating sub-programme A at 6 units and sub-programme B at 5 units would not be feasible, since the total cost would be £160. Some other combination needs to be chosen. Table 2.3 indicates some of the possible combinations giving rise to a total cost of £100.

Assuming the objective is to maximise total benefits subject to the requirement that total costs do not exceed £100, the choice would be 4 units of sub-programme A and 3 of B: here total benefits are £260. Note that at this combination the ratio of marginal benefits to marginal costs is the same for each sub-programme: the ratio for A is £20/£10 = 2, whilst for B it is £40/£20 = 2. This confirms the rule stated above, namely that the point at which the maximum benefit is achieved from a given budget is where—for each sub-programme—the ratio of marginal benefit to marginal costs is the same.

In the example above benefits were measures in £'s. The rule of equalising ratios of marginal benefits to marginal costs can, however, be operationalised even if benefits are not measured in £'s. All that is required is that the benefits of each of the sub-programmes be measured in the same units. Thus, for example, benefits might be measured in terms of reductions in drug consumption.

The problem can therefore be broken down into two stages:

(i) to ensure that each agency utilises its inputs efficiently at each level of output;

(ii) to ensure that the output level at which each agency operates is such that the benefits from the drug enforcement budget are maximised.

Sub-problem (i) refers, therefore, to the organisational efficiency or performance of drug enforcement agencies (are Customs using their resources more efficiently now than in 1980?), whilst (ii) refers to the optimal scale of operation of drug enforcement agencies (is too little being spent on Customs drug enforcement work?).

2.6 Summary

The rationale for government intervention in the market for illicit drugs appears to be that drug misuse imposes external costs on society at large. Consideration of the various consequences of drug misuse suggests that such costs may indeed exist but how one values them depends to some extent on whether one views drug users as ignorant of the health risks and/or as addicts. (The definition of addiction one adopts will also affect one's valuation of external costs.)

Economic theory provides a number of important insights into the problems of external costs and government intervention. For example, it indicates that the mere existence of external costs is not in itself sufficient grounds for government intervention: the external costs must be Pareto-relevant and the costs of reducing the external costs by government action must be smaller than the benefits to be gained from their reduction. However, pursuit of an optimal drug policy—in the sense of finding one that brings society to an optimal level of consumption and intervention — presupposes the existence of a great deal of information. In view of this the government may have little choice but to set some target level of consumption and select the mix of policy measures that brings it as close as possible to the target within the constraints imposed by a limited budget. The chapter indicated how this problem might be approached.

3 Literature Review: the economics of drug enforcement

3.1 **Introduction**

The previous chapter provided a discussion on the welfare economic foundations of drug enforcement policies. It suggested that the rationale for government intervention is that drug misuse imposes external costs on society. Due, however, to the absence of the information required to operationalise the welfare economic approach to formulating an optimal drug control policy, it was suggested that policy-makers may have to content themselves with the more limited objective of formulating a strategy aiming to attain some target level of drug consumption. If the target is set at zero, but there is only a limited budget available for anti-drug measures, the government needs to ensure (i) that each control agency utilises its inputs efficiently and (ii) that the output level at which each agency operates is such that the level of drug consumption is minimised.

In addressing (i) policy-makers need to have information on the input costs facing each enforcement agency and their intermediate outputs. This raises the question of how the intermediate output (or performance) of a drug enforcement agency ought to be measured. The literature of relevance to this issue is reviewed in Section 3.2.

In addressing (ii) policy-makers need to have information on the effects of alternative enforcement measures on illicit drug consumption. The theoretical literature on the issue is reviewed in Section 3.3 and the empirical literature in Section 3.4. A summary of the chapter is contained in Section 3.5.

3.2 **Measurement of the intermediate output of drug enforcement** agencies

Nothing appears to have been written to date on the problems of measuring the intermediate output of drug enforcement agencies. Indeed, the question of measuring the output of law enforcement agencies generally is a subject which has received relatively little attention (cf. Pyle, 1983). Most of the literature has been directed at the issue of measuring the final output of law enforcement

agencies (reductions in the social costs of crime), rather than at the problems of measuring intermediate output for performance evaluation purposes.

Lind and Lipsky (1971) note that for performance evaluation purposes it is not essential to use a measure of final output (e.g. reduction in the extent of illicit drug use). Indeed, since it is vital that one can isolate the effects of the police unit on the selected output measure from the effects of other factors, it may be more sensible to work with measures of intermediate output (e.g. number of drug dealers arrested and convicted). There is, however, a proviso, namely that the measure selected be always positively related to final output. Thus it ought not to be capable of being varied by - discretionary action of the enforcement agency, without any corresponding change in final output. Arrest rates, for example, might be altered by a decision to 'stop and search' more people who may be in unlawful possession of drugs, although the number of convictions might remain unchanged.

3.3 Measurement of the final output of drug enforcement agencies: the theoretical literature

The 1960s and early 1970s saw the publication in the academic literature of a number of theoretical articles by economists examining the effects of enforcement measures on illicit drug consumption. The great majority of these claimed that 'supply-side' enforcement measures (measures aimed at dealers) were doomed to failure. This conclusion, however, has recently been challenged. This section provides a survey of the debate and goes on to consider various other problems affecting the effectiveness of drug enforcement measures. All of the debate to date has been conducted in the context of supply and demand analysis: the first part of the section, therefore, provides an introduction to the basics of supply and demand analysis.

3.3.1 Supply and demand analysis

The determination of prices and quantities consumed in any market depends on supply and demand conditions. These are represented diagramatically by market supply and demand functions.

The market demand indicates the quantity of a commodity demanded at each price level, holding constant other influences such as income and the prices of other goods. Thus, in Fig. 3.1 at a price of £15, 20 units would be demanded.

Alternatively, the demand curve can be interpreted as indicating the (maximum) price consumers are willing to pay for each unit of the commodity in question. Thus, for the 20th unit consumers would be willing to pay £15. This is known as the 'demand price'. The demand curve slopes downwards indicating that consumers' willingness to pay falls as more units are consumed. This reflects the assumption that the valuation of the last unit consumed falls as more units

Figure 3.1
Demand function

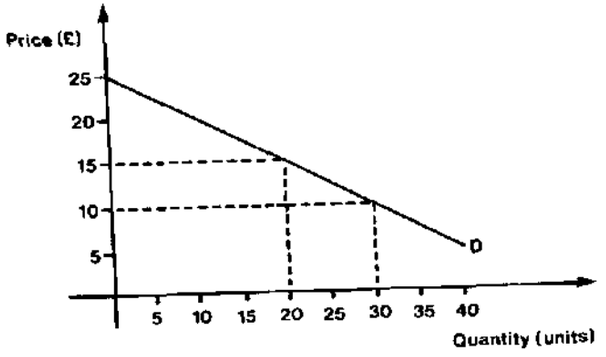
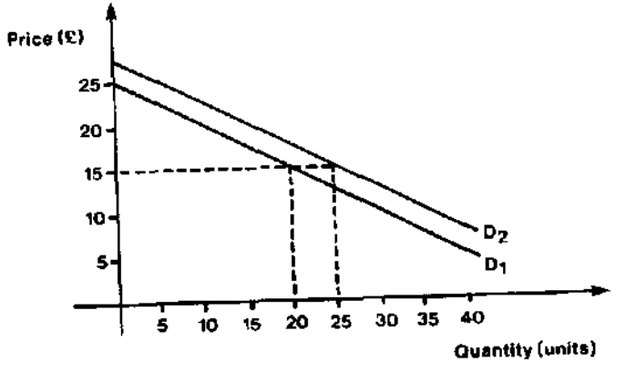


Figure 3.2
Shifts in the demand function



are consumed: the first few units are valued highly, the next few less so, and the final units much less than the first. Thus to persuade consumers to increase their consumption from 20 to 30 units, one would have to reduce the price from £15 to £10. The effect of a change in income or 'tastes' is to shift the demand curve. If the commodity in question is a 'normal' commodity, an increase in income, for example, will result in an increase in quantity demanded at each price. Thus the demand curve shifts outwards as illustrated in Fig. 3.2. Under the *new* demand curve, D_2, 25 units of the commodity are demanded at a price of £15, as opposed to 20 units previously.

The market supply curve indicates the amount of the quantity supplied to the market by all producers at each price level. Thus in Fig. 3.3. at a price of £20 producers would want to supply 80 units of output. Alternatively, the supply curve can be interpreted as indicating the (minimum) price producers are prepared to accept for producing a particular unit of output. Thus, for example, to produce the 40th unit of output, the producer would need to be offered a price of £10. This is known as the 'supply price'. The supply curve slopes upwards indicating that producers' asking price increases as their output increases. This reflects the assumption that as output expands, the cost of producing the last unit rises (at least after a point). Thus to persuade producers to increase their output from 40 to 80 units, one would have to increase the price from £10 to £20.

The position of the supply curve depends on producers' costs. A rise in production (or distribution) costs at each level of output results in producers wishing to supply less to the market at each price level. Thus the supply curve shifts up to the left as illustrated in Fig. 3.4. Thus with the new supply curve producers only want to supply the market with 20 units at a price of £10 compared with 40 previously.

The price and quantity consumed in a market is determined by the intersection of the market supply and demand functions. This is illustrated in Fig. 3.5. The 'equilibrium' is indicated at a point where the price is £20 and total quantity consumed 30 units. Any combination of price and quantity other than this will be a 'disequilibrium' and generally forces will be set in motion to ensure that the price and quantity move towards their equilibrium values.

For example, if producers were to set their level of output at 25 units, they would find that demand was higher than they anticipated. The price at which sellers

Figure 3.3
The supply function

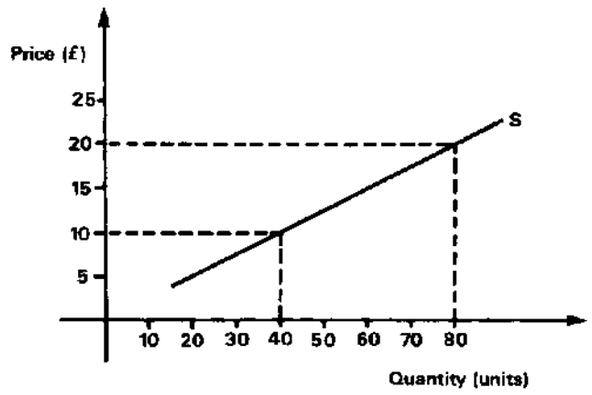


Figure 3.4
Shifts in the supply function

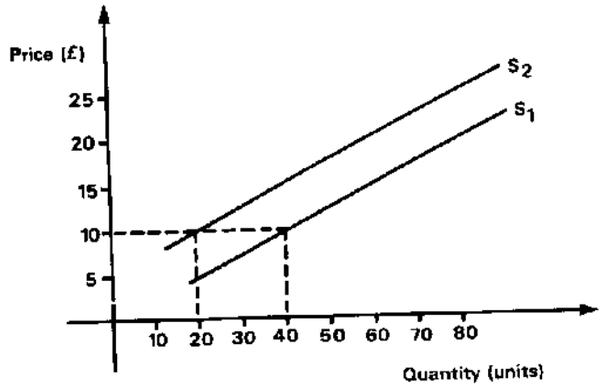
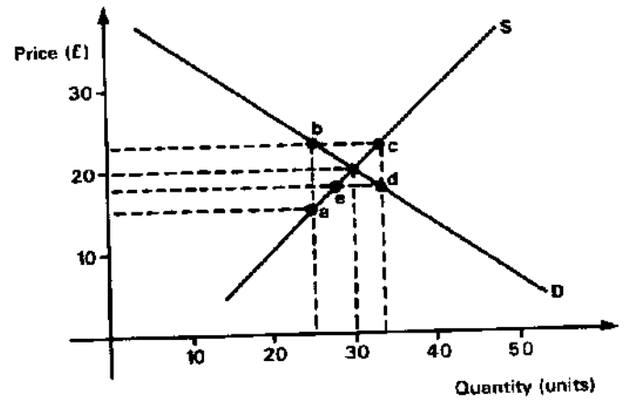


Figure 3.5
Market equilibrium



are prepared to produce 25 units, the supply price, is £.5 but H ^ « - ™ are willing to pay for this quantity, the demand pnce, is £23 The price prevailing S that period will therefore be £23, thereby rationing off the arable supply The fact that the demand price i, so much higher than the supply pnce w7result in producers expanding their production. By how much.theydc-so will depend on how they form their expectations about future prices £*£&> for example, assume the price will be £23 and produce 33 units in the following

period. Here, though, demand is too small, so that some of their output will remain unsold. The demand price—i.e. the amount consumers are prepared to pay for the 33 units—is only £17. If the producer assumes that this will be the price the following period, he will produce 28 units of output. Here, though, there is too little produced, so the producer produces more in the next period. This process will continue until the demand price and supply price are equal and the equilibrium quantity of 30 units is reached. (Cf., however, Section 3.4).

Thus far the question of quality has nc* been mentioned. Implicitly it has been assumed that units of the commodity are always of the same quality. Commodities such as illicitly imported or illicitly manufactured drugs, however, are of variable quality (i.e. purity). Thus, the axes in the figures above ought to be interpreted in terms of quality-adjusted units. In the case of cocaine, for example, the horizontal axis would be measured in terms of the number of grams of cocaine at a given (e.g. 50%) purity level and the vertical axis in terms of the price per gram of 50% (say) pure cocaine. The price per quality-adjusted gram of cocaine could therefore change because (i) the price has changed (but the quality is unchanged), (ii) the quality has changed (but the price is unchanged) or (iii) the price and quality have changed. Thus, in a situation of excess demand, cocaine suppliers might increase the price of a quality-adjusted gram by reducing the purity from 50% to 40%, leaving the unadjusted price unchanged. Providing purchasers recognise this, the analysis can proceed as before, the only difference being that the axes are measured in quality-adjusted units. We assume for the present that illicit suppliers and users are aware of the quality (purity) of the product: the validity of this assumption is discussed later (see Chapter 4).

3.3.2 The effects of law enforcement on illicit drug consumption: the early literature

One of the first papers using supply and demand analysis to investigate the effects of law enforcement measures on the illicit drug markets was that o f Little (1967). Similar arguments are to be found in Koch andGrupp (1971, 1973). This section considers first the arguments of these authors concerning the effects of enforcement measures aimed at suppliers ('supply-side' measures) and then those concerning enforcement and other measures aimed at users ('demand-side' measures).

Supply-side enforcement

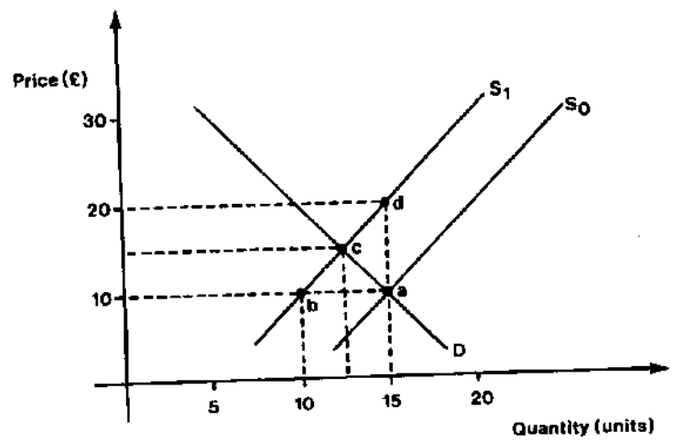
Supply-side enforcement measures take the form of increasing the probability of detection, arrest and imprisonment of illicit importers and distributors. The effect is analogous to a sales tax on the drug in question, part of which is pecuniary (fines, legal fees, forgone earnings during imprisonment, etc.) and part of which is non-pecuniary (social stigma etc.). The effect is to increase the supplier's costs at each level of output. Qualitatively (but not quantitatively) the effects of enforcement measures aimed at suppliers are the same, regardless

of which level of the market they are aimed at. Increased activity by Customs, for example, raises importers' costs and therefore increases their selling prices (i.e. distributors' purchase prices). This increases the distributor's costs and therefore his selling price. As a result, the retailer's costs rise and so will the retail price. Thus, the effect of intensified law enforcement activity at any point in the supply chain is to increase the cost of supplying to the market. Intensified activity at some points in the chain may well have larger impacts on the market supply curve than if directed at other points: this is an issue explored below (Sections 3.3.6 and 3.4; see also Chapter 5). At present our interest is in the direction of such effects, not their magnitude.

Intensified law enforcement against suppliers increases the costs of supplying to the market and hence results in an upwards shift in the supply curve (cf. Fig. 3.4.). The effects on the equilibrium price and quantity are illustrated in Fig. 3.6.

Initially the market is in equilibrium at point a. Following the intensified law enforcement, the supply curve shifts from S_o to S,. The first-round effect is to reduce the quantity supplied from 15 to 10 units: i.e. under their new costs, suppliers are only prepared to supply 10 units at the price of £10. At a price of £10, however, there is excess demand which will tend to drive the price upwards. The second-round effect will therefore involve suppliers responding to this price rise by expanding output along the S, curve until they reach point c, where supply and demand are again in equilibrium. Thus the net reduction in quantity consumed is not 5 (15-10) units, but 3 (15-12).

Figure 3.6
The effects of supply-side drug enforcement on the price of an illicit drug

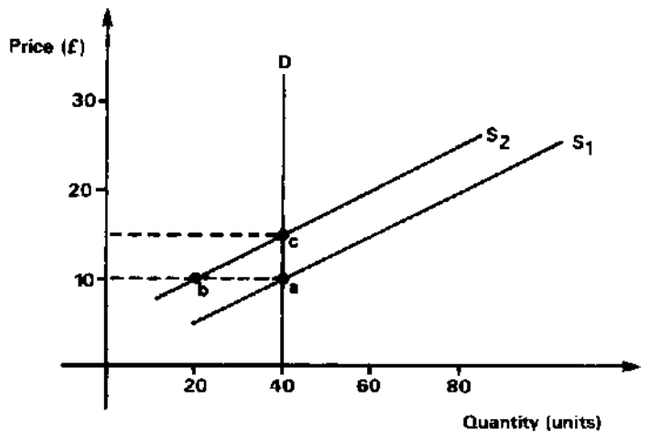


It is important to note the role played by demand in reducing the final level of consumption. In the second-round suppliers might have been tempted to expand their output along Si, until point d, thereby producing at the same level of output as before (15 units). This, however, would not have been possible, given the demand curve in Fig. 3.6, since at point d producers would have been supplying more than the market was demanding at a price of £20. As a result they would have been forced to reduce the price to £15 and cut back production to 12 units.

Thus the effectiveness of supply-side enforcement measures depends on their impact not only on suppliers' costs, but also on demand conditions, or, more precisely, on the slope of the demand curve. This indicates the responsiveness of demand to price changes and is known as the 'price elasticity' of demand. Demand is said to be 'price-inelastic' when the quantity demanded is unaffected by a (small) price change, and 'price-elastic' when a (small) price change induces a relatively large (proportionately larger) change in demand. If demand is perfectly price-inelastic the demand curve is vertical; if it is perfectly elastic the curve is horizontal.

Little (1967), Koch and Grupp (1971, 1973) and others have argued that the demand for the more harmful drugs, in particular heroin, is likely to be highly inelastic because, as a result of their physical dependence, addicts are unlikely to reduce their heroin consumption in the face of price rises. Because of this, supply-side law enforcement is likely to be futile. The problem is illustrated in Fig. 3.7,

Figure 3.7
The effects of supply-side drug enforcement on the price of an illicit drug when demand is price-inelastic



Initially the market is in equilibrium at point a—40 units are consumed at a price of £10 each. Intensified law enforcement shifts the supply curve upwards to S_2. The first-round effect — as before—sees suppliers cutting back supply to 20 units. At a price of £10 per unit, however, an output of 20 units is insufficient to meet the market demand and the price is bid upwards. Suppliers respond to this by expanding output, moving along S_2 until point c, where supply and demand are once again in equilibrium. At point c, however, market consumption is the same as that before the increase in law enforcement activity—i.e. 40 units. Thus supply-side enforcement is entirely ineffective if demand is completely inelastic.

Such measures may, it is argued, not only be ineffective, but also undesirable, since total expenditure by users on the drug (and therefore suppliers' revenues) increases. In Fig. 3.7 total expenditure increases from £400 (£10 x 40) to £600 (£15 x 40). If addicts rely on the proceeds of theft to pay for their drugs, crime rates may be expected to increase as a result of intensified enforcement. Essentially, supply-side law enforcement results in the imposition of an income tax on drug users which may then be shifted onto innocent bystanders if users commit more crime. The losers of such a policy are not drug dealers, nor drug users, but the public at large (cf. Eatherly, 1974).

It should be noted that expenditure on drugs may rise following intensified supply-side enforcement even if demand is not entirely price-inelastic. Fig. 3.8 illustrates the case. Initially the market is in equilibrium at point a where total

Figure 3.8
The effects of supply-side drug enforcement on expenditure on illicit drugs

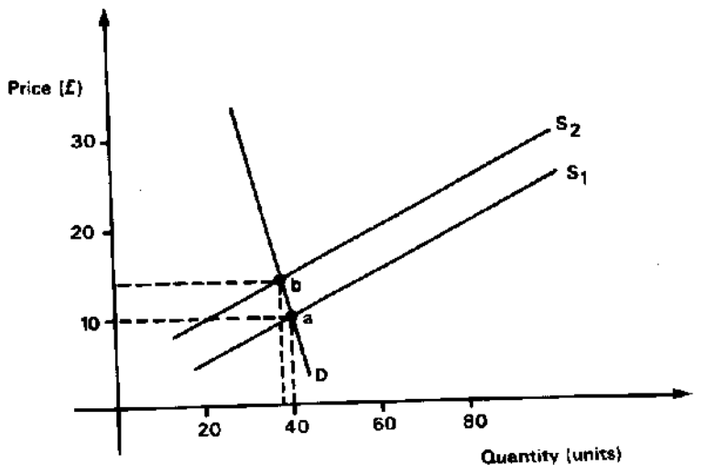
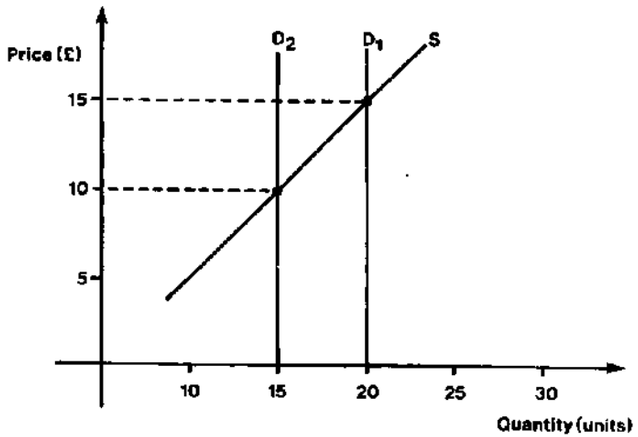


Figure 3.9
The effects of demand-side drug enforcement on the price of illicit drugs when demand is price-inelastic



expenditure is equal to £400 (i.e. £10x40 units). The effect of intensified law enforcement is to shift the supply curve from S_1 to S_2 and the market equilibrium from point a to point b. Here the quantity consumed is lower than at a (38 units), but expenditure is higher (£532—i.e. £14x38 units).

Demand-Side Enforcement

Examples of demand-side measures include health educational programmes and law enforcement measures (e.g. aimed at illicit drug users). Intensified law enforcement aimed at a user increases the probability of him being arrested and prosecuted. This will increase the effective price of drug consumption to the user, even though it leaves the nominal price unchanged. The effective price depends, therefore, not only on the nominal price of the drug, but also on the time and money costs incurred in seeking out reliable dealers (avoiding undercover police officers and dealers selling fake drugs) and in holding the drug prior to consumption (running the risk of apprehension by police officers and of punishment by the court) (cf. Moore, 1972).

Intensified law enforcement activity aimed at users therefore raises the effective price to the user, thereby shifting the demand curve to the left. Fig. 3.9 illustrates the case where demand is entirely inelastic.

Initially the market is in equilibrium at point a—the price is £15 and the quantity consumed 20 units. Intensified enforcement aimed at users shifts the demand curve from Dj to D_2. The first-round effect is for users to cut back their consumption to 15 units—the amount demanded at £15 per unit. At point b, however, there is excess supply, which puts downward pressure on the price level.

As a result, suppliers cut back supply from 20 units to 15, lowering the price in the process from £15 to £10. Thus any policy measure aimed at users results in (i) a reduction in quantity consumed and (ii) a reduction in total expenditure (i.e. £300 to £150). This is despite demand being price-inelastic. These results contrast with the ineffectiveness of supply-side measures when demand is price-inelastic. It is for this reason that economists such as Little (1967) and Koch and Grupp (1971, 1973) have counselled against the use of supply-side law enforcement in markets for addictive drugs such as heroin.

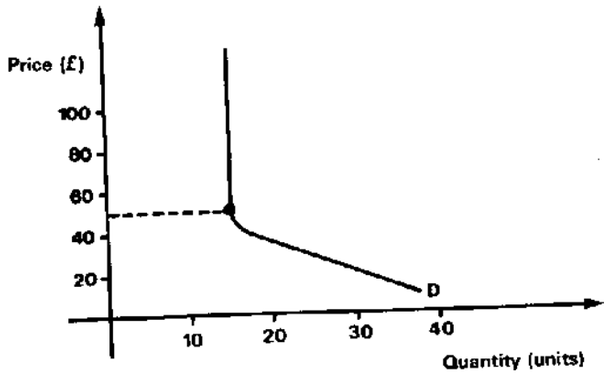
3.3.3 The effects of law enforcement on illicit drug consumption: the recent literature

Over the course of the last few years, however, various counter-arguments have been presented, suggesting that supply-side law enforcement measures may after all have some beneficial effect.

Various writers have pointed to the evidence that, contrary to what is implied by a vertical demand curve, heroin users tend (or are at least able) to use other drugs as the price of heroin rises—for example, methadone, amphetamines, alcohol, tobacco and other substances (see e.g. Holahan, 1973; Bernard, 1983). This suggests that the demand for heroin may not be as price-inelastic as was previously thought to be the case and therefore supply-side law enforcement activity may not be as ineffective as was previously thought.

Other writers concede that the demand for heroin may be highly inelastic over some price ranges, but argue that over some price ranges it will almost certainly be price-elastic. Blair and Vogel (1973), for example, suggest that demand is likely to be elastic at low prices but inelastic at high prices (Fig. 3.10).

Figure 3.10
The Blair-Vogel demand curve



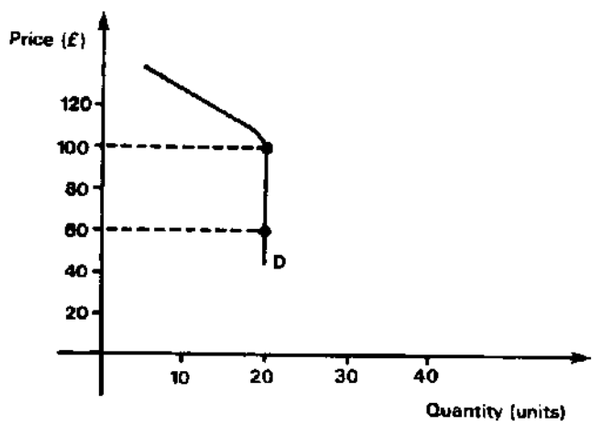
At prices below £50, demand is relatively price-elastic: as prices rise towards £50, non-addicts (occasional users and experimenters) will tend to reduce and eventually curtail their consumption, whilst addicts will tend to reduce their dosage towards the maintenance dosage. By the time the price has risen to £50, therefore, only addicts will be left in the market and they will be consuming at the maintenance level. If they were to consume less, withdrawal symptoms would develop, so that price rises beyond £50 would leave demand unaffected.

The implication of the Blair-Vogel argument is that if the market price is below £50 in Fig. 3.10, intensified enforcement aimed at suppliers will be effective. Intensified enforcement when the price is £50 or above will leave total consumption unchanged and will serve only to increase expenditure on drugs and therefore possibly the amount of property crime committed by addicts in need of money to pay for drugs.

White and Luksetich (1983) also argue that the price elasticity of demand for drugs like heroin is likely to vary over different price ranges. Their view of the demand function is, however, precisely the opposite of that of Blair and Vogel, namely that at low prices demand is inelastic, whilst at high prices it is elastic (Fig. 3.11).

White and Luksetich point to the need for a heroin addict to fund his habit, and note that any price change will have an 'income effect' on an addict's behaviour. In order to maintain the same level of consumption in the face of a price increase, addicts funding their habit through property crime will need to engage either in more crime or in more profitable crime. As prices rise, they will find it increasingly difficult to steal enough and remain undetected

Figure 3.11
The White-Luksetich demand curve



(cf. Holahan, 1972). Some will therefore decide to enrol voluntarily in treatment programmes, whilst others will be apprehended and convicted. Others still will eventually find it impossible to maintain the same level of consumption and be forced to reduce it, presumably by increasing the period between 'fixes'. Thus, the demand function will exhibit the shape indicated in Fig. 3.11.

The policy implications of the White-Luksetich argument are precisely the opposite of those of Blair and Vogel, namely that providing enforcement measures can drive the price high enough, they will eventually be effective. Clearly, though, if the starting point is point a, intensified enforcement is going to result in growing expenditures by users long before it begins to reduce consumption. If the amount of crime committed by addicts has to increase hugely before there is any pay-off in terms of reduced consumption, policy-makers may not be attracted by supply-side law enforcement measures.

In view of their diametrically opposed policy implications, it is of some importance to determine which of the two views of the demand curve presented in Figs. 3.10 and 3.11 is correct. In the event it would seem plausible to argue that they are not mutually inconsistent with one another, but rather refer to different phenomena occurring at different price levels. Blair and Vogel's elastic portion occurs at low prices and results from non-addicts curtailing consumption and addicts reducing consumption to maintenance levels. This phenomenon might be expected to occur at prices below around £50 in Fig. 3.11 and is not inconsistent with the White-Luksetich view that at high prices addicts can be forced to reduce consumption below maintenance levels through the application of intense economic pressure. A market demand curve containing two elastic regions would therefore seem plausible (Fig. 3.12).

Figure 3.12
An alternative demand curve

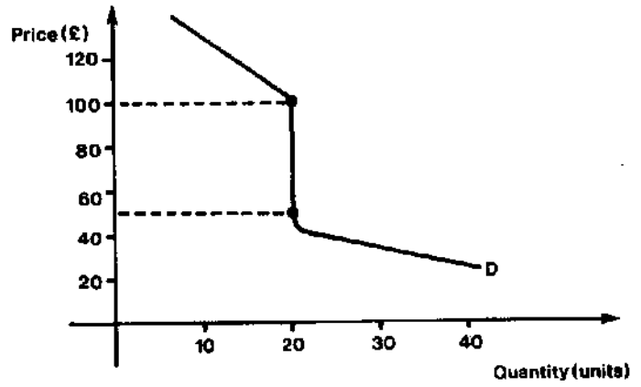
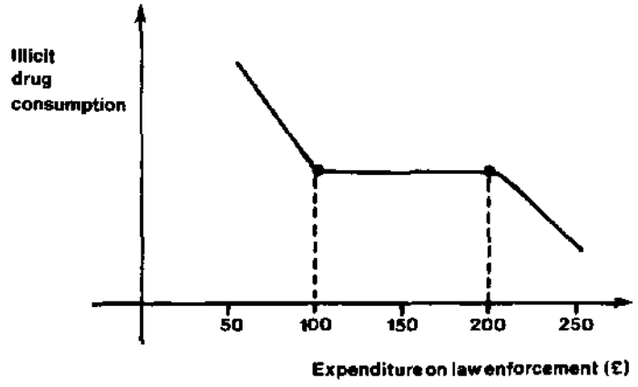


Figure 3.13
The effects of drug enforcement on illicit drug consumption



The policy implications of a demand curve such as that in Fig. 3.12 are illustrated in Fig. 3.13. Below £100 and above £200 expenditure on supply-side law enforcement measures may be expected to yield some pay-off in terms of reduced illicit drug consumption. However, increasing enforcement expenditure within the range of £100-£200 produces no decrease in consumption.

3.3.4 Addiction asymmetry and its implications for law enforcement

Throughout the discussion so far it has been assumed that price rises and price falls have symmetrical effects. Researchers have argued recently that—particularly for addictive drugs—this may not be the case (see e.g. Young, 1982). When prices are falling, for example, new users may be attracted to the market who then develop a 'habit', which they cannot 'kick' when prices rise again. This may be especially true when prices fall to record low levels.

The basic idea behind the asymmetry argument is illustrated in Fig. 3.14. Suppose the initial position is point a: the prevailing price is £50 at which 5 units are demanded. The price level then falls to £20: the price fall attracts new users (or encourages established users to consume more), so that the market moves downwards along the demand curve D to point b. Suppose now the price level were to rise, say to £40. Because new users have already developed a habit, the price rise results in a movement, not back up the D demand curve, but up the steeper D' demand curve. Thus the price rise from £20 to £40 induces a reduction in consumption of only 2.5 (17.5 - 15) units, whereas a price fall from £40 to £20 (starting at point d) would induce an increase in demand of 8.5 (17.5 - 9) units.

This hypothesis suggests that it will be far harder for law enforcement agencies to reduce consumption through supply-side measures than one might conclude

Figure 3.14
Addiction asymmetry

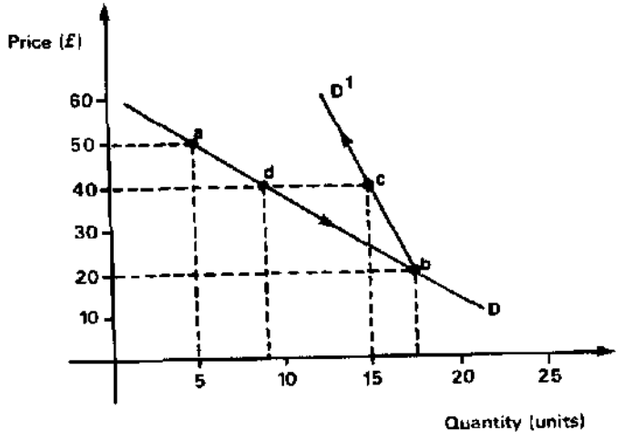
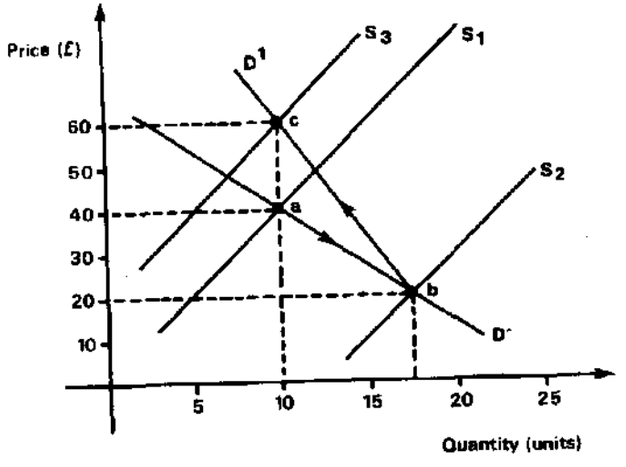


Figure 3.IS
The implications of addiction asymmetry for drug enforcement



merely from an examination of the responsiveness of demand to price reductions. The problem is illustrated in Fig. 3.15.

The market is initially in equilibrium at point a: the price is £40 and the quantity consumed 10 units. Suppose then that, for some reason, the world supply of heroin increases so that importers can obtain heroin more cheaply than previously. The domestic market's supply curve therefore shifts to the right, the new curve being S_2. The new equilibrium position is b, where 17.5 units are consumed at a price of £20 each. Law enforcement agencies are then given the task of reducing consumption to its former level—10 units. Supply-side measures would need to shift the supply curve, not just back to S,, but to S_3, since in the face of price rises, demand contracts from point b along the D] demand curve. Only until point c is reached will consumption be reduced to its former level. In other words law enforcement authorities have to increase the price to £60 (not £40) to restore the previous position.

3.3.5 The spillover effects of law enforcement into other **illicit drug markets**

Thus far the effectiveness of law enforcement measures has been analysed solely in terms of their effects on illicit consumption of, and expenditure on, the drug at which the measures are aimed. Any repercussions that measures aimed at suppliers or users of drug X might have for consumption and expenditure in the markets for drugs other than X have been ignored. There is evidence that users switch between drugs in the face of price changes so the effects on other drug markets are clearly of interest. The literature to date, however, does not appear to have gone into the problem in any depth. (See, however, Bernard 1983.)

Figure 3.16 illustrates the effects of intensified law enforcement aimed at cannabis suppliers on (i) the cannabis market (the left-hand panel) and (ii) in LSD market (the right-hand panel). Initially the cannabis market is in equilibrium at point a—7 units are consumed at a price of £0.70 per unit. Intensified law enforcement directed at cannabis dealers shifts the supply curve from S, to S_2, causing the price to rise to £1.00 and consumption to fall to 5 units. The rise in the price of cannabis, however, results in a *shift* in the demand curve in the LSD market. If LSD and cannabis are substitutes (the case illustrated in the diagram), the rise in the price of cannabis will cause the demand curve for LSD to shift outwards: i.e. more LSD will be demanded at each price. The effect of the outwards shift in the demand curve for LSD from D, to D_2 is to increase both the price of LSD (from £15 to £20) and the quantity consumed (from 5 units to 6). The precise amount by which LSD consumption will rise will depend on the degree to which users regard LSD as a substitute for cannabis, or, in economic jargon, the 'cross-price elasticity of demand'. The degree to which supply-side law enforcement aimed, say, at the cannabis market will be thought counter-productive will be higher (i) the higher the cross-price elasticity of demand and (ii) the more dangerous LSD is considered to be compared to cannabis.

Figure 3.16
The spillover effects on drug markets of supply-side drug enforcement

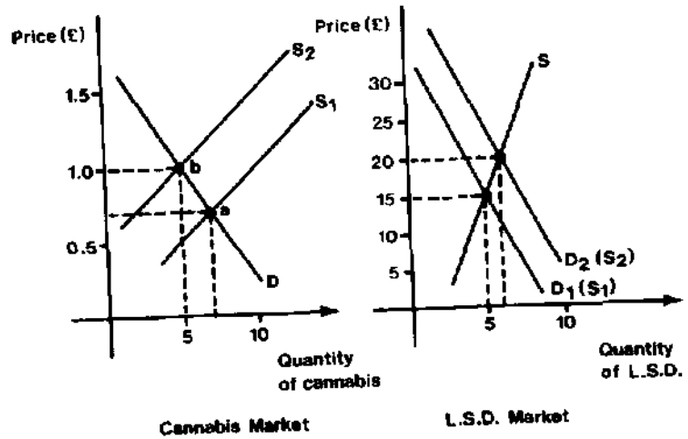


Figure 3.17
The spillover effects on drug markets of demand-side drug enforcement

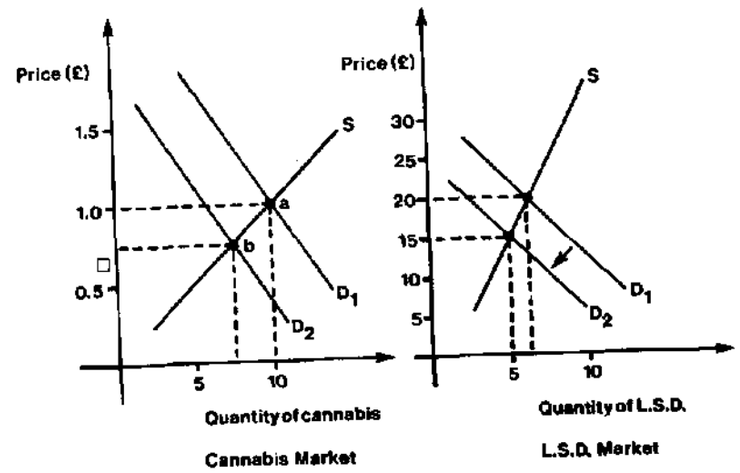


Fig. 3.17 illustrates the effects of a successful policy aimed at reducing the demand for cannabis on (i) the cannabis market and (ii) the LSD market. Initially the cannabis market is in equilibrium at point a: 10 units are consumed at a price of £1.00 per unit. The effect of the demand-side policy measure is to shift the demand curve from D_t to D_2. The new equilibrium in the cannabis market is at point b—the price is lower at £0.75 and the quantity consumed has been reduced to 7.5 units. The fall in the price of cannabis causes a shift in the demand curve for LSD. If cannabis and LSD are substitutes the demand curve for LSD will shift to the left: i.e. less will be demanded at the prevailing price and all other prices. The demand curve for LSD therefore shifts from the curve D[to the curve D_2: at the new equilibrium in the LSD market, only 5 units are consumed compared to the previous 6, at a price of £15 compared to the old price of £20. This suggests that demand-side measures will tend to have desirable 'spillover* effects if drugs are substitutes for one another. The fact that demand-side measures such as education tend to be drug-specific (in contrast to some supply-side law enforcement measures), will tend to reinforce any beneficial spillover effects from one market to the next.

3.3.6 Alternative supply-side enforcement measures

Supply-side enforcement measures may be directed at (i) importers (ii) distributors and wholesale dealers or (iii) retail dealers. The question arises as to whether drug enforcement aimed at some levels of the market may produce a larger shift in the supply curve per £ expenditure than others.

Phares (1975) discusses the problem and concludes that measures directed at importers **are** likely to yield larger net benefits (benefits minus costs) than measures aimed at street-dealers. (Benefits are defined here in terms of reductions in consumption; the effects on drug-related crime are not discussed.) His argument is based on the observation that the quantities exchanged per transaction are much larger at the import level than at the retail level and therefore a successful seizure by Customs is more likely to have an appreciable impact on overall supply than a successful seizure by police at street level. Phares argues therefore that law enforcement efforts ought to be directed at the import level, because "a seizure of one kilo at the importer level would claim fewer enforcement resources than confiscating the same amount once it reached the streets".

The situation is in fact rather more complicated than this. First, because the price structure of the illicit market tends to be steeply graduated, a seizure of one kilo **at** import level is likely to have a smaller effect on retail price than a one-kilo seizure at wholesale or retail level. Tending to offset this, however, is the fact that drugs such as heroin and cocaine tend to be 'cut* (diluted) as they pass along the distribution chain. As a result, **a** one-kilo seizure of reputed heroin at street-level tends to contain far less pure heroin than a one-kilo seizure **at** import level. This 'cutting' effect points, therefore, towards seizures at import

level as having the biggest impact on retail prices. There is, however, a third complication, namely that the probability of detection may vary from one level of the market to the next. To the extent that the number of transactions per kilo is higher at street level, the probability of detection will also tend to be higher (Rottenburg, 1968). Whether or not the risks of detection are in practice higher will depend too, however, on the extent of enforcement activity at the two levels of the market. Because all these factors tend to work in opposite directions, it is impossible to say *a priori* whether law enforcement aimed at import level (or indeed distribution level) yields higher or lower net benefits than enforcement aimed at street level.

3.4 Measurement of the final output of drug enforcement agencies: the empirical literature

The theoretical literature reviewed in the previous section suggested that the effectiveness of a particular enforcement measure will depend on (i) the price elasticity of demand of the drug at which the enforcement measure is aimed and (ii) the impact the enforcement measure has on the supply curve. If the price elasticity of demand is zero, intensified supply-side law enforcement will only serve to drive up expenditure on drugs, without having any effect on drug consumption. Various arguments and counter-arguments were presented on the subject of the price elasticity of demand. Clearly, however, whether the price elasticity is zero or non-zero is an empirical matter which can only be resolved by empirical analysis.

Because demand must exhibit at least some responsiveness to price changes in order for supply-side enforcement to be effective, our review of the empirical literature begins with those studies which provide estimates of the price elasticity of demand. It then goes on to review those empirical studies seeking to assess the effects and effectiveness of drug enforcement strategies.

3.4.1 Empirical evidence on the price elasticity of demand

Price elasticities of demand for drugs such as alcohol and tobacco can be estimated comparatively easily using standard econometric techniques and published data (e.g. from household surveys or from aggregate data from national statistics). Due to the illegality of sale and consumption of illicit drugs, such data for illicit drugs are not readily available. As a result relatively little econometric work has been done in this area: the work which *has* been done is, without exception, American, and, in terms of estimates of price elasticities, is unlikely to be of much relevance to the UK situation.

The most thorough econometric work on illicit drugs in the US is that of Brown, Silverman and Spruill (see e.g. Brown and Silverman, 1974; Silverman and Spruill, 1977). The main objective of Silverman and Spruill's (1977) paper is to explore the relationship between crime and expenditure on heroin. However,

their results are of interest, since they include estimates of the price elasticity of demand for heroin, which are obtained as a 'by-product'. Their analysis uses monthly time-series data from the city of Detroit over the period November 1970-July 1973. Heroin consumption is unobservable: the authors assume, however, that it depends on the price of heroin, with the price elasticity depending on (a) the potency of heroin consumed (the level of dependence being assumed to be determined by the potency) and (b) the price of heroin relative to its price in recent months. A quality-adjusted price index is derived using the method developed by Brown and Silverman (1974) and data from the Bureau of Narcotics and Dangerous Drugs (now the Drugs Enforcement Administration).

The findings of Silverman and Spruill may be summarised as follows. The long-run price elasticity (the elasticity obtaining when prices are stable) is estimated to vary only slightly with the purity of heroin consumed. At purity levels from 2.5% to 10%, a 10% increase in the price of heroin is estimated to result in a 2.5% decrease in consumption (i.e. price elasticity = -0.25). The short-run price elasticity (the elasticity obtaining when prices are fluctuating) is found to be quite sensitive to the price in the recent past. The estimates reported are such that this means that addicts adjust their consumption more in the short-run than in the long-run. One interpretation of this is that when heroin becomes scarce addicts shift into other drugs or detoxify. Subsequently, they establish new connections so that some part of the previous habit can again be supported. The estimates regarding the link between heroin consumption and crime are such that a 50% price increase would result (after several months) in approximately a 14% increase in total property crime.

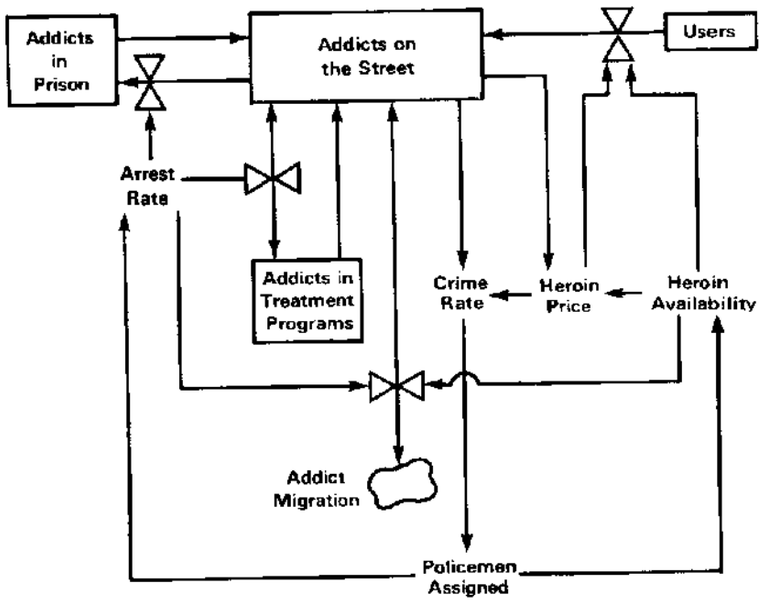
3,4.2 Empirical evidence on the effects of drug enforcement policies

The major problem faced by researchers seeking to assess the impact of drug enforcement measures on **illicit** drug consumption (or drug prices) is that consumption and prices are determined by a variety of factors, of which law enforcement is only one. It is necessary, therefore, to find some way of estimating the effects of supply-side enforcement measures, whilst 'holding constant' the effects of any simultaneous changes in other supply influences and demand influences. Unless such changes are controlled for one cannot determine the extent to which any change in price of consumption is due to intensified enforcement rather than to simultaneous changes in other factors.

The approach adopted by Silverman and Spruill (1977) and Brown and Silverman (1974) provides the most reliable means of estimating the impact of drug enforcement policies, but in neither of their papers do they explore the issue.

Levin *et ah* (1975) appear to have made the only attempt to examine the effects of enforcement policies in the context of a full model of the illicit drug market. Their approach, however, is that of Systems Analysis, not econometrics. The model consists of seven 'modules' and over 300 equations. A variety of

Figure 3.18
Systems analysis model of drug enforcement and the illicit heroin market



alternative policy measures are examined in a series of simulation experiments over a 25-year period. A simplified version of the module indicating the effects of police activity is illustrated in Fig. 3.18.

The top part of the diagram shows the relationship between the four main groups of heroin users—non-addicts, addicts 'on the street', addicts in prison and addicts in treatment programmes. The rate at which non-addicts are converted into addicts on the street depends on the availability of heroin, both directly and indirectly, via the effects of heroin availability on the street price. The latter also depends on the number of addicts on the street. Some addicts on the street will end up in treatment programmes and some in prison: the rate at which street addicts move into treatment programmes (and back onto the street) and into prison will depend on the arrest rate, which will, in turn, depend on the number of policemen on the street. Addicts on the street also commit crime to fund their habit and therefore the number of addicts on the street affects the crime rate, which, in turn, affects the number of policemen on the street. The number of policemen, in turn, also affects heroin availability.

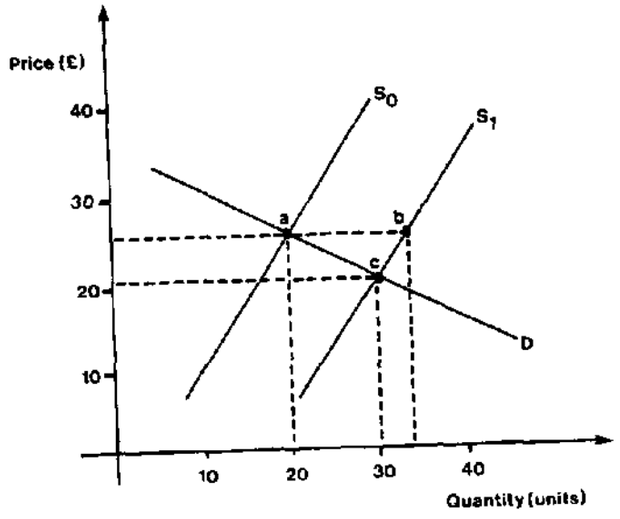
The method of Systems Analysis is to make assumptions about the direction and magnitude of the parameters of the model (for example, the parameter indicating the effect of policemen on heroin availability) and then to run the model so as to see how the variables of interest (e.g. number of addicts, addict-related crime) change over time under different policy scenarios. Because the model's parameters are chosen by the analyst, the Systems Analysis approach provides little by way of information on the effectiveness of policy measures (at least in a narrow sense). It is assumed, for example, that at a maximum only 20-30% of a community's heroin supply can ever be eliminated, whatever the level of police activity. The usefulness of the approach lies in its ability to trace through all the effects of a particular policy measure once one knows the direction and magnitude of the various inter-relationships between all the system's variables. Of course, this is precisely the sort of information one does not have, but which is essential if an optimal deployment of resources is to be achieved. In Section 7.3 another type of approach to modelling is discussed—the econometric approach—in which these unknown parameters are estimated from available data. Such a model may also be used for simulation purposes if desired.

Another problem with the simulation model of Levin *et al.* is that it lacks a sound theoretical basis. At times this leads to the imposition of some curious assumptions. One such assumption is the assumption that an increase in supply of itself generates further increases in supply by virtue of the fact that it results in an increase in the number of addicts. This provides a positive 'feedback loop' in the model, ensuring that an increase in supply produces a continuous exponentially increasing growth in the number of addicts.

From the discussion of Section 3.3 it should be clear that such a development will be the exception rather than the rule. Fig. 3.19 illustrates the effects of an outwards shift in the supply curve. The initial position is point a—where 20 units are consumed at a price equal to of £25. Suppose then some event conspires to shift the supply curve to the right from S_o to S]. The initial effect will be to result in 33 units being produced at the old price £25. At point b, however, there is excess supply—at a price of £25 only 20 units are sold since the demand price is less than the supply price. If producers behave along the lines discussed in Section 3.3.1 they will cut back output until the new equilibrium—point c—is reached.

It should be noted at this point that it is not automatically the case that a new equilibrium is arrived at following a shift in the supply curve. The diagram above has been drawn to ensure that this is in fact what happens: the equilibrium in Fig. 3.19 is known as a stable equilibrium. Not all equilibria, however, are stable. Whether or not an equilibrium is stable depends in part on the manner in which producers form their expectations about future prices and in part on the slopes of the supply and demand curves (see e.g. Gravelle and Rees, 1981, pages 271-287). If the equilibrium in the heroin market is unstable, then the

Figure 3.19
Stable equilibrium in the illicit drug market



assumption of Levin *et al.* that increases in supply of themselves generate further increases in supply, would make sense. *A priori* one cannot, however, say whether or not this is the case and to build into the model what is essentially an unstable equilibrium would seem unwise.

An alternative approach to constructing a model of the drugs market is that adopted by Polich *et al.* (1984). They use a quasi-experimental approach to analyse the effects of intensified law enforcement against each of the main levels of the cocaine and cannabis markets in the United States. They conclude that, in each case, even large increases in law enforcement expenditures would be unlikely to reduce drug use significantly.

Polich *et al.* consider separately the effects of changes in law enforcement activity aimed at (i) importers, (ii) wholesalers and (in) retailers. Regarding (i) they conclude that US drug enforcement agencies (Coast Guard, Customs and DEA) intercept between 14% and 20% of all shipments of cocaine to the US and-between 10% and 27% of all cannabis shipments. They go on to examine the effects of increasing the interception rates on retail prices: an increase in the interception rate from the current (assumed) 20% to 40% is estimated to result in an increase in retail prices of only 3.4%, in the case of cocaine, and 12.4% in the case of marijuana.

These small effects on retail prices stem in part from the price structures of the two markets and in part from the lack of monopoly power of dealers. The price of (pure) cocaine in the US, for example, increases 31 fold between export and retail sale (the exporter purchases 1 kg for $20,000, whilst the retailer sells 1 kg for $625,000). If dealers do not enjoy any degree of monopoly power, one must assume that the importer passes only his increased costs on to the domestic distributors, and that they, in turn, raise their prices to dealers only enough to compensate for the higher cost of purchase. Thus, the 'interdiction tariff simply gets passed down the line, so that the retail price rises only by enough to cover the importer's increased costs. These costs are, however, very small in relation to the total value of the market, so that the effect on retail price is also very small.

Polich *et al.* also estimate that increased imprisonment rates amongst couriers will leave retail prices relatively unaffected, particularly in the case of marijuana. This result also stems from the price structure of the market.

It should be noted, however, that in deriving their result for the effects of increased interception rates Polich *et al.* do not take into account that a higher interception rate means increased risks for both the courier and the importer. As a result the 'interdiction tariff includes not only the cost of replacement shipments but also the higher costs of importing (i.e. courier's compensation rises) and the higher costs faced by importer due to the increased risks. The results for the UK presented in Chapter 6 suggest that this omission results in a significant underestimate of the effects of an increased interception rate.

Polich *et al.* also estimate the effects of intensified law enforcement against wholesale dealers. They conclude that the seizure of dealers' assets is unlikely to have any significant effect on retail prices: a tripling in the value of dealers' assets seized would probably cause the US retail price of cannabis to rise by only 1 %. They also conclude that increased investigative effort against wholesalers is unlikely to be very effective: a tripling in the number of years spent in prison by wholesale dealers is estimated to result in an increase in the average drug retail price of about I3°/o and to require at least another $800 m expenditure on drug law enforcement. (Current US drug law enforcement expenditure is estimated by the authors to be a little under $600 m.)

Finally, Polich *et al.* consider the effects of intensified law enforcement aimed at retail dealers. They estimate that the risks of arrest faced by retail dealers are very small: between 4.3Vo and 11.2% of marijuana dealers are arrested each year. Moreover, only a small fraction of these are imprisoned. Polich *et al.* estimate that if the risk of arrest were doubled and the number imprisoned increased from 1000 to 5000, the increase in the retail price of marijuana would be less than *l°fo.* This result stems from the large retail value of the market and the (assumed) high degree of competition between retailers.

Polich *et al.* conclude their analysis of the effects of law enforcement with a plea for better data on the drugs market and on the activities of law enforcement agencies. They emphasise that insufficient information is available at present to answer the two key questions—(1) how much expenditure would be required to produce a given percentage increase in retail price and (2) which strategies are likely to have the biggest pay-off in terms of their effects on retail price per dollar spent. It is not possible to say, therefore, whether the activities of the US Customs Service ought to be cut back to release resources for intensified investigative activity against high-level dealers or vice versa.

3.S Summary

The early economics literature on drug enforcement measures argued that supply-side law enforcement measures were likely to be futile, since the price elasticity of demand for drugs (especially addictive drugs) is likely to be very low. Moreover, such measures may, it is argued, be counter-productive, because they will tend to result in increased expenditure and therefore higher drug-related crime (addicts engaging in theft to support their habit). The early literature concluded that demand-side measures (arrests of users, education etc.) were more likely to reduce drug consumption and would have the added advantage of reducing—rather than increasing—the level of drug-related crime.

This conclusion has recently been challenged on the grounds that the price elasticity of demand for drugs may not be so low as previously thought. One reason is that users of drugs such as heroin tend (or are at least able) to switch to other drugs as the price of heroin (or whatever) rises. The existence of substitutes means that the demand for hard drugs may not actually be so price-inelastic. Other writers suggest that demand may be price-elastic at least over some price ranges. At low prices some of the market demand will be from occasional users, whose use may be expected to drop (or even cease) as the price rises. Thus, even if addicts' demand is price-inelastic at low prices, the market demand need not be. At high prices addicts' demand may be price-elastic, since as prices become very high they will find it harder and harder to fund their habit. They will be more likely to be detected when engaging in theft and therefore more likely to be removed forcibly from the street. They may also be more likely to enter treatment programmes voluntarily as supporting their habit becomes more difficult. The upshot of all this is that supply-side law enforcement may, after all, have a role to play.

Some writers have suggested that price increases and price reductions may have asymmetrical effects on the demand for drugs. When prices are falling, new users may develop a 'habit[1], which they cannot 'kick' when prices rise again. The implication of this is that it will be harder for drug enforcement agencies to reduce consumption through supply-side law enforcement measures than one might conclude merely from an examination of the responsiveness of demand to price reductions. Another complication is the existence of spillover effects

of enforcement into other drug markets. If, say, cannabis and LSD are substitutes for one another, intensified supply-side law enforcement in the cannabis market will increase both the level of consumption of LSD and its price. There is a danger, therefore, that intensified supply-side law enforcement in one drug market merely results in the problem being shifted into another market.

It has been suggested that measures aimed at importers are likely to yield larger net benefits than measures aimed at street-level dealers, since the quantity exchanged per transaction is higher at the import level than elsewhere. This, however, overlooks a number of complicating factors. At the end of the day it is impossible to say *a priori* whether law enforcement aimed at one level of the market is likely to yield higher or lower net benefits than enforcement measures aimed at other levels of the market.

Empirical work of interest from the drug enforcement perspective is virtually non-existent. Econometric studies of United States drug markets suggest that the price elasticity of demand for heroin is low but above zero in absolute size (about -0.25). These studies do not indicate, however, anything about the effects of enforcement measures. The only full-scale model of an illicit drugs market in which enforcement measures are analysed is that of Levin *et al.* (1975). The model is, however, in the Systems Analysis tradition and therefore the forecasts are derived from assumptions about the effectiveness of enforcement measures rather than estimates. Many of its assumptions are also of questionable validity.

The only reliable empirical study of the effects of drug enforcement measures is that of Polich *et al.* (1984) in which it is concluded that even large increases in expenditure on law enforcement, at any level of the market, would leave US cocaine and marijuana consumption relatively unchanged. •

4 Trends in the UK Illicit Drug Markets

4.1 Introduction

This chapter summarises what is known about the economic characteristics of the UK illicit drug markets. It begins in Section 4.2 with some background detail on the organisation and the composition (as distinct from size) of the illicit markets for heroin, cannabis and cocaine. It also attempts to assess how the composition of the heroin market changed over the period 1980-85. The next section—Section 4.3 — summarises the available data on the main economic indicators, namely purity (quality), price and consumption. Sections 4.4 to 4.6 present the available data on each of these indicators for heroin, cannabis and cocaine respectively. The final section—Section 4.7—contains a summary of the main findings.

4.2 Background to UK drug markets

This section provides a brief overview of the organisation and composition (as distinct from size) of the markets for illicit heroin, cocaine and cannabis in the UK.

4.2.1 The heroin market

This section discusses first the UK heroin distribution system and second the changing composition of the market, in terms of trends in 'market shares' of different types of heroin.

The heroin distribution system in the UK

In contrast to its US counterpart, the UK heroin distribution system has been the subject of comparatively little study. Lewis *et al.* (1985) have, however, undertaken some research in the area and what follows draws heavily on their work. Figure 4.1 presents a simplified version of the heroin distribution system as sketched out in Lewis *et al. (op cit).*

At the import level, heroin is smuggled into the country in consignments of often 1 kg or more. These are then sold by the importer (A)—often after being diluted or 'cut'—to a multi-ounce distributor (B) who buys from the importer

Figure 4.1
Illicit heroin distribution system in the UK. Source: Lewis *et al.* (1985)

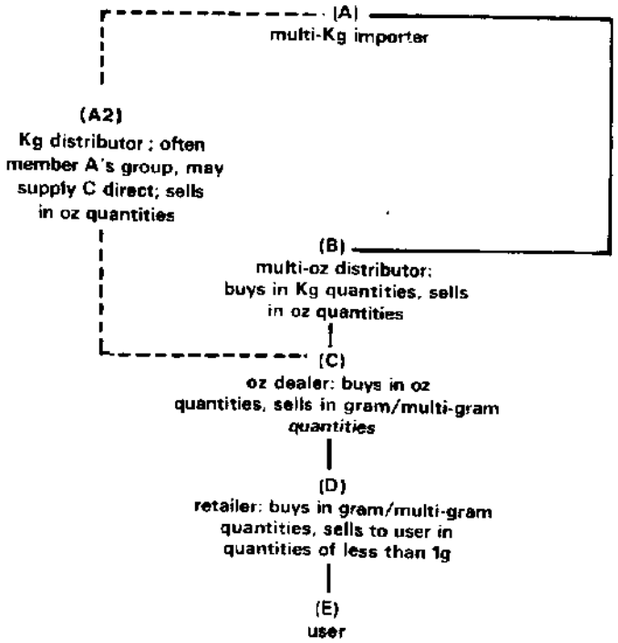


Table 4.1
Levels of the UK illicit heroin market

Level	*Buys*	*Sells*
Importer	kg	kg/oz
Distributor	kg/oz	oz
Ounce-dealer/wholesaler	oz	g
Retailer	g	1g
Non-selling user	1g	—

Source: Based on Lewis *et al.* (1985).

in kg quantities and sells (often after further dilution) to an ounce-dealer (Q—or **wholesaler**—in ounce quantities. Alternatively, the importer may arrange the distribution himself, with a member of his group (A2) selling directly to the ounce-dealer/wholesaler, though quite how frequently this occurs is not known.

The wholesaler, in turn, breaks his purchases into smaller quantities (often after diluting the drug further), selling to the retailer (D) in quantities of 1 gram or

Table 4.2
HM Customs heroin seizures by country of origin, 1980-85

	1980	*1981*	*1982*	*1983*	*1984*	*1985*
Southwest Asia	93%	97%	98%	96%	90%	72%
Pakistan	29%	65%	86%	89%	61%	37%
Iran	20%	—	—	—	—	—
India	4%	—	6%	2%	25%	32%
Turkey	40%	24%	6%	5%	3%	3%
Lebanon/Syria	—	8%	—	—	1%	—
Southeast Asia	7%	3%	2%	4%	10%	28%

Source; HM Customs and Excise.

several grams. The retailer then sells to non-selling users (E) in quantities of (generally) less than 1 gram. The various levels of the market—together with the units in which heroin is bought and sold—are listed for easy reference in Table 4.1.

Fig. 4.1 and Table 4.1 are simplifications of the true picture in at least two respects:

(i) The findings of Lewis *et a!*, suggest that (certainly) individual D in Fig. 4.1 and (probably) individual C will both be users and will often be addicts.

(ii) The user, E, will frequently supply small quantities of heroin to friends on a non-profit basis. Thus at the bottom end of the heroin market the distinction between user and dealer is blurred: it might be more satisfactory to term C and D 'user-dealers' and E a 'non-dealing user', though the latter does not capture the idea that E may be a non-profit supplier.

Types of heroin and trends in market shares

At various stages over the last 10-15 years heroin has been illicitly imported from both Southeast Asia (the 'Golden Triangle' of Burma, Laos and Thailand) and Southwest Asia (Turkey and the 'Golden Crescent' of Afghanistan, Pakistan and Iran), (cf. e.g. Lewis *et al.*, 1985; Lewis, 1985). Southeast Asian heroin comes in two types: (i) a pinkish heroin known as 'No. 3' heroin and (ii) a white powdery heroin known as 'No. 4' (or 'Thai') heroin. Of the two, No. 4 heroin appears to be the more highly valued, because it is thought to be pure, strong and relatively 'clean'.

One indicator of changes in the market share of each type of heroin is the information contained in Customs seizures. Table 4.2 provides a breakdown of the total weight of Customs seizures by country of origin.

The first point that should be made is that the 'country of origin' in Table 4.2 may include heroin consigned rather than produced there. Thus the figures for Pakistan may include Afghani heroin and those for India may include both Pakistani and Afghani heroin. Similarly, imports from Turkey may include

heroin from elsewhere in Asia Minor. These figures suggest that Pakistani heroin came increasingly to dominate the market over the period 1980-83, with Iranian and Turkish heroin accounting for less and less of the market share between 1980-85. The gradual decline in the market share of Southeast Asian heroin over the years 1978-82 (cf. Lewis *et al.*, 1985) appears to have been reversed around 1982/83, with Southeast Asian heroin accounting for 10% of Customs seizures in 1984 and 28% in 1985. Over the last two years Indian heroin has also apparently increased its market share quite significantly.

The figures in Table 4.3 have, of course, to be interpreted with caution, since they refer to only those drugs which are seized by Customs. Trends in the figures will reflect not only trends in composition of the market, but also any changes in Customs practices. In particular, they probably reflect the growing emphasis on intelligence gathering and targeting of importers by Customs (see Section 5.2). Thus the gradual increase in the proportion of seizures originating from Pakistan may reflect a growing tendency on the part of Customs to target Pakistani importers.

An alternative source of information on trends in the composition of the heroin market (albeit at a fairly local level) is the Drug Indicator Project (DIP). Lewis *et al.* (1985) collected data on the (alleged) type and country of origin for each of the heroin deals witnessed by the Project's fieldworkers over the period 1980 (last quarter) to 1983 (first half). These deals included: deals at the retail level (i.e. between users and retailers) and at the wholesale level (i.e. between retailers and wholesalers). Table 4.3 indicates the percentage of heroin deals involving heroin from each of the major producing countries over the period 1980-83.

Care should be taken when comparing Tables 4.2 and 4.3 for a variety of reasons:

(i) for the years 1981, 1982 and 1983 in Table 4.3 not all Southwest Asian heroin is identified by country. Thus, for example, in 1981 18% of deals witnessed involving heroin was claimed to be of Southwest Asian origin but the country of origin was not known;

(ii) the Customs data refer to quantity seized (not number of seizures), whilst the DIP data in Table 4.3 refer to numbers of deals;

(iii) the Customs data refer to the UK as a whole, whilst the DIP data refer to a local market (Inner North London). Thus one cannot preclude the possibility that the figures for Turkish heroin in 1981, for example, differ between Tables 4.2 and 4.3 simply because Turkish heroin was particularly popular in the locality studied by the DIP;

(iv) the country of origin in the DIP data is the alleged country of origin, whilst in the Customs data it is country of origin as established by forensic scientists (cf. Section 4.3.1).

Comparison of the Tables 4.2 and 4.3 does suggest, however, that Iranian heroin probably did not lose its market share as rapidly as the Customs seizures data

Table 4.3
Heroin exchanged during witnessed **deals** by **country** of **origin**

	1980[a]	*1981*	*1982*	*1983*[b]
Southwest Asia	94%	79%[c]	91%[c]	94%[c]
Pakistan	—	7%	41%	31%
Iran	28%	14%	4%	12%
India	—	4%	—	—
Turkey	67%	36%	14%	—
Southeast Asia	6%	21%	9%	6%

[a]Last quarter of year only.
[b]First half of year only.
[c]Figures do not add up to total percentage for Southwest Asia due to fact that some dealers indicated region only and not country.
Source: Table 3 of Lewis *et al.* (1985).

"Last quarter of year only.
[b]First half of year only.
[c]Figures do not add up to total percentage for Southwest Asia due to fact that some dealers indicated region only and not country.
Source: Table 3 of Lewis *et al.* (1985).

suggest, that Pakistani heroin may not have established itself as the market leader quite as quickly as Customs data suggest, and that Southeast Asian heroin may have maintained a rather more constant market share over the period 1980-83 than is suggested by Customs seizures.

4.2.2. The cannabis market

The cannabis distribution system in the UK

The cannabis distribution system in the UK has been the subject of even less study than the heroin distribution system. Despite the lack of hard evidence, however, it is often asserted that the UK cannabis market is 'highly organised' (cf. Atha and Blanchard, 1985). According to Malyon (1985) the market "is extremely diverse, encompassing thousands of small dealers and importers, as well as a number of larger companies".

Some support for this view is provided by the fact that HM Customs frequently make relatively large seizures. In 1948, for example, there were 193 seizures of cannabis of between 10 kg and 100 kg (Home Office, 1985b). In the same year, 12 seizures of quantities in excess of 100 kg were made. This is not, however, compelling evidence for Malyon's assertion that "several organisations are regularly importing amounts of between 2-5 tonnes" (Malyon, *op cit.*, page 90). Nonetheless, it does suggest that imported cannabis passes through several hands before being finally broken down into the standard retail quantity of 1/4oz (7g). The sheer number of Customs seizures (2072 of cannabis in 1984) does suggest too that the distribution system is not effectively monopolised.

Types of cannabis and trends in market shares

Surveys of cannabis users by the Legalize Cannabis Campaign (Atha and Blanchard, 1985) found that Lebanese hashish (cannabis resin) was the most

Table 4.4
Average weight of cocaine consignments seized by Customs, 1979-84

Year	*Average weight (grams)*
1979	393
1980	450
1981	147
1982	161
1983	587
1984	236

Source: Home Office (1985b).

popular variety of cannabis (accounting for "42% of the market"), followed by black hashish from the Indian subcontinent (30%), Moroccan hashish (10%), imported herbal cannabis (9%) and home-grown cannabis (9%). It is unlikely, however, that either sample was representative of all cannabis users: one survey was undertaken at two pop festivals, and the other through branch offices of the Legalize Cannabis Campaign. Most importantly, the samples under-represent the Afro-Caribbean cannabis-using population, whose preference is for herbal cannabis. Nor is it clear whether the percentages quoted above refer to percentages of users indicating a preference for a particular type of cannabis or to percentages of total quantity consumed.

4.2.3 The cocaine market

The cocaine distribution system

The structure of the UK cocaine market does not appear to have been the subject of any research whatsoever. It has been suggested in various quarters (see eg, Home Affairs Committee, 1985a) that as the United States market for cocaine becomes increasingly saturated, countries such as Britain will become the target for South America's surplus cocaine. If this is true, then one would expect the levels of the market to become more differentiated as the scope for specialisation increases (cf. Rottenburg, 1968).

The data on seizures at import level suggest that this has probably not yet started to happen. Since 1979 there has been a sharp upward trend in the average weight of heroin consignments seized by Customs: in 1979 the figure was 0.5 kg, compared to 1.6 kg in 1984 (Home Office, 1985b). There has not been a similar trend, however, in cocaine seizures, as Table 4.4 indicates.

This suggests that whilst the various levels of the heroin market have probably become more established over the period 1979-84, this has not apparently been the case in the cocaine market.

Types of cocaine and trends in market shares

In contrast to heroin and cannabis, cocaine is a relatively homogeneous commodity, the majority of the world's production taking place in the South American countries. Like heroin, however, cocaine tends to be 'cut[1] as it passes its way through the distribution system (see Section 4.6).

4.3 Availability of data on prices, purity and consumption

Obviously data on the prices of drugs on the illicit market, quality (purity) and the quantity consumed are riot readily available. In contrast to the situation obtaining in licit markets, it is relatively difficult to obtain quotations from importers, wholesalers and retailers on prices and purity levels. Nor is it as easy as in markets for licit commodities to obtain data on sales and consumption. Some information is, however, available, albeit subject to a potentially wide margin of error.

4.3.1 Data on purity

Drugs such as cocaine and heroin vary in their purity at different levels of the illicit market. As cocaine and heroin pass along the distribution chain, they are 'cut'—i.e. the purity level is reduced by adulterants.

The only current source of information on purity of drugs at different levels of the illicit market comes from laboratory analyses of seizures made by enforcement agencies. All seizures made by Customs are analysed at the Laboratory of the Government Chemist in order to determine (i) the substance seized, (ii) the purity (in the case of drugs such as heroin and cocaine) and (iii) the nature of any adulterants. The majority of seizures by the police also go for forensic analysis, either to the Metropolitan Police Laboratory (in the case of seizures made in the London area) or to one of six regional laboratories, The primary purpose of forensic analysis at present is to assist enforcement agencies in the prosecution of offenders. (In a few instances the substance seized by the police does not go for analysis if the plaintiff has been caught in possession of a small quantity of powder suspected to be heroin and pleads guilty to unlawful possession of heroin. This 'Guilty Plea[1] policy apparently only operates in parts of Merseyside at present.)

The results of analysis of seized drugs by the Laboratory of the Government Chemist are recorded by HM Customs and Excise. They are also notified on a monthly basis to the Drugs Intelligence Laboratory (DIL) of the Home Office Central Research Establishment at Aldermaston, which collates the findings of the various forensic laboratories analysing enforcement agencies' seizures.

The findings of the 7 police laboratories are not automatically notified to DIL. Only 'significant' seizures are currently notified: the term 'significant', however, has never been clearly defined, with the result that each laboratory decides for

itself which seizures to notify. The sample of seizures whose details are notified to DIL are therefore a non-random sample of all police seizures, the selection process being performed by the laboratories themselves. As from January 1986, however, all heroin seizures in excess of 1 gram will be notified to DIL, as will all cocaine seizures.

DIL has, since 1981, produced an annual survey of purity levels of ail notified seizures. Police seizures are broken down into those of less than 1 gram (user quantities) and those in excess of 1 gram (dealer quantities). Purity levels for Customs seizures and police seizures in excess of 1 gram are based on *weighted* averages, where the weight attached to the i'th seizure is the fraction of the total quantity of powder seized accounted for by the i'th seizure. A Customs seizure of 5 kg of 80% pure heroin will therefore be accorded a higher weight than a Customs seizure of 1 kg of 50% pure heroin.

4.3.2 Data on prices

Retail prices

The NDIU and HM Customs both analyse data on retail prices (prices charged by retailers to users) and consult each other in doing so. Customs Investigation Division officers obtain information on prices by questioning informants and offenders, or, covertly, by talking to users and dealers who do not know their identity. Police officers obtain information in similar ways. Voluntary bodies helping users are sometimes consulted about their knowledge of prices, although the reliability of this source has been questioned by Customs on the grounds that voluntary bodies may be more likely to identify with the user's interest rather than that of enforcement agencies. The enforcement agencies' figures are not based on actual purchases, and so serve only as a guide to the prevailing street price. Some data based on actual purchases are to be found in Lewis *et al.* (1985), who report the means and standard deviations of heroin retail prices for each quarter over the period 1980-83 for the London market, based on transactions witnessed by fieldworkers.

Wholesale and importers' prices

Medium-level drug dealers are questioned on arrest by police officers on wholesale prices, but the data obtained are not recorded on the grounds that such prices are artificial. Importers are also questioned about importers' prices by Customs officers on arrest.

Wholesale prices are also sometimes recorded in fieldwork studies. The study of Lewis *et al.* (1985), in particular, records wholesale heroin prices in London over the same period as retail prices are recorded (i.e. 1980-1983).

Importers' selling prices are also recorded in HM Government's Reports to the United Nations on the workings of the International Treaties on Narcotic Drugs

Table 4.5
Heroin purity at import, distribution and retail levels of the market, 1980-85*

	Level of market		
Period[a]	*Import*[b]	*Distribution*[c]	*Retail*[d]
1980/81	62%	60%	39%
1981/82	65%	59%	47%
1982/83	73%	67%	56%
1983/84	61%	52%	49%
1984/85	61%	52%	34%

[a]Year refers to period August-July.
[b]Customs seizures: figures are weighted averages.
[c]Police seizures in excess of 1 g: figures are weighted averages.
[d]Police seizures of less than 1 g.
Source: Drugs Intelligence Laboratory, Home Office Forensic Science Service.

[a]Year refers to period August-July.
[b]Customs seizures: figures are weighted averages.
[c]Police seizures in excess of 1 g: figures are weighted averages.
[d]Police seizures of less than 1 g.
Source: Drugs Intelligence Laboratory, Home Office Forensic Science Service.

(HM Government, 1983, 1984). It is not clear, however, how reliable these data are: the accompanying purity figures in the 1983 and 1984 Reports are far in excess of the figures recorded by the Laboratory of the Government Chemist, suggesting that the price data may also be somewhat unreliable. These Reports were not, therefore, used as a data source in the present paper.

4.3.3 Data on consumption

There have been few attempts to estimate the total quantity consumed in the UK of each of the three major controlled drugs. Discussions of trends in illicit drug consumption typically employ indicators such as amounts of drugs seized, the number of convictions for drug offences, numbers of notified addicts and the prices (cf. e.g. Home Office, 1985a). Each of these indicators reflects drug consumption. However, they also reflect a variety of other factors. Drug seizures reflect not only supply conditions, but also the effectiveness of drug enforcement agencies: since the effectiveness of the enforcement agencies is one of the main issues to be explored in the present report it would make little sense to use indicators of consumption which themselves depend on the success of drug enforcement measures.

The same is true of data on drug offenders: the number of users found guilty of possession will depend in part on the number of users and in part on the success of the police in identifying and arresting users. Notifications of addicts will reflect drug abuse, but will also reflect the proportion of addicts coming to the attention of doctors, as well as the propensity of doctors to notify addicts to the Home Office. Drug prices are determined by an interaction of supply and demand (cf. Section 3.2.1): inspection of Fig. 3.5 should confirm that an infinite number of different prices are consistent with the same level of quantity consumed. In the absence of an econometric model of the drugs market, it is impossible to determine whether price changes are due to shifts in the demand curve, or shifts in the supply curve, or both.

Table 4.6
Heroin purity at different levels of market, 1984/85

Size of seizure	*Level of market*	*Purity*
1 kg	Importer/Distributor	53.0%
1 oz–1 kg	Distributor/Wholesaler	45.8%
1 g–1 oz (28 g)	Retailer	43.8%
1 g	Non-selling user	34.2%

Source: Drugs Intelligence Laboratory, Home Office Forensic Science Service.

In estimating consumption, therefore, it is vital to use indicators which are not directly affected by the effectiveness of enforcement agencies.

4.4 Trends in the heroin market

4.4.1 Purity levels in the heroin market

Heroin purity at the import, distribution and retail levels for the years 1980/81 to 1984/85 are indicated in Table 4.5.

The figures suggest that the reduction of heroin content between import and retail level in the UK is probably less than 50% and that it probably fell over the period 1980-84. (The percentages implied by Table 4.5 for the years 1980/81 and 1983/84 are 37% and 20% respectively.) In 1984/85, however, there appears to have been a sharp increase in cutting: the figure for 1984/85 is 44%—the highest figure for the period as a whole. In interpreting these figures, however, one has to remember that they are based on seizures made by enforcement agencies and are therefore most unlikely to refer to a random sample of consignments.

Table 4.6 gives average purities of heroin for each of the main levels of the market as outlined in Fig. 4.1 and Table 4.1. The figures in Table 4.6 suggest that the purity of heroin is successively reduced as it passes through the distribution system.

Data supplied to us by DIL indicate, however, that there is a good deal of variation about the means in Table 4.6. 20% of seizures of between 1 g and 30 g (1 oz) analysed by DIL had **a** purity content of 60% or more, whilst almost 30% of seizures of between 30g and 190g had **a** purity level of 30% or less. This suggests that drug dealers may only have a fairly vague idea as to the purity of their purchases.

4.4.2 Heroin prices

This section considers first heroin retail prices and then heroin prices at other levels of the market. As emphasised in Section 3.2, the latter are important since

Table 4.7
UK heroin retail prices, 1980-85

	Retail price per gram				
	Iranian	*Turkish*	*Pakistani*	*SE Asian 3*	*SE Asian 4*
1980					
Jun	£80	£50–£70	£50–£70	£60–£80	£60–£80
Oct	£70	£50–£70	£50–£70	£60–£70	£60–£70
1981					
Jun	£40–£80	£50–£70	£50–£70	£60–£70	£60–£70
Oct					
1982*					
Jun	—		£50–£60		
Oct	—		£40–£60		
1983*					
Jun	—		£40–£60		
Oct	—		£40–£60		
1984*					
Jun	—		£50–£70		
Oct	—		£60–£80		
1985*					
Jun	—		£60–£80		
Oct	—		£60–£80		

*Prices for different types of heroin not shown separately.
Source: HM Customs and Excise.

they provide the means to assess the effects on dealers of drug seizures at levels of the market above street level (cf. Chapter 5).

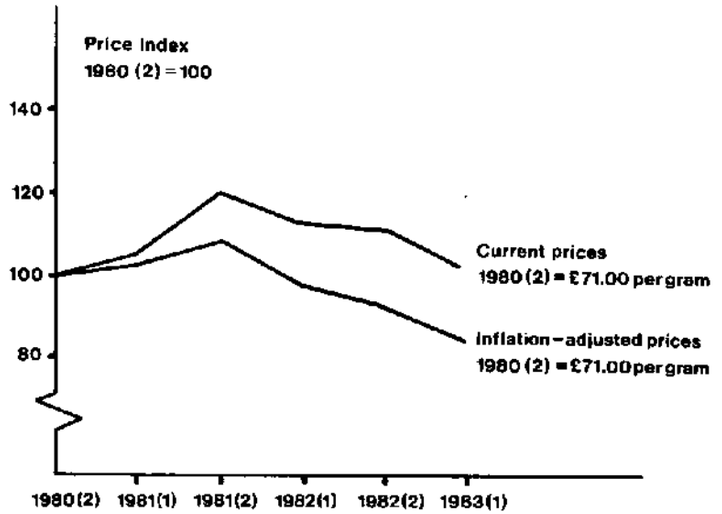
Heroin retail prices

Table 4.7 lists UK heroin retail prices for the period 1980-85 as provided by HM Customs and Excise.

In interpreting the figures in Table 4.7 it is important to bear in mind the changes in 'market shares' of the different types of heroin over the period (see Section 4.2). In particular, Pakistani heroin did not become the 'market leader' until 1981/82. Table 4.7 indicates that the retail price of heroin fell over the period 1980-82 but started rising again in 1983. The retail price of heroin is currently roughly what it was in 1980 and is apparently stable. In real (i.e. inflation-adjusted) terms the retail price over the period as a whole fell from about £70 in 1980 to about £50 in 1985 (1980 prices).

An alternative measure of price is price per pure gram. Since heroin purity at street level fell between 1980 and 1985, the real price per pure gram fell by less than real price per street-level gram. The former fell from about £70 in 1980 to about £50 in 1985 (a fall of 28%), whilst the latter fell from about £179 in 1980 to £147 in 1985 (a fall of only 18%). It is not immediately obvious,

Figure 4.2
Illicit heroin retail price index. Source: Lewis *et al.* (1985)



however, which of these two prices is the relevant price from the point of view of drug users' demand functions. If, as one would expect, drug users experience uncertainty about the quality (purity) of the product they are buying, and have only limited opportunities for establishing the purity level with any degree of accuracy, the price per street-level gram may be the more relevant of the two prices. Which of the two prices is the relevant is, of course, an empirical matter that can only be resolved by collecting and analysing better data.

Fig. 4.2 plots mean heroin retail prices from the Drug Indicator Project over the period 1980-83 (Lewis *et aL,* 1985).

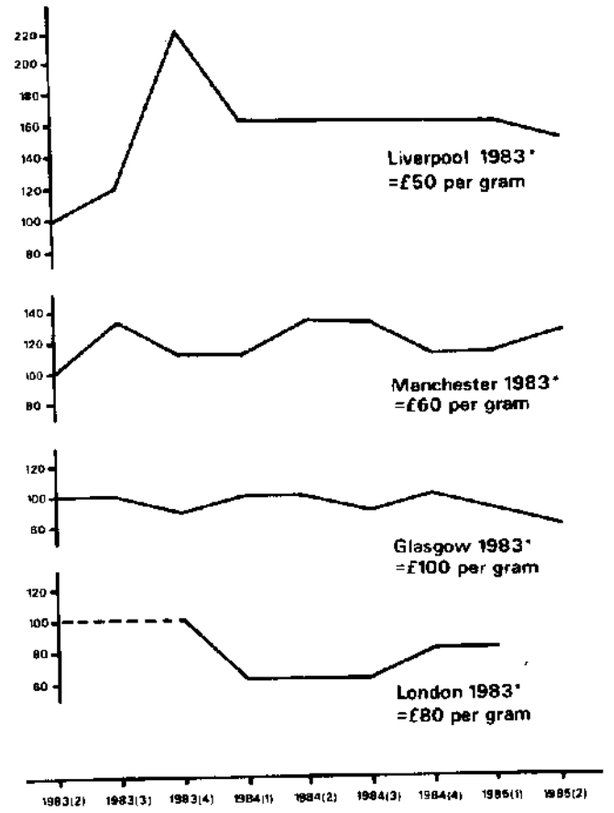
These figures have two advantages over the data in Table 4.7:

(i) they relate to mean values rather than to minimum and maximum values of a range. (The problem with a range is that one might have the mean changing while the range remains the same);

(ii) the index automatically reflects the changing composition of the market, since the data refer to a sample of purchases.

Inspection of Fig. 4.2 reveals that the **DIP** retail price index before adjusted for inflation actually rose over the period in question, although the value for the first half of 1983 (101.40) is only marginally higher than that for the last quarter of 1980 (100.00). After adjusting for inflation, the index fell from £71 per gram in 1980 to £60 in 1983 (1980 prices). Comparison of Table 4.7 and

Figure 4.3
Illicit heroin retail price indices. Source: NDIU



*Second quarter

Figure 4.2 reveals that the mean price in the DIP data is frequently outside the range of the Customs data.

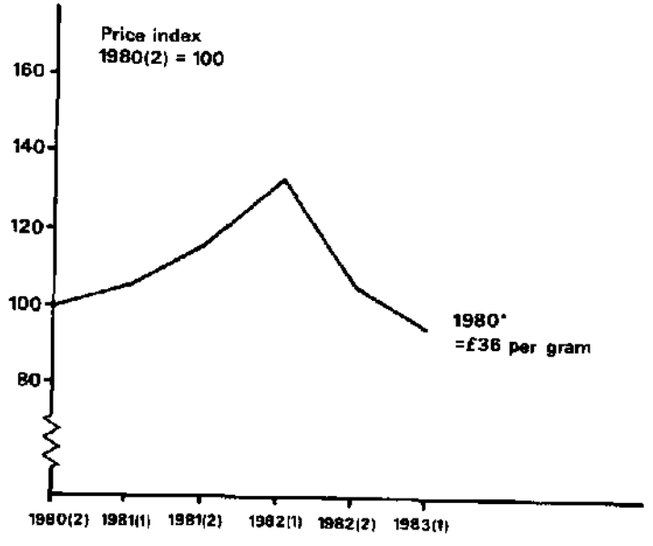
The data in Table 4.7 and Fig. 4.2 refer to Britain as a whole and North London respectively. There are, however, variations in prices across the UK: Fig. 4.3 plots heroin retail price indices for London, Manchester, Glasgow and Liverpool for each quarter over the period 1983 (second quarter) to 1985 (second quarter). From Fig. 4.3 it is evident that there are significant regional variations in heroin street prices and that price movements in one part of the country are not always

Table 4.8
UK heroin wholesale prices, 1980-83

	Wholesale price per gram[a]				
	Iranian	*Turkish*	*Pakistani*	*SE Asian 3*	*SE Asian 4*
1980					
Jul	£35–£49	£32–£42	—	—	£42
1981					
Jan	£42–£53	£42	—	—	£49
Jul	£42–£53	£42	—	—	£49
1982					
Jan					
Jul	£35–£46	£35	—	—	£49
1983					
Jan	£35–£46	£35	—	—	£49

[a]Price per oz converted into equivalent price per gram.
Source: NDIU.

Figure 4.4
Illicit heroin wholesale price index. Source: Lewis *et al.*, (1985)



*Second quarter

Table 4.9
Importers' and retailers' selling prices, 1979

	Selling price per kg	
Type of heroin	*Importer*	*Retailer*
Brown heroin[a]	£30,000	£80,000
SE Asian No. 3	£30,000	£100,000+
SE Asian No. 4	£40,000–60,000	£120,000+

[a]Includes Iranian, Middle Eastern, Mexican.
Source: NDIU.

accompanied by similar price movements elsewhere. This suggests heroin markets are fairly localised (i.e. compartmentalised), with price movements being dominated by changes in local supply and demand conditions. There is no clear trend in the retail price of heroin for any of the four cities: apart from short-term fluctuations, the retail price remained relatively stable over the period 1983-85. This means, of course, that the inflation-adjusted price actually tended to fall: the inflation-adjusted retail price of heroin in Glasgow, for example, fell from £100 per gram to £71 over the period 1983-85, whilst the inflation-adjusted retail price in London fell from £80 per gram to £58 (June 1983 prices).

Heroin prices at other levels of the market

Wholesale prices recorded by NDIU over the period 1980-83 are reproduced in Table 4.8. Again, no real trend is evident. Fig. 4.4 plots a heroin wholesale price index based on Table 2 of Lewis *et al.* (1985). Comparison of Figs. 4.2 and 4.4 reveals that the retail price of heroin peaked before the wholesale price (the second half of 1981 as compared to the first half of 1982), and that the retail price remained roughly double that of the wholesale price throughout the period. If there is any 'cutting' between the wholesale and retail levels, this price difference will understate wholesalers' profit margins.

Data collected by NDIU in 1978 and 1979 for importers' selling prices for certain types of heroin are reproduced in Table 4.9, together with retailers' selling prices.

Table 4.9 indicates that in 1979 the selling price of heroin in the UK increased approximately three-fold between importation and retail. This does not, however, take into account 'cutting' so that the selling price per 'pure* kg would probably have increased by a much larger amount.

Table 4.10 shows selling prices at the different levels of the market for 1983/84 and suggests that the selling price of heroin may have increased by more between import and retail levels in 1983/84 than in 1979.

Table 4.10
Approximate price structure of UK heroin market, 1983/84

Level of seller	*Selling price per kg*
Pakistani producer	£4,000–£5,000 cif[a]
UK importer	£20,000–£25,000
Distributor	£28,000–£35,000
Wholesaler	£55,000–£65,000
Retailer	£70,000–£100,000

[a]cif (carriage, insurance and freight/charged in full)—i.e. includes transportation costs of heroin from Pakistan to UK.
Source: Based on Lewis (1985) and Lewis *et al.* (1985).

Table 4.11
Approximate selling prices per kg of 100% pure heroin, 1983/84

Level of seller	*Selling price per pure kg*[a]
Importer	£33,000–£41,000
Retailer	£143,000–£204,000

[a]Rounded up to nearest £'000.
Source: Based on tables 4.5 and 4.8.

aer pure kg: they therefore take into account the fact that heroin is cut as it masses along the distribution chain.

fhe selling price per kg of pure heroin increases by between 4 and 5 times jetween import and retail level.

1.4.3 **Heroin consumption**

Jeroin consumption can be measured in terms of either quantity of heroin onsumed or expenditure on heroin. Estimates of both are presented below for he period 1979-84.

Quantity of heroin consumed

[n]he most detailed analysis of the extent of heroin use in the UK is that of lartnoll *et al.* (1985), who used a variety of methods to estimate the prevalence f opioid use in the London boroughs of Camden and Islington. The authors hen went on to estimate the discrepancy between the true number of addicts l London and the number notified to the Home Office. Their results suggested iat in any year there were about five times as many regular opioid users in ,ondon as the number of addicts notified to the Home Office. A similar

Table 4.12
Opioid user multiplier for Greater London, 1980–83

	Pop 15–44 ('000s)[a]	*Prev rate (per 1000)*[b]	*Estimated No. users*	*Notified addicts*[c]	*Implicit Multiplier*
1980	2,829	3.84	10,890	2,649	4.1
1981	2,947	5.20	15,320	3,129	4.9
1982	2,997	6.70	20,080	3,805	5.3
1983	3,012	7.10	21,380	4,693	4.5

[a]Population data from OPCS Population Trends.
[b]Prevalence rate—0.5 times estimated prevalence rate in Table IV of Hartnoll *et al.* (1985). (0.5 chosen on basis of Hartnoll *et al.*'s argument that prevalence rate in Camden and Islington likely to be double that of Greater London).
[c]Notified addicts = new notifications plus former addicts re-notified plus number of addicts receiving treatment at January 1st.

Table 4.13
Estimate of UK heroin consumption, 1982

	Min	*Max*	*Mid-point*
1. No. regular opioid users	30,000	50,000	40,000
2. Frequency of use (months/ year)	3	12	7.5
3. % regular opioid users receiving opioids on prescription and not also obtaining heroin elsewhere	10%	10%	10%
4. % non-notified regular opioid users using illicit heroin	75%	75%	75%
5. Average daily intake	0.25 g	0.25 g	0.25 g
6. Total annual UK consumption[a]	1,200 kg	1,900 kg	1,500 kg

[a]Assumes frequency of use of 7.5 months per year.
Source: Hartnoll and Lewis (1984).

figure was apparently found in an unpublished study of the extent of heroin misuse in South Tyneside in 1981 (cf. Hartnoll *et al.* 1985). In their paper on the extent of heroin addiction in Glasgow in 1981, Ditton and Speirits (1982) suggested that the figure may have been nearer 10. There was, however, no statistical analysis to support this claim.

It has been suggested by the Home Office (Home Office, 1985b) that as doctors have become increasingly aware of the notification requirements, the discrepancy between the numbers of notified and unknown addicts has probably fallen. The estimates of Hartnoll *et al.* suggest that, at least over the period 1980-83, the discrepancy was probably increasing. Table 4.12 above shows the discrepancy (implicit 'multiplier') for Greater London for the years 1980-83: at least over the period 1980-82 the multiplier was increasing. It is, of course, quite possible that it has shown a tendency to fall more recently.

HartnoU and Lewis (1984) have used the multiplier figure from Hartnoll *eta!*. (1985), to estimate UK heroin consumption in 1982. Table 4.13 summarises their assumptions.

The estimate of the number of people using opioids regularly for at least part of 1982 ('regular opioid users') is based on the multiplier of five from Hartnoll *etal.* (1985) and the total number of addicts recorded in Home Office statistics as receiving notifiable drugs on 1st January or as having been notified during the year (7,962 in 1982). Not all regular opioid users will be 'active' on each day of the year: interviews with addicts and clinical experience suggests that 7 months per year is a more reasonable figure (line 2 in Table 4.13). Some of those using at any particular time will obtain their opioids on prescription and will not be users of illicit supplies: 10% of regular opioid users are assumed to obtain their supplies from legal sources (line 3). Not all of those relying on the illicit market will be using heroin at any particular time: some will be using other drugs such as methadone, dipipanone etc. 75% of non-notified opioid users are assumed to be using illicit heroin at any point in time (line 4). This figure compares with the figure of 76% of new notifications in the Home Office statistics in 1982 reporting heroin as the principal drug of addiction. The average daily intake is assumed to be 0.25 g (line 5). These figures give low and high estimates of total heroin consumption in the UK in 1982 of 1,200 kg and 1,900 kg.

Table 4.14 gives estimates of the total quantity of 'street-level' heroin consumed in the UK for each year over the period 1979-84. The figures are derived using the method of Hartnoll and Lewis. Low and high multipliers of 4 and 10 have been assumed and the percentage of new notifications reporting heroin as the principal drug of addiction has been used as an estimate of the percentage of non-notified opioid users using illicit heroin. In other respects the assumptions used in Table 4.14 are the same as those employed by Hartnoll and Lewis. With low and high multipliers of 4 and 10 it is likely that the true consumption will lie somewhere between the low and high estimates. The figure of 4 is probably a reasonably reliable lower bound, and the figure of 10 probably unduly generous. The actual figure is therefore likely to be closer to 4 than 10, though it might vary from one year to the next.

The estimates in Table 4.14 suggest that the quantity of heroin consumed per annum has been increasing since at least 1979: the average annual rate of growth of heroin consumption is estimated at 10% for the years 1979-81 and 21 % for the years 1982-84. If the 'true[1] multiplier was rising over the period 1979-81 (as the figures in Table 4.12 suggest), but was falling thereafter, the figure of 10% for the early period will underestimate the true rate of growth, whilst the figure of 21 % will be an overestimate. Even so, the figures suggest that heroin consumption has been growing over the last 6 years and at an increasing rate.

Expenditure on illicit heroin

In estimating expenditure on illicitly obtained heroin it has to be borne in mind that heroin retailers are invariable users of heroin: this is important because

Table 4.14
Estimated annual UK heroin consumption, 1979-84

	1979	*1980*	*1981*	*1982*	*1983*	*1984*
1. No. notified addicts[a]	4,787	5,107	6,157	7,962	10,235	12,489
2. Multiplier:						
Low[b]	4	4	4	4	4	4
High[c]	10	10	10	10	10	10
3. Frequency of use[b] (months/year)	7.5	7.5	7.5	7.5	7.5	7.5
4. % Receiving opioids on prescription[b]	10%	10%	10%	10%	10%	10%
5. Heroin addicts as % new notifications[a]	69.5%	71.9%	73.8%	75.8%	85.0%	91.0%
6. No. using illicit heroin at any one time:						
Low[d]	7486	8262	10224	13580	19574	25571
High[d]	18714	20655	25560	33948	43639	63928
7. Average daily intake (g)[b]	0.25	0.25	0.25	0.25	0.25	0.25
8. Total annual UK consumption (kg):						
Low[e]	720	750	930	1,240	1,790	2,330
High[e]	1,710	1,880	2,330	3,100	4,460	5,830

[a]From Home Office (1985b). Number of notified addicts = number receiving notifiable drugs at January 1st + number notified during year.
[b]Based on Hartnoll and Lewis (1984).
[c]Based on Ditton and Speirits (1982).
[d]Obtained as follows: 1979 (low estimate) = $4,787 \times 4 \times (7.5/12) - 10\% \times 0.695 = 7,486$.
[e]To nearest 10 kg. Obtained as follows: for 1979 (low estimate) = $7,486 \times 0.00025 \times 365 = 720$.

user-dealers (i) face a lower price than non-dealing users (the wholesale price as opposed to the retail price), and (ii) tend to have a larger 'habit' (their daily intake is generally four times larger than that of a non-dealing user) (Hartnoll and Lewis, 1984).

Table 4.15 presents estimates of annual expenditures on heroin over the years 1979-1984. Low and high 'guesstimates'of the number of users per retail dealer of 6 and 12 have been used (line 2): thus—for the low estimate—1 in 7 users is assumed to be a dealer; the average daily intake of a retail dealer and non-dealing user are assumed to be 1 g and 0.125 g respectively (cf. Hartnoll and Lewis, *op at.);* the retail and wholesale prices are based on Lewis *et al.* (1985) and information provided by NDIU.

Total expenditure on heroin in 1984 is estimated at between £111.7m and £237.8m. This represents between 3% and 6% of total expenditure on tobacco and between 1% and 2% of total expenditure on alcohol (Central Statistical Office—National Income and Expenditure Accounts). In real terms heroin expenditure increased by 180% between 1979 and 1984, an annual rate of growth of 10%. These estimates are substantially smaller than the figure implied by

Table 4.15
Estimated annual expenditure on illicit heroin in the UK, 1979-84

Item		*Year* 1979	1980	1981	1982	1983	1984
1. No. using heroin at any one time:							
	Low	7486	8262	10224	12580	18574	25571
	High	18714	20655	25560	33948	43639	63928
2. No. users/retailer:							
	Low	6	6	6	6	6	6
	High	12	12	12	12	12	12
3. No. non-dealing users:							
	Low[a]	6416	7082	8763	11640	16778	21918
	High[b]	17274	18066	23594	31337	40282	59010
4. Average daily intake for non-dealing user (g)[c]		0.125	0.125	0.125	0.125	0.125	0.125
5. Price per gram to non-dealing user (£)[d]		80	70	80	80	75	65
6. Total expenditure by non-dealing users (£ million):							
	Low	23.4	22.6	32.0	42.5	57.4	65.0
	High	63.0	60.9	86.1	114.4	137.8	175.0
7. No. retailers:							
	Low[e]	1064	1180	1460	1940	2796	3653
	High[f]	1439	1589	1966	2611	3357	4917
8. Av. daily intake for retailer (g)[c]		1	1	1	1	1	1
9. Price per gram to retailer (£)[d]		40	35	40	45	40	35
10. Total expenditure on retailers (£ million):							
	Low	15.6	15.1	21.3	31.9	40.8	46.7
	High	21.0	20.3	28.7	42.9	49.0	62.8
11. Total expenditure on heroin (£ million):							
	Low	39.0	27.7	53.3	74.4	98.2	111.7
	High	84.0	81.2	44.8	157.3	186.8	237.8

[a]Equal to (5/7) × low estimate in item 1.
[b]Equal to (12/13) × high estimate in item 1.
[c]Based on Hartnoll and Lewis (1984).
[d]Based on Lewis *et al.* (1985) and information provided by NDIU.
[e]Equal to low estimate in item 1 less low estimate in item 3.
[f]Equal to high estimate in item 1 less high estimate in item 3.

the estimate of heroin imports quoted in the House of Commons by Mr Kilroy-Silk in 1985 (Hansard, 13 July 1985): the figure quoted was £6m worth of heroin coming into the UK each week through Heathrow and Dover alone. The estimates in Table 4.15 are also smaller than the figures arrived at if the fact that retailers are also users is not taken into account: if one assumes that all those using heroin at any one time are non-dealing users, financing a daily habit

Table 4.16
UK cannabis resin retail prices per gram

	Price per gram[a] *Moroccan*	*Lebanese*	*Afghan/Pakistani*	*Indian/Nepalese*
1980				
Jun	£1.10	£1.35–£1.50	£2.10	
Oct	£1.10+	£1.35–£1.50	£2.10	
1981				
Jun	£1.05+	£1.35–£1.50	£2.10	
Oct				
1982				
Jun	£1.20	£1.35–£1.50	£2.10	
Oct	£1.20	£1.35–£1.50	£2.10	
1983				
Jun	£1.20	£1.35–£1.50	£2.10	
Oct	£1.20	£1.35–£1.50	£2.10	
1984				
Jun	£1.95–£2.10	£1.95–£2.10	£2.10	
Oct	£2.45–£2.80	£2.45–£2.80	£2.80	
1985				
Jun	£2.45–£2.80	£2.45–£2.80	£2.80	
Oct	£2.45–£2.80	£2.45–£2.80	£2.80	

[a]Price per ounce 'deal' expressed as equivalent price per gram.
Source: HM Customs and Excise.

of 0.25 g at £65 per gram, one arrives at low and high estimates of heroin expenditure in 1984 of £151.7m and £379.2m.

4.5 Trends in the cannabis market

4.5.1 Cannabis prices

Cannabis retail prices

Table 4.16 lists retail prices for cannabis resin in the UK for the period 1980-85. The retail price of cannabis resin of Southeast Asian origin (Afghan, Pakistani, Indian and Nepalese) remained constant at the equivalent of £2.10 per gram (£60 per ounce) over the period 1980-84 but rose in 1984 to £2.80 per gram (£80 per ounce), where it has remained. The prices of Moroccan and Lebanese cannab is rose sharply in mid-1984 but have remained stable since then. Over the period as a whole, the price of Moroccan cannabis rose in real terms from £1.10 per gram in 1980 to £1.80 in 1985 (1980 prices) and the inflation-adjusted price of Lebanese cannabis rose from about £1.40 in 1980 to about £1.80 in 1985, (1980 prices).

Table 4.17 lists retail prices for herbal cannabis (the preference of the Afro-Caribbean community). The retail price remained constant at £1.00-£1.35 per gram over the period 1980-84 but rose in 1984 to £1.40-£1.75, where it has

Table 4.17
UK herbal cannabis retail prices per gram

Year	*Month*	*Price*[a]
1980	Jun	£1.00–£1.35
	Oct	£1.00–£1.35
1981	Jun	£1.00–£1.35
	Oct	
1982	Jun	£1.00–£1.35
	Oct	£1.00–£1.35
1983	Jun	£1.00–£1.35
	Oct	£1.00–£1.35
1984	Jun	£1.00–£1.35
	Oct	£1.40–£1.75
1985	Jun	£1.40–£1.75
	Oct	£1.40–£1.75

[a]Price per ounce expressed as equivalent price per gram.
Source: HM Customs and Excise.

Table 4.18
Cannabis resin wholesale prices per gram

	'Moroccan'[a]	*'Black'*[a]
1980		
July	£1.30	£1.75
1981		
Jan	£1.10–£3.30	£2.10–£4.00
July	£0.85–£1.00	£1.55–£2.65
1982		
Jan		
July	£0.85–£1.00	£1.55–£2.65
1983		
Jan	£0.85–£1.00	£1.55–£2.65

[a]Equivalent price per gram.
Source: NDIU.

remained. In real terms, however, the retail price in 1985 is much the same as it was in 1980 (£1.00-£I.20 in 1980 prices).

Cannabis prices above retail level

Wholesale prices (prices relating to quantities of 11b or more) up until July 1983 are reproduced in Table 4.18. The prices are between 1/2 and 1/3 those prevailing at street level and tended to fall slightly over the period in question. Malyon (1985), however, quotes a figure of £1.60 per gram (£1,450 for 2 lbs) of medium quality hashish (1985 prices), suggesting that wholesale prices may have remained reasonably stable over the last 2-3 years.

Table 4.19
Cannabis resin importers' selling prices, 1985

	Lebanese	*Moroccan*	*Pakistani*
Price per kg	£1,100–£1,300	£1,500–£1,600	£2,200

Source: HM Customs and Excise.

HM Customs and Excise have provided data on importers' selling prices for the year 1985: these are reproduced in Table 4.19.

The fact that there is not a great difference between the prices in Table 4.19 and the wholesale price figure quoted by Malyon suggests either than the Customs figure may be rather too high (referring perhaps to the distributors' selling price) or that importers of cannabis resin do, after all, tend to distribute their imports themselves.

4.5.2 Cannabis consumption

Estimates of cannabis consumption for the United States are based typically on the results of the annual National Survey on Drug Abuse (NSD A) conducted by the National Institute on Drug Abuse (cf. e.g. Polich *et al.*, 1984). The NSDA is a household survey covering a representative sample of households living in the United States: to maximise response validity, the questions about drug use are asked using a confidential self-administered form that the respondent fills out and seals in an envelope. Information on percentages in each age group admitting use of cannabis in the previous month is combined with information on frequency of use and quantity consumed per session (both obtained from elsewhere) to arrive at estimates of national consumption.

The UK has no equivalent of the NSDA. The nationally-representative British Crime Survey (BCS) does, however, provide some information on cannabis use. Respondents were asked by interviewers if they had ever used cannabis and, if so, how many times during the previous 14 months. In the 1982 Survey *5°Io* of the sample admitted to ever having used cannabis but only 2% to having used it at all during the previous 14 months (Mott, 1985). In the 1983 BCS 3% of the sample admitted to having used cannabis in the previous 14 months, but the way in which the question was posed had been changed to encourage respondents to admit to any usage (Joy Mott, personal communication). Because, however, the survey is conducted on a face-to-face interview basis and the questions on cannabis use are posed in the context of a survey on offences, the BCS is not considered to provide a reliable basis for estimating the number of regular cannabis users in the UK (Mott, 1985).

The only published estimates of the size of the cannabis market are those of Athaand Blanchard (1985). On the basis of the findings of the Legalize Cannabis Campaign (LCC) surveys (cf. Section 4.2.3), they estimate the number of daily users in the UK at 2 m. Combining this information with Atha's (1982) 'Rizla

method' estimates of the number of 'joints' smoked in 1979, they estimate total cannabis consumption at 500 tonnes per annum.

These estimates are not, however, to be relied upon. The LCC Surveys are of cannabis users: quite how one can arrive at an estimate of the number of cannabis users in the population as a whole from the results of a survey of cannabis users (and not even a representative sample of users) is far from clear. Moreover, Atha's 'Rizla method' estimates are subject to a number of shortcomings. The 'Rizla method' estimates the number of 'joints' smoked per year by calculating the number of cigarette papers that are sold but are not used for rolling hand-rolled cigarettes. Since the majority of cannabis consumed in the UK appears to be consumed in the form of joints (2/3 according to the LCC surveys), this can provide a direct way of estimating total cannabis consumption. Atha (1982) used the method on 1979 data arriving at low and high estimates of the total number of 'joints' smoked in 1979 at 1.2 bn and 1.5 bn. He then assumed that a regular user consumes 2 joints per day, thereby arriving at an estimated 1.7 m-2.0 m regular users (or 3.3-3.9% of the UK home population over the age of 15). If an average 'joint' is assumed to contain 0.35 g of cannabis, this would give an estimate of total cannabis consumption in 1979 of between 420 tonnes and 525 tonnes. This, however, is an estimate only of the cannabis consumed in the form of joints. If, as the LCC surveys suggest, 1/3 of cannabis is consumed in other forms, the estimates of total consumption rise to 630 tonnes and 790 tonnes. Atha's calculations also fail to take into account that rolling tobacco is used in joints as well as in hand-rolled cigarettes: the estimates implicitly assume that each joint consists entirely of cannabis resin. Because joints include tobacco as well as cannabis, Atha's estimates will be unduly conservative. If one assumes, for example, that cigarettes and joints both contain on average 0.5 g of rolling tobacco (Atha's assumption for hand-rolled cigarettes) and that only 2/3 of cannabis is consumed in the form of joints, it may be verified that the estimates of total consumption in 1979 rise to 945 tonnes and 1180 tonnes. This is because if some of a joint is taken up by tobacco, a larger number of joints is required in order to account for a given quantity of cannabis.

Thus, taking into account that not all cannabis is consumed in the form of joints and that joints include tobacco as well as cannabis results in a doubling of the consumption estimate from roughly 500 tonnes to somewhere in the region of 1000 tonnes. If a cannabis user consumes on average 14.2 g (1/2 oz) per month (Atha, 1985), this would mean that there were between 5.5 m and 6.9 m regular cannabis users in the UK in 1979 (or 10.8-13.6% of the population over the age of 15). In the 1982 BCS, however, only 2% of the sample admitted to having used cannabis in the previous 14 months. Whilst it is generally acknowledged that the BCS Figures are underestimates, it seems most unlikely that they underestimate prevalence of regular use by a factor of over 5 times.

There are a variety of reasons why the 'Rizla method' gives such a high estimate. For example, it has been implicitly assumed that all tobacco used in joints is

Table 4.20
Cocaine purity at import, distribution and retail levels of the market

	Level of the market		
Year (August–July)	*Import*[a]	*Distribution*[b]	*Retail*[c]
1981/82	77%	57%	52%
1982/83	87%	62%	70%
1983/84	89%	72%	62%
1984/85	87%[d]	84%	46%

[a]Customs seizures: figures are weighted averages.
[b]Police seizures in excess of 1 g: figures are weighted averages.
[c]Police seizures of less than 1 g.
[d]Omits two seizures of 30% and 40% purity, together accounting for 38.2% of total weight of cocaine powder seized by Customs in 1984/5.
Source: Drugs Intelligence Laboratory, Home Office Forensic Science Service.

rolling tobacco. In reality some is likely to be from pre-rolled cigarettes which have been broken open. Failing to recognise this will result in an overestimate of cannabis consumption. If, for example, 20% of tobacco used in joints is from pre-rolled cigarettes, the estimated number of joints would be between 1.6 billion and 2.0 billion, with a total consumption of between 840 tonnes and 1050 tonnes, and a total number of users of between 4.9 m and 6.2 m. Another possible source of error is the assumption that all Rizla papers are actually used, with none being lost, wasted or used for other purposes (e.g. cleaning oboes and clarinets). If some are lost, the estimate will be an overestimate. If, for example, 5% of Rizla papers are wasted (but all tobacco used in joints is rolling-tobacco), the estimates become: 1.4 billion-1.8 billion joints, 748-972 tonnes of cannabis and 4.4 m-5.7 m users. The estimates are therefore highly sensitive to the assumed wastage rate: increasing the assumed wastage rate from 0% to 5% results in a fall in the consumption estimates of between 17% and 20% (i.e. 945 tonnes to 748 tonnes and 1180 tonnes to 972 tonnes).

In view of the oversights in his calculations and the uncertainties surrounding the true values of key parameters (percentage of tobacco in joints from pre-rolled cigarettes, wastage rates, etc.), Atha's estimates of cannabis consumption are subject to a potentially large margin of error, and are not reliable enough to form the basis of an analysis of drug enforcement policies. With the available information, therefore, it would not seem possible to estimate UK cannabis consumption at all reliably.

4.6 Trends in the cocaine market

4.6.1 Purity levels in the cocaine market

Cocaine purity levels at the import, distribution and retail levels for the years 1981/82 to 1984/85 are indicated in Table 4.20. The figures suggest that the

Table 4.21
UK cocaine retail prices

Year	*Month*	*Price per gram*
1980	Jun	£60–£65
	Oct	£55–£65
1981	Jun	£50–£65
	Oct	
1982	Jun	£50–£65
	Oct	£50–£65
1983	Jun	£50–£65
	Oct	£50–£65
1984	Jun	£50–£65
	Oct	£50–£70
1985	Jun	£50–£70
	Oct	£50–£70

Source: HM Customs and Excise.

reduction of cocaine content between importation and retail sale is probably less than 50% but has probably started to rise: the figure for 1983/84 is 30% and the figure for 1984/85 is 46%.

4.6.2 Cocaine prices

Retail prices

Table 4.21 lists cocaine retail prices in the UK over the period 1980-85: the data were provided by HM Customs and Excise. The table indicates that the retail price of cocaine has remained relatively unchanged over the six years in question: in real terms the price has fallen from £60-65 per gram to £35-50 (1980 prices).

Cocaine prices above retail level

HM Customs and NDIU do record quote prices per ounce for cocaine (i.e. a wholesale quantity), but the data are not considered reliable.

Wholesale prices are quoted in HM Government's Reports to the United Nations (HM Government, 1983, 1984), namely £30-40 per gram for 1983 and £30-35 per gram for 1984. In view of our comments in Section 4.3.2, however, it is difficult to know how much faith to have in these figures.

NDIU figures for importers selling prices are available for 1979 only: the figure quoted for both years is £30,000 per kg. HM Customs and Excise, however, have provided us with a figure for 1985 of £22,000-28,000 per kg-

4.6.3 Cocaine consumption

Much has been written in the press about the alleged growth of cocaine consumption. There does not, however, appear to have been any substantial research on the subject at all in the UK. The only nationwide survey of drug use which includes information on cocaine use is the 1982 NOP Survey conducted for the Daily Mail. NOP interviewed a representative sample of 1,326 young people aged 15-21 in 101 British Parliamentary constituencies: 2% of the sample admitted to ever having used cocaine (1% heroin, 17% cannabis), but less than 0.5% admitted to frequent use (0.5% heroin, 4% cannabis).

Plant *et al.* (1984) found that 2% of their sample of 15/16 year-olds in the Lothian region admitted to ever having used cocaine in 1979/80; in 1983 4% of the same sample admitted to ever having used cocaine (Plant *et al.,* 1985). Because, however, no 18-20 year-olds were studied in 1979/80, it is not possible to determine the extent to which the increase is due to: (i) the fact that the individuals concerned were older in 1983 than in 1979/80 and therefore had had 3 years more 'exposure'; or (ii) the possibility that drug-taking amongst a given age-group may have increased over the period 1978-83. In any event the sample is not a nationally representative one, and—like the NOP sample — refers to too small an age-group to provide the basis for estimates of UK cocaine consumption.

4.7 Summary

Of the three main illicit drug markets, the heroin market has been the most studied in the UK. It appears to be relatively specialised, with five distinct levels—importer, distributor, wholesaler, retailer and non-dealing user (Lewis, *et al.,* 1985). There appears, however, to be some overlap. In particular, some importers appear to undertake their own distribution, supplying directly to the wholesaler ('ounce dealer'). Little is known about the organisation of the cocaine and cannabis markets, though the latter is thought to be "highly organised" (Atha and Blanchard, 1985) and competitive (Malyon, 1985).

The composition of the heroin market—in terms of 'market shares' of different types of heroin—appears to have changed over the last six years, with Turkish, Iranian and Southeast Asian heroin accounting for increasingly less of the market and Pakistani (and, more recently, Indian) heroin increasing its market share. There is some evidence that Southeast Asian heroin may be re-establishing its position in the market. Comparison of Customs seizure data with data from the Drug Indicator Project (Lewis *et al.,* 1985) suggests that Pakistani heroin probably established its position as 'market leader' rather more slowly than Customs data imply.

Data on retail prices show that the retail prices of heroin and cocaine in 1985 were roughly the same as they were in 1980. In real terms, therefore, the prices of heroin and cocaine fell between 1980 and 1985. Both the current and

inflation-adjusted retail price of cannabis resin, however, rose over the period 1980-85. The retail price of herbal cannabis, by contrast, fell in real terms, although it rose in current price terms.

Estimates by Hartnoll and Lewis (1984) put heroin consumption in the UK in 1982 at between 1,200 kg and 1,900 kg. Using their methodology, heroin consumption in 1984 was estimated at between 2,330kg and 3,820kg. Our estimates suggest that heroin consumption grew at an average annual rate of 10% over the period 1974-81 and at 21% over the period 1982-84. We have estimated total heroin expenditure in 1984 at between £112m and £238m. This is equivalent to between 3% and 6% of total expenditure on tobacco in 1984.

The only estimates of cannabis consumption are those of Atha and Blanchard (1985), who estimate cannabis consumption at around 500 tonnes per annum. For various reasons we believe these estimates to be unreliable but have not attempted to arrive at more reliable estimates. No estimates of cocaine consumption have been discovered.

5 The Costs and Benefits of HM Customs and Excise Drug Enforcement Activities

S.I Introduction

HM Customs and Excise are responsible for preventing and detecting the illegal import and export of controlled drugs. They are concerned not only with current smuggling activities but also with gathering information about trafficking routes and techniques which may be used in future smuggling operations. In addition, they follow up controlled drugs which have evaded Customs controls and where there is a clear link with the illegal importation.

This chapter presents a preliminary economic analysis of HM Customs drug enforcement activities. It presents data on expenditure by Customs on drug enforcement and attempts to assess the effects of this work on the extent of illicit drug consumption. It also explores the cost-effectiveness of the drug enforcement activities and discusses the limitations of the various possible measures of performance and how economic analysis might be used to assist in determining the most efficient deployment of Customs resources.

It should be emphasised at the outset that, owing to a paucity of 'hard' data and the limited time available for this study, the analysis presented in this chapter—and the next—is of necessity superficial. In Chapter 7 we indicate some of the avenues future workers might profitably explore.

The chapter is organised as follows. Section 5.2 presents data on manpower and expenditure for Customs drug enforcement work for the years 1979-85. Section 5.3 addresses the issue of cost-effectiveness. Section 5.4 discusses the issue of the optimal scale of Customs activity and the impact of Customs drug enforcement work on drug consumption. The final section—Section 5.5 — presents a summary.

5.2 Expenditure by HM Customs on drug enforcement

Table 5.1 gives the number of full-time equivalent (FTE) staff employed on drug enforcement and preventive duties for the years 1979-85. Numbers of staff listed under items 1 to 5 are FTEs on drugs-specific work. Preventive staff

Table 5.3
Expenditure by HM Customs Investigation Division

	Expenditure[a] in £m at 1985 factor cost		
	Heroin	*Cocaine*	*Cannabis*
1980	1.69	0.54	2.30
1981	1.96	0.61	2.50
1982	2.80	0.37	3.00
1983	2.80	0.37	3.00
1984	2.80	0.47	3.00
1985	3.04	0.84	2.97
1986	4.93	1.33	2.68

[a]Expenditure figures based on estimated expenditure per Specialist Investigator p.a. of £33,782 (1985 prices)—See Appendix 1.
Source: HM Customs and Excise.

For both (i) and (ii) measures of output are required. It will be recalled that in Chapter 3 it was suggested that for the purpose of performance evaluation, measures of intermediate—rather than final—output may be preferable, since they are less likely to be influenced by factors external to drug enforcement agencies. The first section (Section 5.3.1), therefore, discusses the problem of measuring the intermediate output of Customs drug enforcement activities.

The next section (Section 5.3.2) discusses how measures of intermediate output and data on expenditure from Section 5.2 might be used to derive an index of cost-effectiveness (CEI). The final section (Section 5.3.3) considers (ii) above, drawing on the discussion in Section 5.3.1.

5.3.1 Output measurement for performance evaluation

The possible measures of the intermediate output of Customs are: (i) numbers convicted for drug smuggling, (ii) length of prison sentence awarded to drug smugglers, (iii) the quantity of drugs seized, (iv) the number of seizures, and (v) the interception rate.

Table 5.4
Persons found guilty or cautioned for illegal import or export of controlled drugs, 1979–84

	Heroin	*Cocaine*	*Cannabis*
1979	65	46	786
1980	95	65	978
1981	106	100	1157
1982	109	57	947
1983	214	93	1162
1984	207	117	1266

Source: Home Office (1985b).

(i) Convictions for illegal importation

Table 5.4 indicates the numbers of persons found guilty or cautioned for illegal importation of controlled drugs in each of the years 1979-84. The number of persons found guilty or cautioned has shown an upward trend over the last six years.

As an indicator of intermediate output, the number of convictions has the drawback that it indicates nothing about the importance of persons convicted in terms of their contribution to the overall supply of illicit drugs into the country. The indicator can be increased simply by concentrating on smaller importers. Moreover, the move on the part of Customs towards the targeting of large-scale drug smugglers might be reflected in a fall in the index.

(ii) Length of prison sentences

A more satisfactory measure of intermediate output would, therefore, take into account the 'importance' of the person convicted. To some extent this will be reflected in the sentence passed by the court. Table 5.5 gives mean length of sentence for those sentenced to imprisonment for drug smuggling for each of the years 1979-84.

Table 5.5
Mean length of sentence for persons sentenced to imprisonment for illegal import or export of controlled drugs, 1979–84

	Mean sentence in months		
	Heroin	*Cocaine*	*Cannabis*
1979	50	52	24
1980	52	35	23
1981	63	75	23
1982	58	48	21
1983	60	53	23
1984	58	51	23

Source: Home Office Statistical Department.

There is no clear trend for any of the three drugs. It has to be borne in mind, however, that sentencing policies may vary from one year to the next and from one court to the next.

(iii) Quantity of drugs seized

Another indicator of intermediate output of Customs is the quantity of drugs seized. Table 5.6 lists the quantities of heroin, cocaine and cannabis seized by Customs for each of the years 1979-85. Seizures of heroin have shown a sharp upward trend over the period. Seizures of cocaine and cannabis, however, have shown no clear trend.

The data in Table 5.6 refer to consignments which are detected and seized by Customs. Not all consignments detected, however, are seized in the UK. Detected consignments which are destined for other countries are sometimes allowed to go through to their destination if Customs and the relevant law enforcement agency of the destination country decide that this is appropriate. In such cases the detection will not be recorded in the UK Customs seizure figures.

Table 5.7 shows the total quantity of smuggled drugs in transit detected by HM Customs and includes any drugs seized by HM Customs.

Table 5.6 also excludes any seizures made by law enforcement agencies in other countries acting on information from HM Customs. Sometimes the drugs seized will have been destined for the UK market. This is argued to be part of the reason for the fall in cocaine seizures in 1984 (Home Affairs Committee, 1985b).

Table 5.8 shows the amounts of drug seized by foreign law enforcement agencies as a result either of information provided by, or a co-ordinated investigation involving, HM Customs. There was a sharp increase between 1984 and 1985 in the cases of heroin and cocaine.

Table 5.9 shows the total quantities of illegally imported or exported controlled drugs detected by HM Customs. The amounts may overstate the true figure, since some in-transit consignments are seized by HM Customs and are therefore already included in the seizures in Table 5.6.

Table 5.6
Amounts of controlled drugs seized by HM Customs, 1979–85

	Quantity seized (kg)		
	Heroin	*Cannabis*	*Cocaine*
1979	43.3	11,586	21.6
1980	36.4	25,500	36.0
1981	85.8	24,210	15.7
1982	185.1	16,546	12.1
1983	215.9	18,892	74.0
1984	312.6	26,256	35.4
1985	348.0	20,424	79.0

Source: Home Office (1985b) for years 1979–84 and HM Customs and Excise (1986) for 1985.

Table 5.7
Controlled drugs in illegal transit through UK detected by HM Customs

	Quantity (kg)		
	Heroin	*Cocaine*	*Cannabis*
1984	17.47	0.32	5.2
1985	82.70	—	1869.7

Source: HM Customs and Excise.

Table 5.8
Amounts of controlled drugs seized by foreign Customs services acting on information from HM Customs

	Quantity (kg)		
	Heroin	*Cocaine*	*Cannabis*
1984	28.01	5.50	2026.9
1985	112.09	21.40	—

Source: HM Customs and Excise.

Table 5.9
Total amounts of controlled drugs detected by HM Customs

	Quantity (kg)		
	Heroin	*Cocaine*	*Cannabis*
1984	358.08	41.22	28,288.1
1985	542.79	100.40	22,293.7

Source: Tables 5.6, 5.7 and 5.8.

There is some discrepancy between seizures and detections: the former accounted for 85*70-92% of the latter in 1984. Even the adjusted seizure data, however, have deficiences as an indicator of intermediate output. They may fail to reflect the importance of persons from whom the drugs are seized, A person may be arrested with 2 kg of heroin but may be known to have illegally imported 50 kg in the previous year. Customs may have chosen not to arrest him previously in the hope of accumulating more information about his colleagues and contacts. To some extent this will be taken into account by the data on convictions, but since the previous illegal importations of 50 kg may not be proved to the court the number of convictions and sentence length may not fully reflect this.

(iv) Number of seizures

The quantity seized by" Customs depends in part on the average size of consignment (in the case of drugs seized from freight or couriers) and the average size of stocks held by importers (in the case of drugs seized within the country from importers). To some extent these will be influenced by Customs activity, increased routine controls may make couriers reluctant to carry large consignments, and Customs officers working inland can (and presumably do) pick their moment for raiding importers' premises, in part, according to the suspected current size of the importer's holdings.

The average size of consignment and of drug stocks of importers will also depend, however, on other factors, such as smuggling techniques, storage facilities etc. Any exogenous increase in the average consignment size or stock

Table 5.10
Number of seizures by Customs, 1979-84

	Heroin	*Cocaine*	*Cannabis*
1979	84	55	1856
1980	85	80	2408
1981	88	107	2556
1982	136	75	2421
1983	195	126	3129
1984	195	150	2994

Source: Home Office (1985b).

holdings by importers will tend to work to the advantage of Customs in terms of seizure figures.

To overcome this one might use the numbers of seizures, rather than quantity seized. Table 5.10 gives the numbers of seizures by Customs of heroin, cocaine and cannabis between 1979 and 1984.

The trend has clearly been upwards, although in the case of cannabis there are fluctuations from one year to the next.

(v) The interception rate

There is, however, another problem with seizure data (both for quantities seized and numbers of seizures), namely that they depend not only on the activity of Customs, but also on the quantity being shipped into the country and the mode of illegal import. For example, the chances of intercepting a courier at Heathrow are higher if 500 couriers pass through daily than if only 50 do so. Likewise, the chances of Customs Investigation Division uncovering one importation network are greater if there are 200 such networks operating than if there are only 20. As a result, seizures would increase automatically if shipments increased. Thus any exogenous increase in shipments (i.e. an increase in shipments resulting from external factors) will work to the advantage of Customs

Figure 5.1
Influence of shipments on Customs' seizures

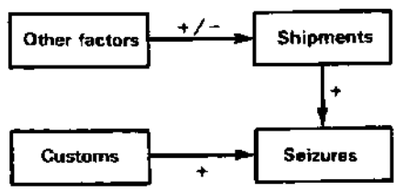
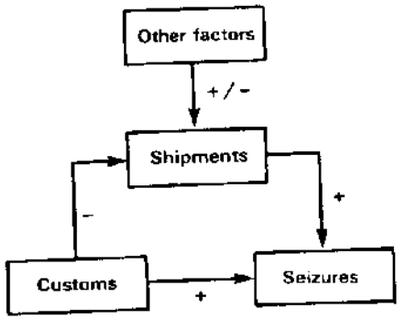


Figure 5.2
Influence of Customs' seizures on shipments



in terms of seizure statistics. In other words, rising seizures are not necessarily an indication of increased intermediate output of Customs. This is illustrated in Fig. 5.1.

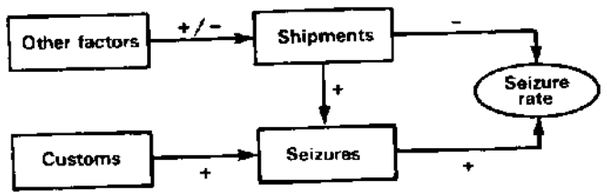
The situation is further complicated by the fact that the number of illegal shipments will depend on the level of Customs activity. If Customs activity has any deterrent effect, importers will be deterred from trying to smuggle drugs when Customs activity increases. This is illustrated in Fig. 5.2.

In Fig. 5.2 the effects of Customs activity on seizures operates via two paths: (i) a direct path, and (ii) an indirect path, operating via its effect on shipments. The effect of (i) is positive (more Customs activity results in higher seizures), whilst the effect of (ii) is negative (more Customs activity results in reduced shipments, which in turn results in fewer seizures). The net effect depends on the relative strengths of (i) and (ii). In particular, it could be negative if the deterrent effect is sufficiently strong. Thus increased activity on the part of Customs might actually result in fewer seizures, although one would not want to interpret this in terms of reduced performance. The effect of enforcement efforts in producer or transit countries will also reduce the number of illegal shipments to be seized.

The interception rate as an output measure

Ideally, one would seek to estimate the strengths of the various paths in Fig. 5.2. Such an exercise is beyond the scope of the present study. In the absence of such estimates, one might try to overcome the problem that the number of shipments depend on Customs work (cf. Fig. 5.1) by relating Customs inputs to the seizure rate, rather than the level of seizures. The seizure rate (or interception rate) gives the quantity seized as a fraction of the total quantity shipped. It is therefore positively related to seizures and inversely related to shipments. This is illustrated in Fig. 5.3.

Figure 5.3
Determinants of Customs' seizure rate of illicit drugs



An exogenous increase in shipments thus affects the seizure rate by two paths: (i) a direct (negative) effect because the seizure rate is defined as the ratio of seizures to shipments; and (ii) an indirect (positive) effect via seizures. Because the effect on the numerator of the seizure rate (i.e. seizures) will be smaller than the effect on the denominator (i.e. shipments)—not all shipments will be seized—any exogenous increase in shipments will automatically tend to reduce the seizure rate.

Thus in contrast to seizures, any exogenous increase in shipments will tend to work against Customs if intermediate output is measured in terms of the seizure rate. The seizure rate may, therefore, be a better measure of output for performance evaluation purposes than the quantity seized. If the seizure rate rises when shipments are constant or increasing, the intermediate output of Customs can be said to be higher. The seizure rate is also of interest since it indicates the risk facing importers and couriers.

Estimating the interception rate

Due to the lack of reliable data on cannabis and cocaine consumption, it is impossible to estimate interception rates for these drugs. We have, however.

Table 5.11
Estimates of UK consumption of heroin at import-level purity, 1980–84

year	UK consumption of 'street-level' heroin[a] (kg)		Purity[b] (%)		Equivalent quantity of import-level heroin[c]	
Aug–Jul	Low	High	Street	Import	Low	High
1980	750	1880	39	62	470	1180
1981	930	2330	47	65	670	1680
1982	1240	3100	56	73	950	2380
1983	1790	4460	49	61	1440	3580
1984	2330	5830	34	61	1330	3250

[a]From Table 4.14.
[b]From Table 4.5.
[c]Obtained by multiplying quantity of street-level consumption by ratio of street-level to import-level purity.

Table 5.12
Estimates of interception rates by HM Customs heroin 1980–84

year	Seizures[a] (kg)	Consumption[b] (kg)		Shipments[c] (kg)		Seizures as % Shipment	
Aug–Jul		Low	High	Low	High	Low	High
1980	36.4	470	1180	510	1220	3.0	7.1
1981	85.8	670	1680	760	1770	4.8	11.3
1982	185.1	950	2380	1130	2560	7.2	16.4
1983	215.9	1440	3580	1660	3800	5.7	13.0
1984	312.6	1300	3250	1610	3560	8.8	19.4

[a]Drugs seized by HM Customs.
[b]From Table 5.11 minus consumption expressed as equivalent quantity of heroin at import purity.
[c]Seizures plus consumption, rounded to nearest 10 kg.
Source: Home Office (1985b).

estimated interception rates for heroin for the years 1980-84. Our estimates suggest that the interception rate has been increasing over the period.

The first step in estimating the interception rate is to adjust the estimates of UK heroin consumption discussed in Chapter 4 to take into account the fact that heroin is cut as it passes along the distribution chain. This means that less than 1 kg of pure heroin needs to be imported for every 1 kg 'on the street'. This adjustment has been made in Table 5.11. The consumption figures in the two right-hand columns are in terms of equivalent quantities of import-purity heroin.

Table 5.12 presents estimates of the interception rate for heroin for the years 1980-84. The results suggest that Customs seized between 9% and 19% of heroin shipments in 1984. The interception rate appears to have risen each year over the period 1980-82 but fell in 1983, despite an increase in seizures of \l*!n. In 1984 consumption of street-level heroin increased as in previous years. The purity of street-level heroin fell dramatically, however, whilst the purity at import level remained unchanged. As a result consumption of import-pure equivalent heroin actually fell in 1984. This, coupled with a 45% increase in seizures, resulted in a sharp increase in the interception rate.

Table 5.12 suggests, therefore, that despite an annual growth in shipments of 27% over the period 1980-84, Customs managed to increase the seizure rate by possibly as much as 180%.

The figures in Table 5.12 refer to drugs seized by HM Customs. For reasons indicated above, not all these drugs will be destined for the UK and not all drugs destined for the UK but detected by HM Customs will be seized by Customs. If drugs seized abroad on information from HM Customs are included in the seizure figures, the interception rate for 1984 rises to 9.5%-20.7'Vo.

5.3.2 Indices of cost-effectiveness for Customs drug enforcement work

The previous section considered various possible measures of Customs intermediate output in the drug enforcement field. Most were found to have increased over the period 1979-85, including the interception rate, which-in contrast to the other measures-ought to be biased against Customs. This suggests that the etiectiveness of Customs drug enforcement work has increased. Because however expenditure has also increased (at least in the case of drugs-specific expenditure)' it is not necessarily the case that the cost-effectiveness has increased.

The cost-effectiveness index (CEI) expresses the results of an activity in terms of the cost of obtaining a unit of the desired benefit (cf. e.g. Drummond, 1980) Thus, in the case of a health care technology designed to extend life expectancy the CEI would indicate the cost per year of life gained. The lower the CEl" the more cost-effective the activity.

Given the fact that all indicators except the interception rate are likely to be biased in favour of Customs, the obvious choice of output measure for use in a CEI is the interception rate. It should be borne in mind, however, that because of the uncertainty surrounding key parameters (for example, the relationship between the number of known and unknown addicts), one cannot preclude the possibility that the rise in estimated interception rate overstates the rise in the true interception rate. This would be the case if the 'addict multiplier' had been falling at any stage dunng the period in question (cf. Home Office, 1985b). Use of the interception rate means confining attention to the cost-effectiveness of Customs in the heroin market. There are two possible expenditure figures-(i) the total drugs-specific expenditure of Table 5.2; and (ii) the expenditure of the Customs Investigation Division on heroin operations. The latter will certainly understate true expenditure by Customs on drug enforcement in the heroin market. The former may understate or overstate true expenditure depending on (a) how much of the preventive staff's time is devoted to heroin' and (b) how much of dmgs-specific expenditure is directed against heroin imports. In the case of (i), therefore, the estimated CEI will understate the true CEI. If (Oisaconstant fraction oftrue Customs expenditure on drug enforcement in the heroin market, the estimated CEI will be a constant fraction of the true CEI If (0 is an increasing proportion of the true expenditure figure, the discrepancy between estimated CEI and true CEI will diminish over time. This means that a rising estimated CEI need not be indicative of a rising true CEI. It may reflect a reduction in the difference between true and measured expenditure If uniformed staff spent the same percentage of their time dealing with heroin cases each year, then Investigation Division expenditure would probably account for a growing share of Customs total expenditure on drug enforcement in the heroin market. It is more likely to be the case, however, that uniformed staff have spent an increasingly higher percentage of their time dealing with heroin cases.

In the case of (ii), the measured CEI will either overstate or understate the true CEI. In either case, if measured expenditure is a constant multiple of true

Table 5.13
Indices of Cost-effectiveness of Customs Drug Enforcement Work

	1980	*1981*	*1982*	*1983*	*1984*
1. Total Customs drugs-specific expenditure (£m)[a]	8.85	9.75	11.01	12.28	13.19
2. Expenditure by Investigation Division on enforcement in heroin market (£m)[b]	1.69	1.96	2.80	2.80	2.80
3. Heroin interception rate (mid-point) (%)[c]	5.05	8.05	11.80	9.35	14.10
4. Cost-effectiveness index based on (1)[d]	1.75	1.21	0.93	1.31	0.93
5. Cost-effectiveness index based on (2)[e]	0.33	0.24	0.24	0.30	0.20

[a] From Table 5.2.
[b] From Table 5.3.
[c] From Table 5.12.
[d] (1) : (3)
[e] (2) : (3)

expenditure, the estimated CEI will be a constant multiple of the true CEI. Again, however, if the discrepancy between true and estimated expenditure falls over time, the estimated CEI will come closer and closer to the true CEI, so that a rising estimated CEI might occur with a constant (or falling) true CEI.

Table 5.13 presents two CEIs based on the two expenditure figures (i) and (ii). The CEI has a straightforward interpretation: it indicates the expenditure required (in £m at 1985 factor cost) to intercept 1 °*Io* of heroin shipments. Thus using the index based on Investigation Division expenditure (line 5), the table indicates that the expenditure required to intercept 1% of shipments was £O.33m in 1980 and £0.20m in 1984.

Both indices have tended to fall—with the exception of 1983. There are several reasons for supposing that, at least over the period 1980-82, the true CEI has probably been falling. First, the 'addict multiplier' — for London, at least—appeared to be rising during this period (cf. Table 4.12). Second, the increased emphasis on 'targeting' and intelligence by Customs is a relatively recent phenomenon (suggesting that over 1980-82 the discrepancy between actual and measured expenditure may have remained reasonably constant). Third, the interception rate is biased against Customs. Thus the true CEI may well have fallen during this period. Whether or not it continued to fall as Table 5.13 suggests, is a matter for speculation.

5.3.3 Analysis of optimal input combinations

In Chapter 2 it was argued that enforcement agencies can be viewed as production units, combining inputs (e.g. manpower) to 'produce' intermediate

£12,15m and therefore the retail price per gram from £70 to £71.50, an increase of 2.1%.

Shortcomings in the analysis

This calculation ignores, however, the fact that the risks facing the importer and courier will be higher (100% higher) following the increase in the interception rate. This will mean that (i) couriers will increase their charges to compensate for the increased risks and (ii) importers will increase their selling prices, not only to cover the costs of the extra shipments needed to import 100 kg successfully, but also to cover the increase in courier charges and to compensate for the increased risks facing importers. This is particularly important to take into account given HM Customs' policy of trying to ensure that principals and organisers can be convicted rather than merely couriers.

Effects of Customs seizures on retail price: revised estimate

Table 5.15 examines the effects of an increase in the interception rate taking into account these extra costs. As in Table 5.14 the importer's costs of importing 200 kg under the current 15% interception rate are £1.18m. His selling price is in the region of £25,000 per kg, so that his revenue from the sale of the 100 kg is £2.5m. As before, the total retail value of the 100 kg imported is £11.9m.

The effects of the increase in the interception rate are indicated in the right-hand column. As before, to import 100 kg successfully into the UK the importer needs to arrange shipments totalling 143 kg. However, his import costs per kilo are higher under the new situation, because his couriers require extra

Table 5.15
Revised estimates of increased interception rates on heroin price

	Current situation	*Hypothetical situation*
Interception rate	15%	30%
Amount shipped to import 100 kg into UK	118 kg	143 kg
Amount seized	18 kg	43 kg
Amount imported successfully	100 kg @ 60%	100 kg @ 60%
Cost per kg shipped	£10,000	£12,000
Costs of importing 100 kg	£1.18m	£1.72m
Selling price (100 kg) ('full cost')	£2.5m	£5.57m
Mark-up per kg	112%	224%
Total retail value (170 kg @ 35%)	£11.9m	£15.0m
Retail price per gram	£70	£88
Increase in retail price	—	25.7%

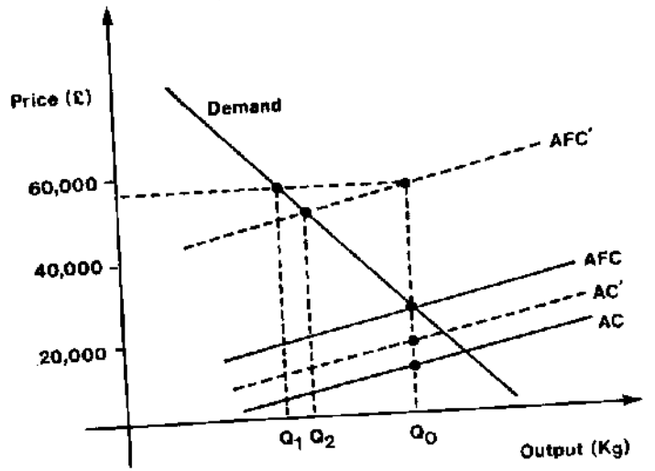
compensation for the higher risks they face. We have assumed that the importer's costs rise to £12,000 to cover the increased courier charges. The cost of importing 100 kg thus rises from £1.18m to £1.72m, not £1.43m.

However, the importer is likely to try to pass on more than the increase in his purchase costs, due to the fact that he faces increased risks. Suppose importers adopt a full-cost pricing policy (cf. Sawyer, 1979, pages 123-127), so that their selling prices are based on 'full cost', including an allowance for profit. At least part of the latter—if not most—is likely to be viewed by the importer as compensation for risk. Selling prices thus include: (i) direct costs (i.e. purchase costs), (ii) indirect costs (i.e. overheads) and (iii) a mark-up for profit. The sum of (i), (ii) and (iii) is viewed as the importer's full costs.

Under current conditions the importer's selling price—and hence full (average) cost— is £25,000 per kg. This includes direct and indirect costs totalling £11,800 per kg (i.e. £1.18m 100) and a profit mark-up of 112% (i.e. £11,800 + (1.12X £11,800) = £25,000).

When his risks double, the importer may be expected to increase his profit mark-up. We assume initially that he increases it by 100% to 224%. His full costs for the 100 kg importation are therefore £5.57m (i.e. £1.72m plus 224%). The importer's customers therefore face a bill of £5.57m for the 100 kg rather than the original £2.5m. The extra £3.O5m is passed along the distribution chain, raising the retail value of the original 100 kg from £11.9m to £15.0m. The retail price per gram thus rises from £70 to £88, an increase of 25.7%.

Figure 5.4
Role of demand in price and output changes



Limits to increased mark-ups

This, however, is likely to be an overestimate of the impact on retail prices, since it ignores the fact that if importers charge more, distributors are likely to foresee that a rise in the retail price is likely to result in a fall in consumption and therefore a fall in demand by wholesalers. Distributors will therefore purchase less from importers. This is illustrated in Fig. 5.4.

The upward-sloping lines AC and AFC are the importer's average costs {direct plus indirect) and average full costs respectively. The downward-sloping line is the distributor's demand curve. At output Q_0 average costs are £11,800 and average full costs £25,000. The intensified activity on the part of Customs results in an upwards shift in the AC curve: at output Q_o average direct and indirect costs are now £17,200. The AFC curve also shifts upwards as a result of the upwards shift in the AC curve, but also because of the increased mark-up. At output Qo average full costs are £55,700. However, at a selling price of £55,700 per kg the importer can sell only Q| kilos. Because, however, his unit costs are (assumed to be) rising, his selling price of £55,700 per kg exceeds his average full costs at output Qi. He therefore reduces his selling price from £55,700 and increases his output from Qj to Q_2.

If the price elasticity of demand by users (and therefore distributors) is non-zero, therefore, the price increase will be less than £30,700. It may also be less because the importer may not have the monopoly power to raise his mark-up by 100%. If the importer is not a monopolist, he may be expected to consider the implications that any change in his price will have on his competitors' behaviour. Fear of losing his market share may cause him to absorb some of the increased risks in the form of reduced profits. Without detailed knowledge of the structure of the heroin market at the import and distribution levels and the pricing policies adopted by importers, it is not possible to predict with any accuracy how importers' prices will change following an intensification in Customs enforcement.

Sensitivity of results to different mark-ups

One can, however, examine the sensitivity of the results in Table 5.15 to changes in the assumption regarding the mark-up following intensified enforcement activity on the part of Customs. Table 5.16 examines three possible mark-ups in the hypothetical situation of a 30% interception rate: (i) 112% (the current mark-up); (ii) 150%; and (iii) 224% (the mark-up assumed in Table 5.15). If, for example, lack of monopoly power prevents any increase in mark-up, the rise in retail price is only 8.6%.

The results in Table 5.16 suggest, therefore, that a doubling of the interception rate from the current 15 % would result in an increase in the retail price of heroin of between 8.6% and 25.7%. If the price elasticity of demand for heroin is in the region of 0.25, consumption would fall by between 2.1% and 6.4%.

Table 5.16
Effects of increased interception rate on retail price under alternative assumptions about profit mark-up

	Mark-up	*Selling price (100 kg)*	*Total retail value (170 kg)*	*Price per gram*	*% Increase*
Current situation	112%	£2.5m	£11.9m	£70	—
Hypothetical situation	112%	£3.6m	£13.0m	£76	8.6%
	150%	£4.3m	£13.7m	£80	14.3%
	224%	£5.6m	£15.0m	£88	25.7%

5.5 Summary

The number of full-time equivalent (FTE) staff in HM Customs working exclusively on drug enforcement work has increased steadily since 1979. By 1985 there were 891 FTE staff employed exclusively on drug enforcement. The number of preventive staff—whose work includes drug detection—declined steadily over the period 1979-84, but showed an increase in 1985. This decline is a result of Customs placing increasing emphasis on the use of intelligence and other selective measures, such as mobile controls. Drug-specific expenditure increased in real terms at an average annual rate of 9.0% over the period 1979-85. Over the latter part of this period it grew slightly faster (9.6% p.a.) and in 1985 was £23.6m (1985 prices). The period 1982-85 also saw a redeployment of manpower in the Investigation Division away from intelligence work directed at cannabis importers towards work directed at heroin and cocaine importers. In 1986 it was planned that 55% of the Investigation Division's expenditure on drug enforcement work would be directed at the heroin market (44% in 1985) and that 15% would be directed at cocaine importers (13% in 1985).

For performance evaluation purposes five possible measures of intermediate output were examined: (i) numbers convicted for drug smuggling; (ii) length of prison sentence for drug smugglers, (iii) the quantity of drugs seized, (iv) the numbers of seizures, and (v) the interception rate. Each was argued to suffer from limitations, with (i), (iii) and (iv) being biased *in favour* of Customs (in the sense that factors external to Customs over the last five years will have tended to increase the indicators automatically), and (v) being biased *against* Customs. The interception rate for heroin for 1984 was estimated at between 9% and 19% and appears to have increased over the last five years. A cost-effectiveness index (CEI) based on the interception rate and two alternative measures of expenditure on drug enforcement suggest that the cost-effectiveness of Customs drug enforcement work has probably increased, at least for the years 1980-82, and possibly thereafter too. For various reasons, however, the CEIs presented should be interpreted with caution.

The final part of the chapter examined the effects of Customs drug enforcement activities on drug consumption (or, more accurately, on retail prices). The results suggested that a doubling of the interception rate in the heroin market from 15% to 30% would probably result in an increase in the retail price of somewhere between 9% and 26%. Without better knowledge of the structure of the heroin market at each level and importers' pricing policies, it is impossible to be more precise. Indeed, it has to be recognised that the true figure may lie outside this estimated range.

6 The Costs and Benefits of Police Drug Enforcement Activities

6.1 Introduction

The police forces in the UK are responsible for investigating the unlawful trafficking, manufacture and possession of controlled drugs. The police and HM Customs work closely together in the investigation of drug offences and often mount joint operations. Although police drug enforcement work is becoming more specialised by type of organisational unit, e.g. regional crime squads, force drug squads, it is not possible, with the information presently available, to undertake separate analyses of their enforcement work at the different levels—distribution, wholesale and retail—of the market below import level.

This chapter focuses, therefore, on the drug enforcement activities in general of the police in England and Wales. It presents data on expenditure by the police on enforcement and attempts to assess the effects of this work on illicit drug consumption. It also explores the cost-effectiveness of police enforcement activities, discussing the limitations of the several possible measures of performance and how production function analysis might be used to assist in resource deployment decisions.

As in the previous chapter, the analyses presented have been limited by the non-availability of certain data and by the time available. In Section 6.2 the available data on expenditure by the police on drug enforcement are described. Section 6.3 addresses the issue of cost-effectiveness. Section 6.4 discusses the issue of the optimal scale of enforcement activity and the effects of this activity on illicit drug consumption. Section 6.5 investigates the likely effects of changes in the law relating to drug trafficking.

6.2 Expenditure by the police on drug enforcement work

Expenditure on drug enforcement by the police can be related to three organisational units (i) Regional Crime Squads, (ii) force drug squads and (iii) CID and uniformed officers.

Table 6.1 shows expenditure by the 8 regional crime squads in England and Wales on drugs-related work for the year 1984 when an estimated 256 full-time equivalent (FTE) police officers were involved. The total expenditure figure in the table excludes No. 3 region, since no data for this region are included in the 1984 police statistics (Chartered Institute of Public Finance and Accountancy, 1985). Table 6.1 shows, therefore, that at least £6.3m was spent by 7 regional crime squads on drug enforcement in 1984. If total net expenditure by Region No. 3 grew at roughly the same rate over the last four years as for the other regions (6.9%), the total figure for the 8 regions would be in the order of £7.0m.

There can be little doubt that expenditure by Regional Crime Squads on drugs-related work has increased over the last five years or so. Of the non-Metropolitan Regional Crime Squads only No. 8 Region was able to provide annual data for 1978-85 on man-hours devoted to drugs investigations: these are shown in Table 6.2.

Table 6.1
Expenditure by Regional Crime Squads on drug-related work, 1984

	Manpower			*Net expenditure (£'000)*	
	Total[a]	*Drugs-specific*		*Total*[a]	*Drugs-specific*
Region		*(%)*[b]	*FTEs*		
No. 1	183	20%	36.6	4,486	897.2
No. 2	74	30%	22.2	1,888	566.4
No. 3	140	20%	28.0		
No. 4	118	25%	29.5	3,061	765.25
No. 5	116	46%	53.4	3,405	1566.30
No. 6	92	53%	48.8	2,782	1474.50
No. 7	87	17%	14.8	2,390	406.30
No. 8	44	52%	22.9	1,210	629.20
Total	854		256.2	19,222[c]	6305.15[c]

Source:
[a] Chartered Institute of Public Finance and Accountancy (CIPFA) (1985).
[b] Percentage of man-hours devoted to drugs work. Source: Association of Chief Officers of Police (ACPO).
[c] Excludes No. 3 region for which expenditure data are not included in CIPFA (1985).

(i) Regional Crime Squads

It should be noted that the figures relate only to successful operations and do not include time spent on preparatory work. Although there is some annual variation, it is clear that the trend has been upwards. The average percentage of man-hours for the year 1987-81 was 2.51%; for the years 1982-85 the average percentage was 4.70%.

The experience of No. 8 Region may not be typical of all Regions. In some Regions (No. 1 Region, for example), the Regional Crime Squad has only recently become directly involved in drugs investigations. In others the increase

Table 6.2
Percentage of man-hours devoted to drug investigations by No. 8 Regional Crime Squad, 1978-85

Year	*% Man-hours*
1978	1.12
1979	2.33
1980	1.17
1981	5.41
1982	1.45
1983	5.07
1984	7.53
1985	4.74

Source: South Wales Constabulary.

Table 6.3
Expenditure on police force drug squads, England and Wales 1974–85

Year	*No. officers*	*Expenditure in £m at 1984 factor cost*[a]
1974	483	£10.8m
1984	596	£13.4m
1985	713	£16.0m

[a] Based on CIPFA (1985) figure of £22,467 net expenditure per police officer p.a. (England and Wales).
Source: ACPO.

in commitment appears to have been fairly continuous—at least as far as the last few years have been concerned. The percentages of man-hours for No. 5 Region, for example, were 8.83% in 1982, 27.66% in 1983 and 46.16% in 1984 (first 4 months only).

(ii) Force drug squads

Expenditure by force drug squads for the years 1974,1984 and 1985 are detailed in Table 6.3. The data are at constant factor cost, being based on 1984/85 data on net expenditure per police officer. Table 6.3 indicates that force drug squads accounted for £16.0m (0.65%) of police net expenditure in 1984/85. The figure is, however, rising rapidly. The 1985 figure is 10.4% higher than the 1984 figures.

(iii) CID and uniformed officers

CID and uniformed police officers are typically involved in investigating unlawful possession offences, rather than supply offences.

Table 6.4
Cheshire Constabulary estimated expenditure associated with work by CID and uniform police officers on drug-related cases in 1984

Man-hours on drug cases for 1984[a]	1,680
No. FTE police officers[b]	0.9
Net expenditure per police officer[c]	£20,275
Net expenditure on drugs cases	£18,247

[a]Data provided by Cheshire Constabulary, Research and Planning Section. Based on an estimated 6 hours per drug-related case: includes time spent on arrest, searches, processing at police station, interviewing, charging, collection of evidence, completion of file of evidence. Total figure refers to CID and uniformed officers (including serious crime squad officers); does not include drug squad officers' or civilians' time.
[b]Assumes 40 hours worked per week and 47 weeks per year.
[c]CIPFA (1985).

"Data provided by Cheshire Constabulary, Research and Planning Section. Based on an estimated 6 hours per drug-related case: includes time spent on arrest, searches, processing at police station, interviewing, charging, collection of evidence, completion of file of evidence. Total figure refers to CID and uniformed officers (including serious crime squad officers); does not include drug squad officers' or civilians' time.
[b]Assumes 40 hours worked per week and 47 weeks per year.
[C]CIPFA (1985).

Table 6.4 shows the estimated (net) expenditure by Cheshire Constabulary in 1984 associated with drug enforcement work by CID and uniformed officers. In 1984 1.5% of those found guilty of unlawful possession of a controlled drug in England and Wales were from the Cheshire force area (Home Office, 1985b). If the work on drugs cases by CID and uniformed police officers from Cheshire Constabulary accounted for 1.5% of all work on drugs cases by CID and uniformed police officers in the 43 police forces in England and Wales, there would have been a total of 112,000 man-hours spent by CID and uniformed police officers on drugs work. This is equivalent to 60 FTE police officers. In expenditure terms this is equivalent to £1.3m (i.e. 60 FTE police officers @ £22,467 p.a.). This estimate should be treated with some caution, as it is unlikely that Cheshire Constabulary is representative of all forces.

6.3 The cost-effectiveness of police drug enforcement work

Over the last few years the police have become increasingly concerned about the resource implications of their drug enforcement work. The terms of reference of the recent Association of Chief Police Officers' (ACPO) working party on drug-related crime included an assessment of the effectiveness of drug enforcement work and an examination of ways in which effectiveness might be improved.

This section examines (i) the problems encountered in attempting to monitor the cost-effectiveness of police drug enforcement work and (a) how economic analysis might be used to assist the police in improving their efficiency.

6.3.1 Output measurement for performance evaluation

This section considers six possible measures of the intermediate output of police drug enforcement activities: (i) convictions for supply-side and demand-side

offences, (ii) length of prison sentences awarded by the courts for the offences, (iii) the quantity of drugs seized, (iv) the number of seizures, (v) the police seizure rate, and (vi) the risks facing drug dealers. Many of the strengths and weaknesses of (i) to (v) are the same in this context as they were for Customs. The discussion of the limitations of the various measures focuses on problems which are specific to the analysis of enforcement measures aimed below import level.

(i) Convictions for dealing and possession

Tables 6,5 to 6.6 present data on convictions from 1979 to 1984 for 'supply-side' and 'demand-side' offences for heroin, cocaine and cannabis respectively. Convictions for supply-related offences and possession have increased virtually continuously over the last six years for each of the three drugs, although 1981 stands out as a peak year for cocaine. Convictions for unlawful production of cannabis have fluctuated from one year to the next, without any clear trend.

Table 6.5
Numbers of persons found guilty or cautioned for unlawful supply and possession offences involving heroin or cocaine

	Unlawful supply/possession with intent to supply unlawfully		*Unlawful possession*	
	Heroin	Cocaine	Heroin	Cocaine
1979	72	40	364	214
1980	144	61	533	336
1981	184	122	582	378
1982	237	83	735	301
1983	295	96	1139	402
1984	652	128	1912	509

Source: Home Office (1985b).

Table 6.6
Numbers of persons found guilty or cautioned for unlawful supply and possession offences of cannabis

	Unlawful supply/ possession with intent to supply unlawfully	*Unlawful production*	*Unlawful possession*
1979	908	1225	10774
1980	988	2173	12450
1981	1147	1581	13074
1982	1201	1431	15278
1983	1380	1165	17706
1984	1736	1360	17862

Source: Home Office (1985b).

Table 6.7
Mean length of sentences of unsuspended imprisonment for heroin offences

	Length of sentence (months)		
	Unlawful supply	*Possession with intent to supply unlawfully*	*Unlawful possession*
1979	32	32	6
1980	19	17	8
1981	35	27	12
1982	28	30	9
1983	36	36	9
1984	37	41	11

Source: Home Office Statistical Department.

Table 6.8
Mean length of sentences of unsuspended imprisonment for cocaine offences

	Length of sentence (months)		
	Unlawful supply	*Possession with intent to supply unlawfully*	*Unlawful possession*
1979	41	58	13
1980	21	20	14
1981	31	23	16
1982	43	23	5
1983	47	28	7
1984	42	34	17

Source: Home Office Statistical Department.

Table 6.9
Mean length of sentences of unsuspended imprisonment for cannabis offences

	Length of sentence (months)			
	Unlawful supply	*Possession with intent to supply unlawfully*	*Production/ cultivation of cannabis*	*Unlawful possession*
1979	15	16	5	4
1980	20	13	4	4
1981	19	13	4	3
1982	14	16	5	3
1983	12	15	4	4
1984	17	14	6	4

Source: Home Office Statistical Department.

(ii) Length of prison sentence

Tables 6.7 to 6.9 show mean lengths of sentence of unsuspended imprisonment for supply-side and demand-side offences involving heroin, cocaine and cannabis from 1979 to 1984. In most cases there is no clear trend. In the case of heroin supply-related offences, however, sentences tended to become longer. This may reflect a real increase in the 'importance' of the dealers convicted. It may also reflect, however, changes in the sentencing practice of the courts following the Lord Chief Justice's guideline judgement in December 1982 on the sentencing of drug offenders.

(iii) Quantity of drugs seized

Table 6.10 presents data on the quantities of heroin, cocaine and cannabis seized by the police for the years 1979-84. For heroin and cocaine, there have been sharp upwards trends, while for cannabis, there has been a slight upward trend but with considerable fluctuations from one year to the next.

Comparison of Tables 6.10 and 5.6 indicates that Customs seizures are far in excess of police seizures in terms of quantity seized. This has been argued by some (see e.g. Stimson, 1985) to indicate that, as a drug enforcement agency, Customs provides "better value for money" than the police.

This conclusion does not necessarily follow. For one thing, nothing has been said about the cost of the two agencies. More importantly, the argument fails to take into account the steep graduation in the price structure of the market, so that a seizure of 1 kg at wholesale level may not produce the same effect on the retail price as a seizure of 1 kg at import level. Inferences cannot be made about the optimal scale of operation of the two drug enforcement agencies merely by comparing the number of seizures each made in a year. This issue is discussed in greater depth in Section 6.4.

Table 6.10
Seizures by police of certain controlled drugs

	Quantity seized (kg)		
	Heroin	*Cocaine*	*Cannabis*
1979	1.6	2.4	547.4
1980	1.8	4.2	788.6
1981	7.6	5.4	547.4
1982	10.3	6.6	829.9
1983	20.3	6.0	628.5
1984	49.0	30.1	2777.9

Source: Home Office (1985b).

Police seizure data may, however, provide a useful indication of intermediate output and may therefore be of value in evaluating performance over time. The difficulty here is that the police operate at several different levels of the market. The total quantity seized is therefore sensitive to the allocation of effort across the various levels of the market. The total would increase if the police devoted proportionately more of their effort to the upper levels of the market, though this would not necessarily be indicative of improved performance. Indeed, increasing seizures could be perfectly consistent with a decline in organisational efficiency. If the switch to the upper levels of the market is sufficiently dramatic, any decline in performance would be more than offset by the increase in average size of seizure.

Whether or not this has been the case is difficult to tell. There does, however, appear to have been some tendency on the part of the police to move 'up market'. Table 6.11 gives the average weight of seizure for heroin, cocaine and cannabis for the years 1979-84. The average weight of heroin seizure has increased by 465% over the period, and the average weight of cocaine seizure by 400%. The average weight of cannabis seizures has fluctuated about what appears to be an upward trend. The average weight of heroin seized by police is now over 60% of the average wholesale quantity (1 oz or 28.3 g).

It may be that the upwards trend is accounted for by a tendency on the part of dealers to hold larger stocks. Whether or not this is true is impossible to say, but seems unlikely. It is more likely that at least some of the increase in quantity seized is accounted for by 'up-market drift'.

(iv) Number of seizures

To some extent this can be taken into account by looking at the number of seizures. Since the probability of detection is positively related to the number

Table 6.11
Average size of police seizures of certain controlled drugs

	Average size of seizure (grams)		
	Heroin	*Cocaine*	*Cannabis*
1979	3.1	8.2	36.7
1980	2.9	11.5	58.8
1981	10.4	13.6	36.7
1982	12.1	21.0	48.6
1983	11.6	10.7	31.7
1984	17.5	40.7	133.9

Source: Home Office (1985b).

of transactions (cf. Rottenburg, 1968), and is therefore higher *ceteris paribus* for the wholesaler than the distributor, the police face a trade-off between the total quantity they seize and the number of seizures they make. To make a large seizure requires more effort than making a small seizure. Thus—with a given budget—one would expect an increase in total quantity seized to be achieved only at the expense of a decline in the number of seizures. To eliminate the effects of up-market drift, it may be that the number of seizures would provide a better indicator of intermediate output than the quantity seized.

In the event, the number of seizures made by the police has tended to increase, as well as the total quantity seized. Table 6.12 indicates the number of police seizures of heroin, cocaine and cannabis from 1979 to 1984.

Table 6.12
Number of seizures of certain controlled drugs by police

	Heroin	*Cocaine*	*Cannabis*
1979	515	293	12,554
1980	612	365	13,417
1981	731	396	14,896
1982	848	314	17,062
1983	1,745	558	19,822
1984	2,800	739	20,747

Source: Home Office (1985b).

(v) Seizure rate

However, similar criticisms can be levelled at the use of data on police convictions and seizures as were levelled at the use of Customs convictions and seizures. The number of seizures and quantities seized by the police, for example, depend not only on the intensity and efficiency of their activity, but also on (a) the quantity of drugs shipped to the UK and (b) the quantity seized by Customs. Thus any exogenous increase in shipments will tend to work to the advantage of the police in terms of seizure statistics. Similarly, the number of dealers arrested and charged by the police will depend on the number of dealers in the market. Any exogenous increase in the number of dealers will tend to make it easier for the police to arrest a given number of dealers.

As in the case of Customs, therefore, it may be better to measure intermediate output in terms of the seizure rate (or arrest rate), rather than the level of seizures (or arrests).

In calculating the police seizure rate it must be borne in mind that most heroin they seize is from above retail level. In 1984, for example, they made 1,894 seizures of less than 1 gram (Home Office, 1985b), so that at least 47 kg of the 49 kg seized was from levels of the market above the retail/user level. To estimate the total quantity of heroin in the system at the wholesale/distribution levels, the amount of street-level heroin consumed has to be converted into an equivalent quantity of wholesale/distribution heroin taking estimated purity levels into account. Table 6.13 presents estimates of the quantity of heroin in the market of distribution level during 1980-84.

Table 6.14 presents estimates of the police seizure fate over the period 1980-84. The rate appears to have increased from about 0.25% in 1980 to about 2.2% in 1984. The rate of increase, however, is slower than the rate of increase of quantity seized (50% p.a. as compared to 66%).

Table 6.13
Estimates of UK heroin consumption at distribution-level purity

	Estimated UK consumption of street-level heroin (kg)[a]		*Purity*[b] *%*		*Equivalent quantity of distribution-level heroin (kg)*	
	Low	*High*	*Street*	*Distribution*	*Low*	*High*
1980	750	1880	39	60	487	1222
1981	930	2330	47	58	741	1856
1982	1240	3100	56	67	1036	2541
1983	1790	4460	49	52	1687	4203
1984	2330	5830	34	52	1523	3812

[a]From Table 4.14.
[b]From Table 4.5.

Table 6.14
Estimates of heroin seizure rates by police, 1980–84

	Seizures[a] *(kg)*	*Consumption*[b] *(kg)*		*Imports*[c] *(kg)*		*Seizure rate (%)*	
		Low	*High*	*Low*	*High*	*Low*	*High*
1980	1.8	487	1222	489	224	0.1	0.4
1981	7.6	741	1056	749	1864	0.4	1.0
1982	10.3	1036	2591	1046	2601	0.4	1.0
1983	20.3	1687	4203	1707	4223	0.5	1.2
1984	49.0	1523	3812	1572	3861	1.3	3.1

[a]From Table 6.10. Home Office (1985b).
[b]From Table 6.13.
[c]Sum of consumption and seizures: represents amount imported successfully.

(vi) Risks facing dealers

For the same reasons as it is of interest to estimate customs seizures as a fraction of imports or shipments, it is of interest to express the number of convicted drug dealers as a fraction of all dealers (or users). Since it is not possible to determine the level of market at which dealers operate from the data on convictions for supply-related offences, it is not possible to estimate the risks facing different types of dealers.

In order to estimate the risks facing heroin dealers it is necessary to estimate their number. In Chapter 4 the number of retail dealers was estimated from the estimated number of users, by assuming low and high values for the number of users per retail dealer. If one is then prepared to make low and high 'guesstimates' of the number of retail dealers per distributor/wholesaler, one can estimate the total number of dealers from the estimated number of users. Table 6.15 presents estimates of the risks of arrest and imprisonment facing heroin dealers for the years 1979-84. Low and high 'guesstimates' of the number of retailers per wholesaler/distributor of 6 and 12 have been assumed. It may

Table 6.15
Estimates of risks facing heroin dealers 1979–84

		1979	*1980*	*1981*	*1982*	*1983*	*1984*
1. No. retailers[a]:							
	Low:	1064	1180	1460	1940	2796	3653
	High:	1439	1589	1966	2611	3357	4917
2. No. retailers per distributor/wholesaler:							
	Low:	6	6	6	6	6	6
	High:	12	12	12	12	12	12
3. No. wholesalers and distributors:							
	Low:	89	98	122	162	233	304
	High:	240	265	328	435	559	819
4. Total no. drug dealers:							
	Low:	1158	1278	1582	2102	3029	3957
	High:	1679	1854	2294	3046	3916	5736
5. No. proceeded against for supply-related offences[b]		104	193	225	325	435	880
6. No. imprisoned for supply-related offences[b]		33	85	128	166	207	443
7. No. proceeded against for supply-related offences as % dealers:							
	Low:	6.2	10.4	11.1	10.7	11.1	15.3
	High:	8.9	15.1	16.1	15.5	14.4	22.2
8. No. imprisoned for supply-related offences as % dealers:							
	Low:	2.0	4.6	5.7	5.4	5.3	7.7
	High:	2.8	6.6	8.1	7.9	6.8	11.2

[a]From Table 4.15.
[b]Figures refer to heroin only. Data supplied by Home Office.

well be the case that the true figure lies outside the assumed range for each of the years covered. Moreover, it may well be the case that the true figure has changed over the years. Because of the uncertainty surrounding the true value, the estimates in Table 6.15 should be treated with caution.

Taken at face value, the figures suggest that in 1984 a heroin dealer faced a probability of arrest of between 0.15 and 0.22 and a probability of being imprisoned of between 0.08 and 0.11. If the low estimate of 6 retailers per wholesaler is too high, the total number of dealers will be underestimated and the risks overestimated. If the high estimate of 12 retailers per wholesalers is too low, the total number of dealers will be overestimated and the risks therefore underestimated. To the extent that the ratio of retailers to wholesalers has remained constant, the risks facing heroin dealers appear to have increased over the period 1979-84.

6.3.2 Indices of cost-effectiveness of police drug enforcement work

The ideas behind the cost-effectiveness index (CEI) were discussed in Section 5.3.2 in the context of Customs drug enforcement activities. Unfortunately, due to lack of expenditure data for Regional Crime Squads' drugs work prior to 1984/85, it is not possible to construct CEIs for several years as was done in the case of Customs. Because, however, Regional Crime Squads were not involved in drugs work until the early 1980s, one can probably safely equate expenditure on force drug squads in 1974 with all police drugs-specific expenditure in that year. There are also problems on the output side as well. Due partly to lack of data on either the purity of illicit heroin in 1974 or the quantity consumed in the early 1970s, it is not possible to attempt to estimate the quantity of illicit heroin in the UK at distribution/wholesale level in 1974. In any case, even if it were, it would not be possible to isolate heroin-related expenditure by force drug squads.

Table 6.16
Indices of cost-effectiveness of police drug enforcement work

	1974	*1984*
1. Total police drugs-specific expenditure (£m)[a]	10.8	20.4
2. No. seizures (all drugs)[b]	9,893	25,233
3. Convictions for unlawful supply/possession with intent to supply[b]	1,123	2,858
4. Cost-effectiveness index based on (2)	1,092	808
5. Cost-effectiveness index based on (3)	9,617	7,138

[a]From Tables 6.1 and 6.3. 1974 figures includes only expenditure on Drugs Squads; 1984 figure includes expenditure on Regional Crime Squads and expenditure on Drugs Squads.
[b]Home Office (1985b).

Table 6.16 presents two CEIs using data on (i) total number of police seizures and (ii) convictions for unlawful supply or possession with intent to supply unlawfully. In the case of (i), therefore, the CEI indicates the expenditure (in £'s at 1984 factor cost) required to make one seizure. Both CEIs were smaller in 1984 than in 1974, suggesting an increase in cost-effectiveness. It should be borne in mind, however, that both (i) and (ii) suffer from limitations as measures of intermediate output. In particular, they are biased in favour of the police, in the sense that factors external to the police over the last 10 years will have tended to increase them both automatically. The rise in the CEIs may be expected, therefore, to reflect these developments. It is not necessarily the case, then, that the fall in the two CEIs is due to an increased cost-effectiveness on the part of the police in their drug enforcement work.

6.3.3 Analysis of optimal input combinations

As indicated in Section 5.3.3, production function analysis is a useful tool for assisting in resource deployment decisions. Pyle (1983) provides a survey of studies of police production functions, though as indicated in the previous chapter, these appear to be more directed towards the issue of optimal scale of production, rather than towards the problem of optimal input combinations. Despite this, these studies may be expected to provide a useful starting-point for any production function analysis of police drug enforcement activities.

6.4 The efficient scale of police drug enforcement activity

This section uses a similar methodology to that employed in the analysis of Customs final output to analyse the effects on illicit heroin retail prices of police

Table 6.17
Effects on the retail price of illicit heroin of increased seizure rate by police at wholesale level

	Current situation	*Hypothetical situation*
Seizure rate	2.5%	5.0%
Amount bought from distributor by wholesaler to have 100 kg to sell	102.6 kg	105.3 kg
Quantity seized	2.6 kg	5.3 kg
Amount wholesaler has to sell	100 kg @ 55%	100 kg @ 55%
Cost per kg bought	£35,000	£35,000
Costs of obtaining 100 kg	£3.59m	£3.68m
Revenue (122 kg @ 45%)—'full cost'	£6.11m	£8.83m
Mark-up	70%	140%
Total retail value (160 kg @ 35%)	£11.2m	£13.92m
Retail price per gram	£70	£87
Increase in retail price	—	24.3%

drug enforcement efforts. First are considered the effects of police seizures on the retail price and second, the effects of imprisonment of drug dealers.

Effects of police seizures on the illicit heroin retail price

Table 6.17 presents estimates of the effects of increasing police heroin seizures at the wholesale level from the current (assumed) 2.5% to 5.0%.

To have 100 kg to sell, wholesalers will need to order 102.6 kg from distributors because on average, 2.6 kg will be seized by the police. The cost per kg to the wholesaler is £35,000 (the distributor's selling price). The cost of obtaining enough heroin to have 100kg to sell is therefore £3.59m. Wholesalers cut the purity of the heroin from 55% to 45%, thereby transforming the 100 kg into 122 kg. They sell the 122 kg at £50,000 per kg, obtaining a total revenue from the 100 kg consignment of £6. Urn. If the £6.1 lm is viewed as the distributor's 'full cost', this gives a mark-up of 70%. The heroin is subsequently cut further (from 45% to 35%), so that the total quantity of street-level heroin is 160 kg, valued at £11.2m (£70 per gram).

Suppose now the police were successful in raising their seizure rate at the wholesale level from 2.5% to 5.0%. Wholesalers now have to arrange to purchase 105.3 kg to obtain 100 kg to sell. Of the 105.3 kg the police will, on average, seize 5.3 kg. The costs to the wholesaler of obtaining 100kg are, therefore, now £3.68m (105.3 x £35,000). Suppose that, as in the case of importers, wholesalers operate a 'full-cost* pricing policy and seek to double their mark-up following the intensified enforcement activity by the police. They therefore set a target mark-up of 140%. Adding a 140% mark-up to costs of £3.68m gives rise to a 'full cost' of £8.83m. Thus the wholesaler's full cost increases by £2.72m, which is passed on in full down the distribution chain. The retail price for the 122 kg therefore rises from £11.2m to £13.92m and the retail price per gram from £70 to £87—a rise of 24.3%.

As in the case of Customs seizures, it is of interest to examine the sensitivity of estimates to changes in the assumption regarding the mark-up. Table 6.18

Table 6.18
Effects of increased heroin seizure rate by police at wholesale level on retail price under alternative assumptions about profit mark-up

	Mark-up	*Selling price per 100 kg*	*Total retail value*	*Retail price per gram*	*% Increase*
Current situation	70%	£6.11m	£11.2m	£70	—
Hypothetical situation	70%	£6.26m	£11.35m	£71	1.4%
	100%	£7.36m	£12.45m	£78	11.4%
	140%	£8.83m	£13.92m	£87	24.3%

gives estimates based on three alternative scenarios: (i) a mark-up of 70% (the current mark-up), (ii) a mark-up of 100%, and (Hi) a mark-up of 140% (the mark-up in Table 6.17).

Comparison of Tables 6.18 and 5.16 reveals that a doubling of the Customs interception rate has roughly the same effect on retail price as a doubling of the police seizure rate (at wholesale level) if both importers and wholesalers double their mark-ups in response to intensified enforcement. Under these circumstances Customs would have to seize around 6 kg for every 1 kg seized by the police at wholesale level in order to produce the same effect on retail price. (A doubling of the Customs seizure rate would produce an extra 15 kg per 100 kg shipment, whilst a doubling in the police seizure rate at wholesale level would yield an extra 2.5 kg per 100 kg consignment. According to the figures in Tables 6.17 and 5.15 both would have roughly the same effect on retail prices.)

This result depends crucially, however, on the assumption that both importers and distributors/wholesalers have sufficient market power to double their mark-ups following intensified enforcement. In practice, this is most unlikely. It seems highly likely that importers enjoy considerably more monopoly power than dealers further down the distribution chain. If this is the case, they will be in a better position to increase their mark-ups than other dealers. If, for example, importers were able to double their mark-ups but distributors were unable to increase their mark-ups at all due to competition, a doubling in the interception rate import level from 15% to 30% would produce an increase in retail price of 26%, whilst a doubling in the seizure rate at wholesale/distribution level would increase the retail price by only 1.4%. Under these conditions the police would have to seize roughly 3 kg from wholesale level for every 1 kg seized by Customs in order to produce the same effect on retail price. In the absence of better information on the market structure at each level of the market and dealers' pricing policies it is clearly impossible to indicate what the real position is likely to be. What these estimates do indicate, however, is the need to look further than the quantities being seized when trying to evaluate the relative cost-effectiveness of alternative drug enforcement strategies. In particular, it is necessary to look at both the price structure of the market and the degree of monopoly at each level of the market.

Estimated effects of increased incarceration of heroin dealers

Another way of examining the effects of intensified drug enforcement activity by the police is to estimate the effects of imprisoning twice as many heroin (and other drug) dealers. Table 6.19 examines the effects of increasing the proportion of heroin wholesalers and distributors who are convicted from an assumed current 10% to 20%. High-level dealers are assumed to value each year out of prison at £75,000 and to discount future values at a rate of 10%. If imprisoned, they are assumed to receive a sentence of 5 years.

Table 6.19
Effects of increased imprisonment of heroin dealers

	Current	*Hypothetical*
Imprisonment rate	10%	20%
Valuation imputed to risk of imprisonment (@ £75,000 p.a.)[a]	£28,430	£56,862
No. distributors and wholesalers[b]	300 to 1000	300 to 1000
Dealers' total valuation of risks	£8.5m to £28.4m	£17.0m to £56.8m
Retail value of market[c]	£111.7m to £237.8m	£120.2m to £294.6m
Increase in retail price		7.6% to 23.9%

[a]Assumes prison sentence of 5 years and discount rate of 10%.
[b]Based on Table 6.15.
[c]From Table 4.15.

At least the final two of these three assumptions are almost certainly over-generous. Evidence suggests that rate of time preference (i.e. rates at which individuals discount future costs and benefits) may be closer to 30% than 10% (Fuchs, 1982). This will result in an overestimate of the effects of increased imprisonment rates on retail prices. The mean length of sentence for heroin supply-related offences in 1984 was 37 months (Table 6.7) and just under 5 years for smuggling (Table 5.5). Whether distributors and wholesalers (as distinct from importers)can expect to earn more than £75,OOOp.a. onaverage is difficult to tell. It is assumed that under current conditions high-level dealers impute a value of £28,340 to the risks they face of imprisonment. It is also assumed that there are a minimum of 300 and a maximum of 1000 high-level dealers (cf. Table 6.15) so that the total valuation of 10% imprisonment risk by high-level dealers is between £8.5m and £28.4m. Under current conditions the retail value of the market is between £111.7m and £237.8m (Table 4.15).

A doubling of the risk of imprisonment increases the total valuation of imprisonment risks by high-level dealers to between £17.0m and £56.8m. It is assumed that these extra costs are passed on in full down the distribution chain, causing the retail value of the market (and therefore the retail price, if consumption is unchanged) to rise by between 7.6% and 23.9%.

This calculation ignores the fact that the number of dealers will be reduced by the increase in the imprisonment rate. Some will be imprisoned and others may leave the market voluntarily, deciding that the increased risks are unacceptably high. The effect of this will be to overestimate the increase in retail price.

6.5 The effect of changes in laws relating to drug trafficking

Since 1983 the Government has introduced, either by executive action or legislation, harsher penalties to deter drug traffickers. In 1983 the Home

Secretary announced that parole would be severely restricted for those sentenced to more than five years unsuspended imprisonment for trafficking offences. The maximum penalty for trafficking offences involving Class A controlled drugs (e.g. heroin, cocaine) was increased in September 1985 from 14 years imprisonment to life imprisonment. In England and Wales the Drug Trafficking Offences Act 1986 provides for the confiscation of the proceeds of drug trafficking in addition to any other penalty the court may impose. The question arises as to what effects these measures may be expected to have on illicit drug consumption.

6.5.1 Longer prison sentences for heroin traffickers

The benefits of longer sentences

The effects of longer prison sentences can be estimated using the method employed in Table 6.19 above. Suppose that the average length of sentence is increased from 5 years (the assumption in Table 6.19) to 20 years. The effects of this change are illustrated in Table 6.20.

The current situation is the same as that depicted in Table 6.19. In the hypothetical situation the imprisonment rate is still 10% but the length of prison sentence is 20 years rather than 5. The value dealers impute to their risks rises to £63,852. Note that, because future earnings are discounted, the dealer's valuation of his risks increases by much less (proportionally) than the sentence length (124% compared to 300%). The total number of traffickers is assumed to remain unchanged at 300-1000. In reality this is unlikely to be true, so that our estimate will be an overestimate. The total valuation of risks by dealers will rise to £19.1m-£63.8m. This will be passed along the distribution chain so that the retail price of heroin rises by between 9.5% and 14.9%.

Table 6.20
Effects of increased sentence for heroin traffickers

	Current situation	*Hypothetical situation*
Imprisonment rate	10%	10%
Valuation imputed to risk of imprisonment (@ £75,000 p.a.)[a]	£28,430	£63,852
No. distributors and wholesalers[b]	300 to 1000	300 to 1000
Dealers' total valuation of risks	£8.5m to £28.4m	£19.1m to £63.8m
Retail value of market[c]	£111.7m to £237.8m	£122.3m to £237.2m
Increase in retail price		9.5% to 14.9%

[a]Assumes sentence length of 20 years and discount rate of 10%.
[b]Based on Table 6.14.
[c]From Table 4.15.

A quadrupling of the average prison sentence facing traffickers from 5 years to 20 years is therefore estimated to result in a rise in the retail price of heroin of not more than 15%. Because of the deterrent effect, the increase may well be less. If the price elasticity of demand for heroin is - 0.25, this would result in a reduction in consumption of 3.75%. If the adjustment were on the number of users, rather than on their daily intake, this would result in a fall in the low estimate of the number using illicit heroin at any one time from 25,600 to 24,600 (cf. Table 4.14).

The costs of longer prison sentences

If prisons are operating at full capacity, longer prison sentences for drug traffickers can be achieved only by (i) increasing the capacity of the prisons or (ii) releasing other prisoners early. The cost of (i) will be relatively high, given that it will involve substantial capital expenditures. It will be higher than the average expenditure involved in keeping a person in prison. The cost of (ii) will be felt in terms of any increase in the incidence of crime resulting from the early release of other prisoners. The mix of (i) and (ii) needs to be chosen so as to minimise the total costs involved in extending drug traffickers' prison sentences. Whether this minimised cost is likely to be smaller than the benefits associated with what is likely to be a small reduction in drug consumption, is not at all clear *a priori*.

6.5.2 Sequestration of assets

The benefits of asset sequestration

Seizure of assets can be analysed by adding the value of assets seized to the first year's forgone earnings. Thus if the prison sentence is 5 years and the trafficker has £100,000 worth of assets seized, he loses £175,000 in year 1, £75,000 in year 2, and so on.

Table 6.21 estimates the effects of sequestration of assets of heroin distributors. The imprisonment rate amongst distributors is assumed to be 10% and distributors are assumed to have an earnings potential of not more than £100,000 p.a. The length of sentence is 5 years and the discount rate 10%. There are assumed to be between 100 and 300 heroin distributors (as distinct from wholesalers—cf. Fig. 4.1).

In the hypothetical situation the sentence is still 5 years but distributors are assumed to have assets to the value of £500,000 seized on arrest. This increases a distributor's valuation of his risks to £87,900. Distributors' total valuation increases to between £8.79m and £26.37m. This is passed along the distribution chain so that the retail price rises by between 4.5% and 6.3%. Again, this is an overestimate insofar as it overlooks the deterrent effect on distributors: at least some distributors will consider the uncertainty surrounding their earnings

Table 6.21
Effects of sequestration of assets of heroin distributors

	Current situation	*Hypothetical situation*
Imprisonment rate	10%	10%
Valuation imputed to risk of imprisonment	£37,900[a]	£87,900[b]
No. distributors	100 to 300	100 to 300
Distributors' total valuation of risks	£3.79m to £11.37m	£8.79m to £26.37m
Retail value of market	£111.7m to £237.8m	£116.7m to £252.8m
Increase in retail price		4.5% to 6.3%

[a]Assumed 10% discount rate, 5 year prison sentence, forgone earnings p.a. of £100,000.
[b]As for (a) but assumes assets to value of £500,000 seized on arrest.

too risky to make it worthwhile their continuing in business. This will reduce the figures of £8.79m and £26.37m. If, for example, 10% of distributors decided to leave the business, the increase in retail price would only be of the order of 3.6-5.2%.

Whether or not the figure of £500,000 is realistic is difficult to say. It may well be the case that distributors have assets in excess of £500,000, but how much of these could be seized, given the problems involved in tracing traffickers' funds through the international banking system, is a source of concern (cf. e.g. Home Affairs Committee, 1985a). Insofar as the figure of £500,000 is too low, the estimates in Table 6.21 will be underestimates.

The costs of asset sequestration

The costs of asset sequestration involve the costs of tracing drug traffickers' funds, the costs involved in the implementation of any requirements that bankers notify the authorities in the event of deposits over a certain value (cf. Home Affairs Committee, 1985a), and the costs involved in selling physical assets. Since any assets seized are to become state property, some of these costs (if not all) may be offset by the revenue accruing from sequestration operations, In this sense sequestration may be a less costly exercise than increasing prison sentences.

6.6 Summary

In 1984 there were 256 full-time equivalent police officers involved in drug enforcement work by regional crime squads in England and Wales and a further 596 in force drugs squads. The manpower deployment is increasing rapidly: the 1985 figure for drugs squads was 713, a 20% increase on the 1984 figure. A rough estimate suggests that another 60 FTE police officers may have beer

The question arises as to by how much illicit consumption ought to be reduced. In principle, it ought to be reduced until the point at which no further net gain can be achieved by further reduction. In other words, there will come a point when further reductions would involve gains to third parties which are smaller than the losses to drug misusers. To identify this point, however, requires a great deal of information, and one may have to be content with adoption of a target level of illicit consumption. Even if this approach is adopted, measurement of external costs and private costs and benefits is still important, since policy-makers need to ensure that the costs of enforcing the target level are smaller than the benefits society gains as a result of it being attained. There is, in other words, little economic sense in enforcing a target level of zero illicit drug consumption at a cost of £20m if the external costs are only £5m.

This raises two questions: (i) how ought private and external costs and private benefits to be valued? and (ii) what are their values? Each is discussed in turn.

7.2.1 Addiction and ignorance of health risks

In Chapter 2 it was seen that the valuation placed on private costs and benefits associated with illicit drug consumption depends crucially on the view taken on the issues of (i) ignorance of health risks and (ii) addiction. Regarding (i) the relevant questions would appear to be: are the health risks associated with drug misuse known? If not, what are the implications in terms of the valuation of the private costs and benefits of drug misuse and what action ought the government to take with regard to provision of information on health risks? Regarding (ii) the questions to be addressed are: how should addiction be characterised? What are the implications of different characterisations in terms of the valuation of the private costs and benefits of drug misuse?

In his discussion of the welfare economics of drug misuse, Culyer (1973) ignores the issues of ignorance of health risks and addiction. In their paper on public policy towards smoking, Littlechild and Wiseman (1984) take the view that smokers (and non-smokers) are aware of the health risks associated with tobacco and that addiction is not an issue, since "many scientists and governmental bodies have concluded that smoking is not addictive" (Littlechild and Wiseman, 1984, page 12).

Whether such arguments can be substantiated in the context of drugs such as heroin and cocaine is doubtful. Even if the risks of drug misuse are known in general, there is still a good deal of uncertainty surrounding 'product quality' and therefore the health risks associated with a particular purchase. Moreover, many argue that regular use of drugs such as cocaine and heroin can produce dependence—either physical or psychological or both—although Johnson (1978) argues that the addicting power of heroin is "vastly overrated".

The implications that recognition of ignorance of health risks and addiction have for the valuation of the private costs and benefits of drug misuse would seem, therefore, to be a subject which merits attention in future research.

7.2.2 Measurement of private and external costs and benefits of drug consumption

Chapter 2 outlined two alternatives to the formulation of drug control policies: (i) the welfare economics approach, involving an assessment of the 'socially optimal' level of illicit drug consumption based on assessments of the private and external costs and benefits and the costs of government intervention, and (ii) the pursuit of a predetermined target level of illicit drug consumption (possibly equal to zero). The disadvantage of the latter approach is that there is no assurance that the costs of attaining the target will be smaller than the benefits society gains as a result of it being attained. It was seen, however, that in circumstances where the socially optimal level of illicit drug consumption is zero, an estimate of the total external costs of drug misuse (at the privately optimal level of consumption) may be useful, in the sense that if the costs of attaining the target level exceed these costs, society would be better off not increasing resources to achieve the target of zero consumption.

Some research effort, therefore, would seem warranted in this area. If, on consideration of the issue of addiction, it is decided that it is highly probable that the socially optimal level of illicit drug consumption is indeed zero, a useful exercise might be a study estimating what the external costs would be in the absence of government intervention. Such a study would involve two stages: (i) an estimate of the total external costs of drug misuse at current levels of consumption and (ii) an estimate of how much illicit consumption would increase in the absence of control policies. The latter would involve estimating a demand function for the drug in question (cf. Section 7.4).

7.3 Economic parameters of UK illicit drug markets

Chapter 4 explored the principal economic dimensions of the UK illicit drug markets, namely quality (purity), prices and consumption. In each of the markets examined—heroin, cannabis and cocaine—substantial gaps were found in the available information.

7.3.1 Data on purity

The current system of recording the results of forensic analysis of police seizures of cocaine and heroin gives rise to a non-random sample of seizures. It would be more satisfactory if the results of forensic analyses of all police seizures were recorded on a systematic basis at one location, in a manner which made retrieval of the information for statistical analysis straightforward. This would involve the setting up of a computer databank, with a record of each seizure, indicating details such as (i) weight of seizure, (ii) purity, (iii) location of seizure, (iv) date seized and (v) agency/body making the seizure (e.g. Customs, police regional crime squad etc). Storage of data in this fashion would not only facilitate statistical analysis for research purposes, but would also facilitate statistical

analysis for intelligence purposes (e.g. to produce a listing of all seizures with a particular 'profile', indicating salient details).

7.3.2 **Data** on **prices**

The principal sources of information on prices are NDIU and HM Customs and Excise. These data have two major shortcomings:

(i) they relate generally to the retail level of the market and are therefore of no value in analysing the effects of seizures at import, distribution and wholesale levels;

(ii) they are not based on actual transactions and are therefore only a guide. In the case of the Customs data on heroin prices for the early 1980s, there is some evidence (cf. Chapter 4) that the range of prices quoted may have been too low and too narrow. In any case, it is quite possible for the range to be constant over time with wide fluctuations in the retail price within the range or vice versa.

It is important that more systematic data on prices be available, preferably at all levels of the market. Such data might be obtained either through fieldwork along the lines of Lewis *et al.* (1985), or through undercover purchases by drug enforcement agency officials. The work of Brown and Silverman (1974) and Silverman and Spruill (1977) was based on price data obtained via undercover purchases by United States narcotics agents. Following a purchase, the agent files a report, indicating the date, place and price paid. This information is then stored, along with the results from the forensic analysis. Price data accumulated in this way have the great advantage of being based entirely on actual purchases. It would seem potentially worthwhile, therefore, in the UK for details of prices of undercover purchases to be recorded, along with the results of forensic tests, in the same databank as the details of the results of forensic analyses of seizures (cf. Section 7.3.1).

7.3.3 Data on consumption

There is no reliable information available on the extent of drug misuse on a nationwide/population basis. The wide range of estimates of illicit heroin consumption reflect the uncertainty surrounding key parameters such as the discrepancy between the numbers of notified and unnotified addicts.

For cannabis and cocaine, the household survey method adopted in the United States by the National Institute of Drug Abuse is one possible way forward. Given the fact that the British Crime Survey is orientated towards offences against the law, this would not seem to be a sensible vehicle for investigating illicit drug usage patterns. An alternative might be the General Household Survey, which would have benefits in terms of providing the opportunity for econometric analyses of the demand for illicit drugs (cf. Section 7.4). If the

GHS were to be used, it would seem preferable for the questions on drug misuse to be asked using a confidential form completed by the respondents and returned by them in a sealed envelope—along the lines of the US National Survey on Drug Abuse. The questions ought to relate to regular use (e.g. in the last month) and non-regular use, as well as to dosages, so that sufficient detailed information is collected on which to base estimates of UK consumption.

In the case of heroin, it would seem imperative that further studies gathering information on the 'extent of misuse' along the lines of Hartnoll *et al.* (1985) be undertaken. If illicit heroin consumption is to be estimated at all accurately, then such studies need to be regularly replicated on a nationwide basis.

7.4 Costs **and benefits of drug enforcement** strategies

Suggestions for future research on the issue of the costs and benefits of drug enforcement work are discussed under three headings: (i) data, (ii) economic analysis for optimal input utilisation, and (iii) economic analysis for determining the optimal scale of enforcement activity.

7.4.1 Data

The quality of data on enforcement agencies' inputs and (intermediate) outputs needs to be improved if any systematic economic analysis is to be done in this field. On the input side, data are required on theagencies' input usage at each level of the market. Input usage needs to be recorded on a physical (e.g. manpower) and expenditure basis, separately for each item. Ideally, such information would be available on a quarterly basis. In the case of the police, it would be helpful to have the data available on a force and regional crime squad basis. In order to have better information on how much time preventive staff (i.e. uniformed police and Customs officers) devote to drugs work, it may be useful to set up small-scale pilot studies. In the case of the police, it may be that details recorded in officers' notebooks and daily diaries provide a useful source of information on time devoted to drugs work.

On the output side it is desirable to have the existing data on intermediate output — seizures, arrests, convictions, etc.—more readily available on alevel-of-market basis. At present all police data are grouped together, so that it is not possible to determine whether a seizure has been made by a regional crime squad or a local force drugs squad: it is clearly imperative to be able to do so if separate analyses are to be undertaken for each level of the market. It would be also useful to explore alternative measures of intermediate output which may-overcome some of the deficiencies of existing measures. HM Customs (1986), for example, reported that 70 drug 'organisations' were believed to have been smashed during 1985. Indicators such as this, even if constituting relatively 'soft data', may be useful as supplementary indicators of intermediate output.

The enforcement agencies themselves could play an important role in the development of alternative 'performance indicators', since they are in the best position to appreciate the practical shortcomings of the various measures available.

Ideally all data on enforcement agencies' input utilisation and intermediate outputs would be recorded in a national databank in a manner which makes extraction of the data for statistical analysis straightforward (cf. Sections 7.3.1 and 7.3.2).

7.4.2 Economic analysis for optimal input utilisation

Cost-effectiveness analysis

Chapters 5 and 6 discussed the use of cost-effectiveness indices (CEIs) as a means of assessing changes in performance over time. Cost-effectiveness analysis is used mainly, however, to assess the least costly way of achieving a given objective (cf. e.g. Lind and Lipsky, 1971). It might be used, for example, to determine whether it is more cost-effective to 'buy into' drug organisations or to use the more traditional method of surveillance. Such an analysis would have to examine alternative measures of output carefully, for example, it might be useful to weight the data to take account of the size and nature of the organisations destroyed. The result of the cost-effectiveness analysis would be expressed in terms of 'cost per (weighted) organisation destroyed'. This cost-effectiveness index could be used to compare a variety of alternative enforcement approaches and select the one with the lowest CEI (i.e. smallest cost per unit of desired output).

Production function analysis

Chapters 5 and 6 also discussed how production function analysis might be used to ensure an efficient utilisation of inputs. Such an analysis might be used to explore issues such as: should Customs be spending a greater proportion of their budget on intelligence work and less on uniformed preventive staff? Should the police be devoting more of their resources to forensic analysis ('profiling', for example)?

Production function analyses of enforcement activity would be orientated firmly towards the cost-minimisation problem, so that measures of intermediate—rather than final—output would be the relevant output measure. Such analyses would proceed in the spirit of, for example, Feldstein (1967). Given the results of the analysis the cost-minimising input combinations could be calculated and compared with the existing combinations. It would then be possible to suggest that the number of man-hours devoted to, say, static Customs controls be reduced and the number devoted to, say, mobile Customs controls be increased or vice versa.

7.4.3 Economic analysis for determining the optimal scale of enforcement activity

The types of question of interest here are: should more be spent on drug enforcement at import level and less on drug enforcement at retail level? Should more be spent on enforcement at the distribution level and less on enforcement at wholesale level? In short, what is the mix of enforcement activity at each level of the market which brings the greatest benefit to society in terms of reductions in illicit drug consumption?

A variety of different types of study are of potential value in addressing this issue. These include (a) econometric analyses of the demand for illicit drugs, (b) econometric models of the illicit drugs market and (c) models of dealer behaviour.

(a) The demand for illicit drugs

In Chapter 3 it was seen that the effectiveness of supply-side enforcement measures is likely to depend crucially on the elasticity of demand for illicit drugs with respect to the drug's own price and the prices of other drugs. If the (own) price elasticity is close to zero—so that any price change will leave demand unaffected — supply-side enforcement measures will not reduce demand, but will merely serve to drive up expenditure on the drugs and probably also crime by addicts. If the cross-price elasticity is high and positive, intensified supply side enforcement aimed at one drug will shift the demand curves for other drugs in such a way that the demand will be greater at each price. This appears to be what happened in the United States: cocaine demand seems to have been stimulated by drug enforcement measures aimed at heroin dealers.

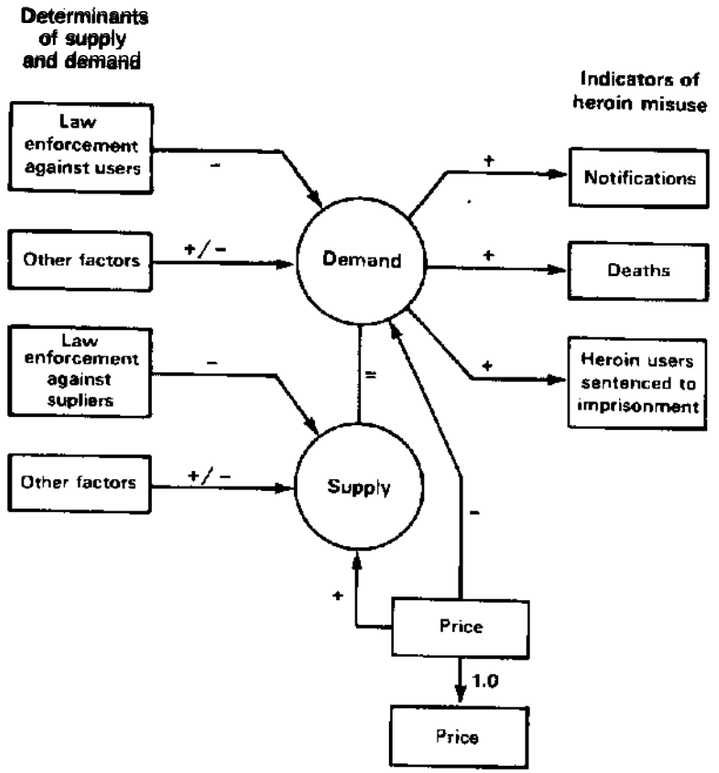
Some research effort might, therefore, profitably be aimed at the estimation of price elasticities. If regular information on the number of drug misusers, and the amounts of different illicit drugs used were collected, and if more systematic data on retail prices at a regional level become available, the two sets of data might be spliced together to arrive at a large-scale, individual-level data set, which could be used as a basis for estimating demand functions. Such analyses would need to have sound theoretical foundations—incorporating notions of habit formation, for example (cf. Philips, 1974)—and might draw on recent theoretical developments in the economics of addiction (cf. e.g. Jones, 1986).

Econometric studies of the demand for illicit drugs would generate information not only on price elasticities, but also on the responsiveness of demand to other variables of relevance for public policy—e.g. income elasticities, the effects of education (health-specific and general).

(b) Models of illicit drug markets

An econometric study along the lines of Brown and Silverman (1974) and Silverman and Spruill (1977) is likely to yield a number of insights into the effects

Figure 7.1
Simple latent variable model of illicit heroin market



of enforcement activity on levels of illicit drug consumption. Such a study would involve constructing a model incorporating both sides of the market—i.e. supply and demand—and would aim to isolate the effects of different policy measures e.g. enforcement, health education.

A major problem in trying to develop econometric models of illicit drug markets is that the actual quantity of drugs consumed is unobserved. Brown and Silverman (1974) were forced, as a result, to estimate what are known as 'reduced-form' coefficients. The price elasticities of demand and supply and the effects of drug enforcement measures on supply cannot, however, be recovered from these estimates (cf. Appendix 2). A more promising approach would be to use latent variable (LV) methods (cf. Joreskog and Sorbom, 1981). This involves treating illicit drug consumption as an unobservable (or latent)

variable and relating it to indicators of consumption, such as the number of convictions for unlawful possession.

A formal discussion of the potential for LV methods in the econometric analysis of illicit drugs markets appears in Appendix 2. An intuitive idea of the approach can be gleaned from Figure 7.1, which illustrates a simple LV model of the illicit heroin market. In the centre of the diagram are the two unobservable (or latent) variables, supply and demand. These are assumed to be equal to one another—i.e. the market is in equilibrium (cf. Chapter 3). Both supply and demand are dependent on price: demand is inverseiy related to price (hence the negative sign on the arrow pointing from price to demand) and supply is positively related to price. Demand also depends (inversely) on law enforcement (LE) against users and on other factors. Supply depends on LE against dealers and on other factors. Although actual illicit heroin consumption (i.e. the quantity of heroin supplied and demanded) is unobservable, indicators are available—e.g. the number of notified addicts, deaths of addicts and the number of convictions for unlawful possession. Using the information on indicators and determinants of supply and demand, it ought to be possible to estimate the parameters of interest, such as the price elasticity of demand, the responsiveness of supply to enforcement measures and so on.

Such a model could be estimated on a 'pooled' sample of cross-section and time-series data, by using, say, quarterly data over several years for several different cities. This would require data on: (i) various indicators of illicit drug consumption, (ii) the determinants of supply and demand (including law enforcement expenditure at each level of the market, for each city, for each period), and (iii) data on street prices for each city for each period. The various issues to be borne in mind when estimating models on a pooling of cross-section and time-series data are discussed in Judge *et al.* (1980) and the specific problems arising in LV models in Joreskog and Sorbom (1977).

(c) Models of trafficker and dealer behaviour

In Chapters 5 and 6 it was seen that a major impediment to generating more precise predictions of the effects of intensified enforcement activity on street prices is the lack of information on the economic behaviour of drug traffickers and on the conditions under which they operate. Economic theory provides a variety of models of entrepreneurial behaviour, differing in part on the assumptions made concerning the objectives of business enterprises and in part on the assumptions made about the structure of the market in which enterprises operate (cf. e.g. Sawyer, 1979). The major problem likely to arise in pursuing this line of enquiry would be data availability. Enforcement agencies may, however, be able to generate such data from their extensive surveillance work on drug traffickers and, as Polich *et al.* (1984) suggest, data might be gathered from court records, case files and interviews with imprisoned drug traffickers. This avenue may, therefore, be one worth pursuing.

7.5 Summary of proposals

The proposals above may be summarised under two headings: (i) data and (ii) analysis.

(i) Data

More systematic data on the prices and purity of illicit drugs at each level of the market are required. Undercover purchases by enforcement officers would seem a potentially useful method of generating such data. The results of forensic analysis of all police and Customs seizures and undercover purchases could be recorded on one databank, indicating (a) purity, (b) weight, (c) location of seizure/purchase, (d) enforcement agency involved.

More reliable data on illicit drug consumption are needed. Studies of the prevalence of misuse would seem worth replicating on a national basis and at regular intervals. Consideration should be given to the feasibility of using existing household surveys to collect information on the extent of usage of drugs such as cocaine, cannabis and amphetamines.

Data on input utilisation and expenditure by drug enforcement agencies would have to be improved upon before any economic analysis could be undertaken. These data would ideally (a) be itemised on an expenditure and physical unit (e.g. manpower) basis, (b) be available for each level of the market (i.e. available separately for police regional crime squads, local force drugs squads etc.) and (c) be available on a regular (e.g. quarterly) basis.

Data on intermediate outputs—such as convictions for drug offences, seizures etc.—need to be available separately for each level of the market. Development of alternative, 'soft' 'performance indicators'—such as numbers of illicit drug organisations 'smashed'—would seem worthwhile. Ideally data on input utilisation and outputs would be stored on the same databank as the information on purity and price.

(ii) Analysis

The top priority here must be the construction of an econometric model of the illicit drug market, designed to provide information on the effects on consumption of changes in expenditure on enforcement at each level of the market. Latent variable methods might be used to overcome the unobservability of illicit drug consumption and the data might be based on a time series of observations on e.g. prices, enforcement expenditure etc. for a number of different cities. Production function analysis might be used to explore the efficient resource deployment within an enforcement agency. It could be used to address questions such as: should Customs be spending more man-hours on

intelligence work and less on 'routine control' duties? Cost-effectiveness analysis could be used to explore a variety of enforcement options. Demand studies using data on the prevalence of drug misuse would provide useful information on the responsiveness of demand to changes in price of a drug and the prices of other drugs. A study estimating the external costs of drug misuse might be helpful in ensuring that the cost of reducing illicit drug consumption does not exceed the cost of the benefits society stands to gain. Finally, analyses of traffickers' behaviour would be useful in helping to predict the effects of intensified enforcement activity.

Appendix 1: Expenditure by HM Customs on Drug Enforcement

The manpower figures in Table 5.1 are converted into expenditure at 1985 factor cost the appropriate expenditure per person figure for 1985. Table A1.1 gives total numbers, total expenditure and expenditure per person for each of the items in Table 5.1 for 1985. The figures for drugs-specific expenditure in Table 5.2 also include various other costs (see note (b) to Table 5.2). The figure of £7.90m drugs-specific expenditure in 1979, for example, is arrived at as indicated in Table A1.2. The figure of £33,782 per Specialist Investigator p.a. includes expenditure associated with Investigators (salaries etc.) and expenditure associated with their support staff. The ratio of Specialist Investigators to support staff is roughly 7:1 (Table A1.3). The expenditure per Investigator is therefore £31»214 + (l/7)x£l7,973 = £33,782.

Table A1.1
Expenditure on drug enforcement by Customs **on per person** basis, **1985**

	Number	*Total expenditure (£'000)*	*Expenditure per person (£)*
1. Specialist Investigators	262	8,178	31,214
2. Outfield Station fraud	24	555	23,125
3. Collection Investigation units	60	1,170	19,500
4. Support staff	119	2,815	23,655
5. Other	426	8,472	19,887
6. Preventive staff	2,621	51,122	19,505

Source: See notes for Table 5.1 for explanations.

Table A1.2
Derivation of 1979 drugs-specific expenditure figure in Table 5.2

1. Expenditure associated with items in Table 5.1:	
(i) Specialist Investigators : 121[a] @ £31,214[b]	= £3.78m
(ii) Outfield Station fraud : 20[a] @ £23,125[b]	= £0.46m
(iii) Support staff : 58[a] @ £23,655[b]	= £1.37m
Sub-total	= £5.61m
2. Other expenditure on drugs work:	
Expenditure:	= £2.29m
Total drugs-specific expenditure	= £7.90m

[a]From Table 5.1.
[b]From Table A1.1.
[c]Source: HM Customs and Excise.

Table A1.3
HM Customs Investigation Division—expenditure on drug enforcement, 1985

	Numbers (FTEs)[a]	*Expenditure per person (£)*[b]
Specialist Investigators	262	31,214
Support staff	37[c]	17,973
Ratio of Specialist Investigators to support staff	7:1	

[a]Full-time equivalents.
[b]From Table A1.1.
[c]Figure supplied by HM Customs and Excise.

Appendix 2: The Use of Latent Variable Methods to Estimate Econometric Models of Illicit Drug Markets

The potential for latent variable (LV), methods in the econometric analysis of illicit drugs markets can be illustrated best with a simple example.

Consider the following model of an illicit drug market.

$$S: \eta_1 = \beta_{12}\eta_2 + \gamma_{11} + \gamma_{12\times 2} + \zeta_1 \tag{1a}$$

$$D: \eta_2 = \beta_{22}\eta_2 + \gamma_{21} + \gamma_{22\times 2} + \zeta_2 \tag{1b}$$

where η_1 denotes quantity demanded and quantity supplied (assumed to be equal), η_2 price, x_2 an exogenous variable (e.g. law enforcement), the β's and γ's parameters and the ζ's error terms. (1a) is therefore the supply function and (1b) the demand function. The model can be written in matrix notation as

$$\underline{\eta} = \Gamma \underline{x} + \underline{\zeta} \tag{2}$$

where

$$B = \begin{bmatrix} 1 & -\beta_{12} \\ 1 & -\beta_{22} \end{bmatrix}, \qquad \Gamma = \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix}$$

and $\underline{\eta} = [\eta_1\ \eta_2]'$, $\underline{x} = [1\ x_2]'$ and $\underline{\zeta} = [\zeta_1\ \zeta_2]'$.

The reduced-form equations for the model are

$$\eta_1 = \pi_{11} + \pi_{12}x_1 + \gamma_1 \tag{3a}$$

$$\eta_2 = \pi_{11} + \pi_{12}x_2 + \gamma_1 \tag{3b}$$

where

$$\pi_{11}=\frac{\beta_{12}\gamma_{12}-\beta_{22}\gamma_{11}}{\beta_{12}-\beta_{22}}$$

$$\pi_{21}=\frac{\gamma_{12}-\gamma_{22}}{\beta_{12}-\beta_{22}}$$

$$\pi_{12}=\frac{\beta_{12}\gamma_{22}-\beta_{22}\gamma_{12}}{\beta_{12}-\beta_{22}}$$

$$\pi_{22}=\frac{\gamma_{22}-\gamma_{12}}{\beta_{12}-\beta_{22}}$$

The reduced-form (3) can be written in matrix notation

$$\underset{\sim}{\eta}=\Pi\underset{\sim}{x}+\underset{\sim}{\nu} \tag{4}$$

where

$$\Pi=\begin{bmatrix}\pi_{11}\ \pi_{12}\\ \pi_{21}\ \pi_{22}\end{bmatrix}$$

and $\underset{\sim}{\gamma}=[\gamma_1\ .\ \gamma_2]'$.

When η_1 and η_2 are observable variables, simultaneous equation methods can be employed to estimate the parameters of (1a) and (1b), provided sufficient identifying restrictions are placed on B and Π. One might, for example, set $\gamma_{11}=\gamma_{22}=0$ (cf. e.g. Harvey, 1981). If η_1 is not observed—as is the case in the illicit drug market—standard simultaneous equation techniques cannot provide estimates of the model's structural parameters. The method adopted by Brown and Silverman (1974) was to estimate the reduced-form equation (3b). If one is working with the restrictions $\gamma_{11}=\gamma_{22}=0$, one has

$$\pi_{21}=\gamma_{21}/(\beta_{12}-\beta_{22})\quad \pi_{22}=-\gamma_{12}/(\beta_{12}-\beta_{22})$$

Clearly, there is no way of working backwards to estimates of γ_{12}, γ_{21}, β_{12} and β_{22} from estimates of π_{21} and π_{22}. One cannot, in other words, arrive at estimates of the price elasticity of demand, the price elasticity of supply and the responsiveness of supply to drug enforcement measures using this approach.

An alternative is to treat η_1 as a latent variable in a LV model (cf. e.g. Joreskog, 1982). This requires that one find a set of *indicators* of drug consumption—for example, the number of notified addicts, the number of admissions to

treatment and rehabilitation centres etc. Suppose that three such indicators are available, y_1, y_2 and y_3, and that these are related to η_1 in a linear fashion:

$$y_1=\lambda_{11}\eta_1+\epsilon_1 \tag{5a}$$

$$y_2=\lambda_{12}\eta_1+\epsilon_2 \tag{5b}$$

$$y_3=\lambda_{13}\eta_1+\epsilon_3 \tag{5c}$$

where the λ's are parameters and the ϵ's error terms. In the terminology of Joreskog (1982), (2) is the *structural equation model*, and (5) the *measurement model*. In fact, to complete the measurement model, it is necessary to indicate that η_2 is an observed variable. This is done by introducing another y variable, y_4, and letting η_2 and y_4 be identically equal. The measurement model can thus be written

$$\underset{\sim}{y}=\Lambda_y\underset{\sim}{\eta}+\underset{\sim}{\epsilon} \tag{6}$$

where

$$\Lambda_y=\begin{bmatrix}\lambda_{11} & 0\\ \lambda_{12} & 0\\ \lambda_{13} & 0\\ 0 & 1\end{bmatrix}$$

and $\underset{\sim}{y}=[y_1\,y_2\,y_3\,y_4]'$ and $\underset{\sim}{\epsilon}=[\epsilon_1\,\epsilon_2\,\epsilon_3\,0]'$.

Providing sufficient identifying restrictions are imposed on B and Π (cf. e.g. Robinson, 1974), one can use a variety of methods to estimate the model's structural parameters (Joreskog and Sorbom, 1981). The model (1) is only an illustrative example. More complex models might involve more x variables and/or effects of x variables on y variables (eg, numbers of treatment centres influencing admissions). The latter type of complication would be taken into account by introducing a further η variable in (2) and modifying (6) appropriately.

References

Ashton, H. and R. Stepnery. (1982). *Smoking-Psychology and Pharmacology,* London: Tavistock.

Atha, M. J. (1982). *Epidemiological Aspects of Cannabis Use in Britain.* Unpublished extended essay, Department of Psychology, University of Sheffield.

Atha, M. J. (1985). *Quantitative assessment of cannabis use patterns amongst regular users.* Paper presented to November 1985 meeting of Society for the Study of Addiction, London.

Atha, M. J. and S. Blanchard. (1985). *Cannabis use in Britain.* Appendix to Malyon (1985).

Atkinson, A. B. & Meade, T. £. (1974). Methods and preliminary findings in assessing the economic and health service consequences of smoking, with particular reference to lung cancer, *Journal of the Royal Statistical Society Series A,* 137, pp.297-311.

Bernard, G. (1983). 'An economic analysis of the illicit drug market'. *International Journal of the Addictions,* 18(5): 681-700.

Blair, R. D. and R. J. Vogel. (1973). 'Heroin addiction and urban crime'. *Public Finance Quarterly,* 1(4): 457-67.

Brown, G. F. and L. P. Silverman. (1974). 'The retail price of heroin: estimation and applications'. *Journal of American Statistical Association,* 69(347): 595-606.

Burrows, P. (1974). 'Pricing versus regulation for environmental protection'. **In** A. *5. CuLyeT(ed.) Economic Policies and Social Goals,* London: Martin Robertson.

Chartered Institute of Public Finance and Accountancy. (1985). *Police Statistics 1984-85: Actuals.* London: CIPFA.

Culyer, A. J. (1973). 'Should social policy concern itself with drug abuse?' *Public Finance Quarterly,* 1(4): 449-56.

Department of Health and Social Security. (1985). 'Memorandum to House of Lords Select Committee on the European Community'. *Co-operation at Community Level on Health-Related Problems.* London: HMSO.

Ditton, J. and K. Speirits. (1982). *The rapid increase of heroin-addiction in Glasgow during 1981.* Mimeo: Department of Sociology, University of Glasgow.

Drummond, M. F. (1980). *Principles of Economic Appraisal in Health Care.* Oxford: Oxford University Press.

Eatherly, B. J. (1974). 'Drug-law enforcement: should we arrest pushers or users?' *Journal of Political Economy,* 82(1): 210-14.

Feldstein.M. S. (1963). Review of B. A. Weisbrod's'The Economics of Public Health: Measuring the Economic Impact of Diseases'. *Economic Journal,* 73(289): 129-30.

Feldstein, M. S. (1967). *Economic Analysis for Health Service Efficiency.* Amsterdam: North-Holland.

Fuchs, V. R. (1982). 'Time preference and health; an exploratory study'. In V. R. Fuchs (ed.) *Economic Aspects of Health.* New York: NBER.

Godfrey, C. and M. Powell. (1986). *The confusion of economic costs: estimates of the cost of alcohol and tobacco consumption and their relation to Government preventive health policy.* Paper presented to January 1986 Meeting of Health Economists Study Group, University of York.

Gravelle, H. and R. Rees. (1981). *Microeconomics.* London: Longman.

HM Customs **and** Excise. (1986). *Press Notice No. 1067.*

HM Government. (1983). *Report to the United Nations on the Working of the International Treaties on Narcotics Drugs and Psychotropic Substances in the United Kingdom.*

HM Government. (1984). *Report to the United Nations on the Working of the International Treaties on Narcotics Drugs and Psychotropic Substances in the United Kingdom.*

Hartnoll, R. and R. Lewis. (1984). *The illicit heroin market in Britain: Towards a preliminary estimate of national demand.* Mimeo: Drugs Indicators Project, University College Hospital, London.

HartnoII, R., R. Lewis, M. Mitcheson and S. Bryer. (1985). 'Estimating the prevalence of opioid dependence'. *The Lancet,* January 26, 203-5.

Harvey, A. C. (1981). *The Econometric Analysis of Time Series.* Oxford: Philip Allan.

HoJahan, J. (1972). 'The economics of heroin'. In *Dealing with Drug Abuse: A Report to the Ford Foundation.* New York: Praeger.

Holahan, J. (1973). 'The economics of control of the illegal supply of heroin'. *Public Finance Quarterly,* 1(4): 467-77.

Home Affairs Committee. (1985a). *Misuse of Hard Drugs (Interim Report),* London: HMSO.

Home Affairs Committee. (1985b). *Minutes of Evidence: HM Customs and Excise.* London: HMSO.

Home Office. (1984). *Prevention: Report of the Advisory Council on the Misuse of Drugs.* London: HMSO.

Home Office. (1985a). *Tackling Drug Misuse: A Summary of the Government's Strategy.* London: HMSO.

Home Office. (1985b). *Statistical Bulletin: Statistics on the misuse of drugs in the United Kingdom and Supplementary Tables, 1984.*

Johnson, B. D. (1978). 'Once an addict, seldom an addict'. *Contemporary Drug Problems.* Spring: 35-54.

Jones, A. (1986). *The economics of addiction: a dual approach.* Paper presented to January 1986 meeting of Health Economists Study Group, University of York.

Jones-Lee, M. W., M. Ham merlon and P. R. Philips. (1985). 'The value of safety: results of a national sample survey'. *Economic Journal,* 95(377): 49-72.

Joreskog, K. G. (1982). 'The **LISREL** approach to causal model-building on the social sciences'. In. K. G. Joreskog and H. Wold (eds.) *Systems Under Indirect Observation: Causality, Structure, Prediction.* Amsterdam: North-Holland.

Joreskog, K. G. and D. Sorbom. (1977). 'Statistical model for analysis of longitudinal data'. In D. J. Aigner and A. S. Goldberger (eds.) *Latent Variable Methods in Socioeconomic Models.* Amsterdam: North-Holland.

Joreskog, K. G. and D. Sorbom. (1981). *LISREL: Analysis of Linear Structural Relationships by the Method of Maximum Likelihood— User's Guide.* Chicago: International Educational Services.

Judge, G. C, R. Griffiths, R. C. Hill and T-C. Lee. (1980). *The Theory and Practice of Econometrics.* New York: Wiley.

Koch, J. V. and S. E. Grupp. (1971). 'The economics of drug control policies'. *International Journal of the Addictions,* 6(4): 571-84.

Koch, J. V. and S. E. Grupp. (1973). Police and illicit drug markets: some economic considerations. *British Journal of Addiction,* 68, 351-62.

Levin, G., E. B. Roberts and G. B. Hirsch. (1975). *The Persistent Poppy: A Computer-Aided Search for Heroin Policy.* Cambridge Mass.: Ballinger.

Lewis, R. (1985). 'Serious business—The global heroin economy'. In A. Henman, R. Lewis and T. Malyon (eds.) *Big Deal: The Politics of the Illicit Drug Business.* London: Pluto.

Lewis, **R., R. Hartnoll, S. Bryer, E. Daviaud and M. Mitcheson.** (1985). 'Scoring Smack: the illicit heroin market in London'. *British Journal of Addiction,* 80: 281-290.

Lind, R. C. and J. P. Lipsky. (1971). Measurement of police output: conceptual issues and alternative approaches. *Law and Contemporary Problems* 36(4): 566-88.

Little, A. D., **Inc.** (1967). *Drug Abuse and Law Enforcement; A Report to the President's Commission on Law Enforcement and Administration of Justice.* Washington DC: Arthur D. Little Inc.

McDonnell, R. and A. Maynard. (1985). 'The costs of alcohol misuse'. *British Journal of Addiction.* 80: 27-35.

Malyon, T. (1985). 'Love seeds and cash crops—the cannabis commodity market*. In A. Henman, R. Lewis and T. Malyon (eds.) *Big Deal: The Politics of the Illicit Drug Business.* London: Pluto.

Mooney, G. **H., E. M. Russell and R. D. Weir.** (1980). *Choices For Health Care.* London: Macmillan.

Moore, M, H. (1972). 'Policies to achieve discrimination on the effective price of heroin'. *American Economic Review,* 63(2): 270-77.

Mott, J. (1985). 'Self-reported cannabis use in Great Britain in 1981'. *British Journal of Addiction,* 80: 37-43.

Mullen, F. M. (1984). *Speech to the Fourteenth Annual Legislative Weekend of the Congressional Black Caucous Foundation Inc.*

Phares, D. (1975). 'Heroin and society: an economist's perspective on public policy'. In R. L. Rachin and E. H. Czajkoski (eds.) *Drug Abuse Control: Administration and Politics.* London: Lexington.

Phlips, L. (1974). *Applied Consumption Analysis.* Amsterdam: North-Holland.

Plant, M. A., D. F. Peck and R. Stuart. (1984). 'The correlates of serious alcohol-related consequences and illicit drug use amongst a cohort of Scottish Teenagers'. *British Journal of Addiction,* 79(2): 197-200.

Plant, M. A., D. F. Peck and E. Samuel. (1985). *Alcohol, Drugs and School-Leavers.* London: Tavistock.

Polich, J. M., P. L. Ellickson, P. Reuter and J. P. Kalion. (1984). *Strategies for Controlling Adolescent Drug Use,* Santa Monica: Rand Corporation R-3O76-CHF.

Pyle, D. J. (1983). *The Economics of Crime and Law Enforcement.* London: Macmillan.

Robinson, P. M. (1974). 'Identification, estimation and large-sample theory for regressions containing unobservable variables'. *International Economic Review,* 15: 680-92.

Rottenburg, S. (1968). 'The clandestine distribution of heroin, its discovery and suppression', *Journal of Political Economy.* 76(1): 78-90.

Sawyer, M. C. (1979). *Theories of the Firm.* London: Weidenfeld and Nicolson.

Silverman, **L. P. and** N. **L, Spruill.** (1977). 'Urban crime and the price of heroin'. *Journal of Urban Economics,* 4: 80-103.

Society of Civil and Public Servants. (1985). *United Kingdom — Open House for Smugglers,* London: CPSA.

Stigler, G. J. (1970). 'The optimal enforcement of laws'. *Journal of Political Economy,* 78(3): 526-36.

Slimson, G. (1985). 'Can a war on drugs succeed?' *New Society,* November 15.

Sugden, R. and A. Williams. (1978). *The Principles of Practical Cost Benefit Analysis.* Oxford: Oxford University Press.

Weisbrod, B. A. (1961). *The Economics of Public Health: Measuring the Economic Impact of Diseases.* Philadelphia: University of Philadelphia Press.

White, M. D. and W. A. Luksetich. (1983). 'Heroin: price elasticity and enforcement strategies'. *Economic Inquiry,* 21: 557-564.

Williams, A. (1967). *Output budgeting and the contribution of microeconomics to efficiency in government.* CAS Occasional Paper No. 4, Civil Service Department, London: HMSO.

Young, T. (1982). 'Addiction asymmetry and the demand for coffee'. *Scottish Journal of Political Economy,* 29(1): 89-98.