# What Price Drug Use? The Contribution of Economics to an Evidence-Based Drugs Policy

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## Abstract

This paper presents a review of the recent economics literature in the area of illicit drug use. Particular attention is paid to the economics of addiction and the rational addiction model, the welfare economics framework for analysing the social costs of drug use, and the attempts that have been made by economists to evaluate recent or proposed policy interventions. A dominant theme in this review is the problem of poor data availability. This is particularly true when it comes to implementing the Rational Addiction model, but it is also apparent in the literature on estimating the costs of illicit drug use to society as a whole. One of the main conclusions of this review is that until recently public policy has not been particularly influenced by research carried out by economists. It is not clear whether this is because economists have had to grapple with inadequate data, and hence their conclusions are couched in uncertainty, or whether it is because drugs researchers have assumed a very limited role for economists in their analysis.

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# 1. Introduction

The purpose of this paper is to provide an overview of the literature that has considered illicit drug use from an economics perspective. The importance of this type of review cannot be overemphasised. In a recent editorial of the journal Drug and Alcohol Review, John Bridges of the National Bureau of Economic Research expressed serious concern over the reluctance of drug researchers and policy makers to incorporate economics into drug research. He concluded that:

> … Unless illicit drug researchers and policy makers allow advances in the understanding of the economics of illicit drugs to better inform research and policy, prospects for developing more effective responses are dismal. (Bridges, 1999, p.252).

Quite why this concern should arise will become apparent as we proceed, although it is worth noting that in the US, it has been argued that drugs policy is formulated with very little regard to any research, irrespective of discipline (Reuter, 2001).

Illicit drug use, by definition, is a covert activity and as such is not well understood, although its consequences are easily observed and attract considerable media and government attention. Indeed, recent governments have placed a high priority on addressing drugs issues, with the current administration appointing a senior civil servant (the so-called 'Drugs Tsar') to oversee the implementation of a ten-year plan to tackle drug misuse (Home Office, 1998). It should be noted, however, that policies aimed at tackling drugs misuse are likely to be difficult to implement and evaluate if the understanding of how illicit drugs markets operate is limited. For example, if policies are designed to restrict supply and hence increase the street price for drugs, this will only be desirable if policy makers are aware of the price sensitivity of demand. Unfortunately, until recently the study of the economics of illicit drugs markets has been characterised by a literature that has an understandable imbalance between empirical and theoretical (or hypothetical) contributions. This imbalance is understandable because the nature of illicit drugs markets makes the collection of reliable data difficult. Having said this, in the absence of reliable data, some important theoretical advances into our understanding of drug addiction have been made. In particular, economists have sought to rationalise addiction in the sense that it represents individually optimal behaviour that conforms to the classical notion of utility maximisation. The theory of Rational Addiction (Becker and Murphy, 1988)

represents the most significant theoretical contribution in this respect, and it has heavily influenced the empirical work that has followed. We will consider this contribution in more detail in Section 2.

Fortunately, in the last two decades suitable data have become available that allow researchers to consider some of the issues that have been thrown up by the theoretical literature. Typically there are two areas that receive attention. Firstly, a number of attempts have been made to quantify some of the social costs of illicit drug use, particularly productivity effects and the relationship between drug use and crime, although, as we will see later, the extent to which this has been successful in influencing policy is debatable. Secondly, a considerable proportion of the literature has focussed on the demand for illicit drugs and how sensitive it is to price changes. In this respect, researchers have also tried to determine the relationship between legal drug use (alcohol and tobacco) and illicit drug use, and how changes in the price of the former may affect the demand for the latter. However, all this research must come with a health warning. Illicit drug use remains covert, and much of the data are from self-completion surveys or are derived.

This paper proceeds as follows. In the next section we consider the economics of addiction, paying particular attention to the theory of Rational Addition, and how it has been implemented empirically. We show that the Rational Addiction model is a particularly important contribution to the literature as it challenges the view that drug users are myopic, irrational, and insensitive to changes in price. However, we also consider some theoretical extensions to the basic Rational Addiction framework, and try to determine whether there is any evidence to cast doubt on the assumptions that drive the model. Following this discussion, in Section 3 we explore the welfare economics literature to see what it can offer in terms of analysing the social costs of drug abuse. We start by presenting the basic framework for analysis, which considers the possible divergence between the private costs faced by drug users in making their consumption decisions and the social costs that may arise as a consequence of this consumption. We consider each possible cause of this divergence and determine whether there is any support in the literature for these concerns. Following this discussion of the welfare economics framework, we briefly turn our attention to the general policy debate (i.e. whether psychoactive drugs ought to be prohibited or regulated). We conclude the paper by scrutinising current drugs policies and the contribution of economics to the formulation and evaluation of these interventions. In particular, we consider the merits of supply-side and demand-side policies in reducing drug consumption, and whether there is any evidence that changes in drugs prices have a noticeable effect on consumer demand. We

finish the paper by summarising the main contributions that emerge from the economics literature.

## 2. The Economics of Addiction

Any analysis of illicit drugs ultimately requires some reflection on the nature of addiction, particularly harmful addiction. Although it is argued that certain drugs are not associated with addiction (e.g. cannabis is often claimed to be non-addictive in a physical sense), the consumption of psychoactive drugs is generally considered to represent addictive behaviour. In economics, a good is typically defined as addictive if an increase in the stock of past consumption results in an increase in current consumption, ceteris paribus (Becker et al., 1994). The primary concern for economists is whether or not the consumption of addictive goods represents individually optimal behaviour, or whether addicted people behave irrationally. The latter argument was seriously questioned by the publication of Becker and Murphy's (1988) theory of Rational Addiction, which built upon a model of addiction introduced by Stigler and Becker (1977).

### 2.1 Rational Addiction

In the Rational Addiction model, addicted individuals are shown to exhibit consistent, forward-looking and individually optimal behaviour. The Rational Addiction model has been widely discussed since its publication, and in this section we provide a brief exposition of the theory (for more detailed discussions see Grossman et al., 1998a; Neri and Heather, 1995; and Stevenson, 1994b, and for a reinterpretation of the model see Ferguson, 2000).[1] The Becker-Murphy theory of Rational Addiction proceeds as follows. Individuals can consume two types of good: one that is addictive (c) and a composite of non-addictive goods (y). Utility at time t, u(t), is assumed to be dependent on current consumption of the addictive good, c(t), and non-addictive goods, y(t), plus a measure of previous addictive consumption, called the stock of consumption capital (S). The stock of consumption capital captures the process of learning about the effects of the addictive goods through previous consumption experience (e.g. the relief from stress or simple escape from reality gained through consuming 'mind-altering'

[1] Also, for a more general discussion of the economics of habit formation and addiction see Messinis (1999) and Becker (1992); and for an overview of both economic and other approaches to addiction see Buck et al. (1996) and Montoya and Atkinson (2000).

drugs), plus previous life experiences. This stock enters the utility function as it affects the satisfaction derived from current consumption. Written formally, utility at time t is given by:

$$u(t) = u[y(t), c(t), S(t)]. \quad [2] \tag{1}$$

The stock of consumption capital or 'addictive stock' is treated as a simple investment function, which depreciates at a rate $d$ (which represents the depletion of the physical and mental effects of past consumption). The rate of change of this addictive stock is given by:

$$\dot{S}(t) = c(t) - dS(t). \tag{2}$$

If individuals live for length of life T, and have a constant rate of time preference, $s$, then an individual's discounted life-time utility is given by:

$$U(t) = \int_0^T e^{-st} u[y(t), c(t), S(t)]dt \tag{3}$$

which, according to rational choice theory, an individual will maximise subject to an expenditure constraint and the investment constraint (2). The expenditure constraint is a function of wealth at time t, the interest rate in a perfectly competitive capital market, the price of the addictive good (the price of the composite good, y, is normalised to 1), and the income per period. In addition to these two constraints, it is assumed that consumption of c in period t is non-negative, and that wealth in the following period must be positive.

The final part of the model is to relate this rational choice of utility maximisation to addictive behaviour. Two important aspects of addictive behaviour are considered, both of which relate to the consumption capital stock. Firstly, it is assumed that harmful addiction is characterised by the physiological property of tolerance: "given levels of consumption are less satisfying when past consumption has been greater" (Becker and Murphy, 1988, p. 682). In other words, the more an individual has consumed in period t-1, the lower the marginal utility of consumption in period t (i.e. higher levels of consumption are required to yield the same

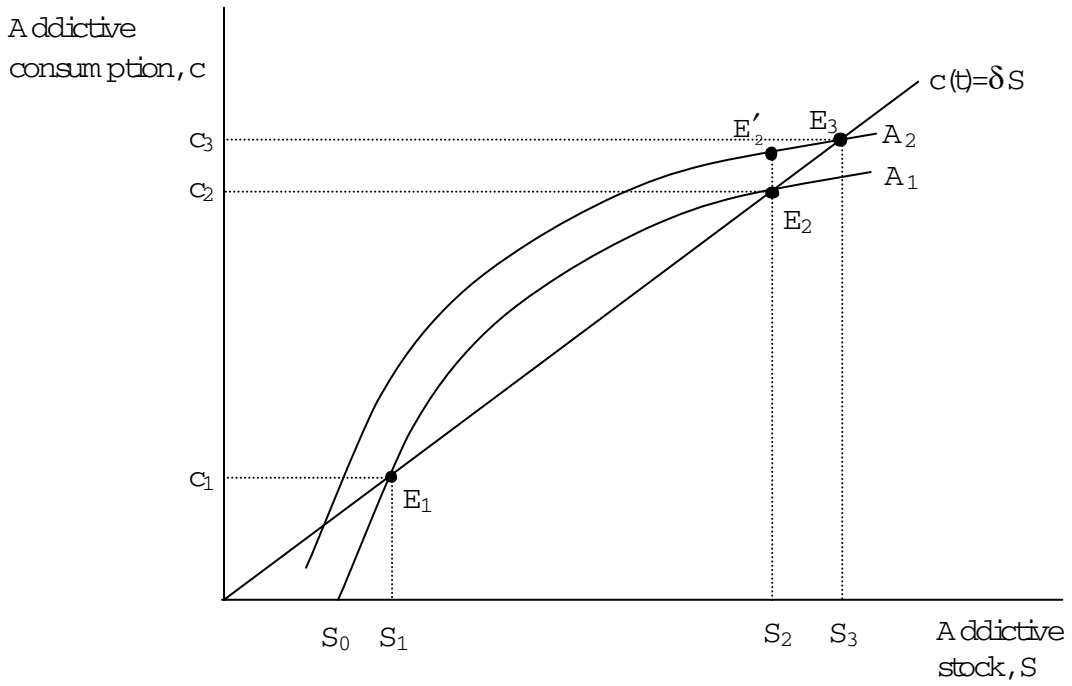
[2] Alternatively, more structure could be imposed on the utility function by assuming that c(t) and S(t) enter into utility via an intermediate production function, where the output is something like euphoria or pleasure (Chaloupka, 1991).

utility). Thus, assuming utility at time t is a concave function requires that $\partial u(t)/\partial S(t) \equiv u_s < 0$.[3] The second characteristic of addiction is the reinforcement effect, $\partial c(t)/\partial S(t) > 0$, whereby greater past consumption raises the marginal utility of current consumption, and hence leads to an increase in current and future consumption (i.e. current and past consumption are complements). Thus it is assumed that $\partial^2 u(t)/\partial c(t)\partial S(t) \equiv u_{cS} > 0$. If addicts were not rational they would only pay attention to the reinforcement effect, but in this model drug users are rational and so must take into account both effects. Thus Becker and Murphy show that the reinforcement effect must outweigh the tolerance effect. In other words, the positive effect of an increase in the stock of consumption on the marginal utility of current consumption must exceed the negative effect of a greater stock of consumption on the future harm from greater current consumption (Buck et al., 1996).

We can now bring the components of the model together to see how addictive behaviour is characterised by rationality. Following Becker et al. (1991), the implications of the Rational Addiction model are illustrated graphically in Figure 1. The curve $A_1$ relates consumption to the addictive stock for an individual with a given concave utility function, rate of time preference, set prices for addictive and non-addictive goods, and given wealth. It can be thought of as a demand curve for the addictive good. The ray from the origin, $c(t)=dS$, is the steady state line where current consumption of the addictive good just offsets the depreciation of the stock of consumption capital. If $A_1$ is below the steady state line, current consumption does not offset the decline in consumption stock. This means that S begins to fall and thus so does consumption of c, towards abstention. Conversely, if $A_1$ is above the steady state line, consumption and the addictive stock increase, and the addictive habit persists. We can thus use Figure 1 to explore a number of drug use experiences, even those where the initial endowment of S is zero. In all cases, the amount of consumption capital relative to current consumption will determine the behaviour of the addict (or even someone experimenting with drugs).

[3] Becker and Murphy are careful to note that addiction can be beneficial in some circumstances, however it is only harmful if marginal utility with respect to the stock of consumption is negative.

Figure 1. Addictive behaviour and the stock of consumption capital




Central to the Rational Addiction theory is the existence of multiple points of equilibrium, or unstable equilibrium, and the complementarity of consumption between periods. In Figure 1 there are two equilibrium points, $E_1$ and $E_2$, the first of which is unstable. To see why, consider a user in equilibrium at $E_1$, with current consumption $c_1$ and stock of consumption capital $S_1$. This point is not stable because any exogenous shock to the stock of consumption capital will cause a permanent move either to abstention or to the higher equilibrium, $E_2$. For example, following Neri and Heather (1995), suppose the user experiences a negative life event (say the loss of a job or divorce) that causes $S_1$ to increase (on the assumption that a negative life experience strengthens the relative euphoric effect of past drug consumptions). This in turn causes consumption to increase along $A_1$ and thus, due to reinforcement, the stock further increases so that eventually the higher equilibrium of $E_2$ is reached. On the other hand, if the initial shock was positive (say the birth of a new child), then $S_1$ will decrease, causing consumption to decrease and eventually the user abstains from drugs altogether as the depletion of the stock exceeds current consumption. This is similar to the experience of those who experiment with drugs but do not become regular users. If initial consumption is zero and the stock is less than $S_1$, an experiment with drugs, say as a result of curiosity, results in a consumption level that is not sufficient to offset the depletion of the

capital stock and so eventually the individual returns to abstention. Considering $E_2$, it is clear that changes in the stock will be smoothed away over time so that $E_2$ remains a stable equilibrium. For example, if $S_2$ were to be increased this will initially cause consumption to rise above $c_2$, moving the user rightward along $A_1$. Over time as the depreciation of the stock is not fully offset by consumption the stock begins to fall and equilibrium is eventually restored at $E_2$.

Despite its intuitive appeal, the Rational Addiction framework is limited in some respects. A more detailed discussion of the main criticisms of the model is given later, but it is worth noting that it is not clear what happens to the model's predictions if some of the assumptions are relaxed. For example, it could be argued that there is considerable uncertainty about discount rates. Becker and Murphy argue that poorer or less educated individuals are likely to discount their futures heavily as they take account of the future consequences of their current actions less than others. However, Buck et al. (1996) suggest that these individuals are probably less certain about their futures than, say, those from middle class or well-educated families. This suggests that discount rates are likely to be a function of uncertainty, and as such may vary according to life changes or public policy aimed at reducing uncertainty. Another area of uncertainty is the individual's lifespan, which may be endogenously determined with the choice of drug consumption. Quite how uncertainty changes the predictions of the Rational Addiction model is not clear, although it is an area that requires more research.

## 2.2 Rational Addiction, Price Changes and Demand

Figure 1 can also be used to illustrate the effect of policy interventions on the demand for drugs. Later, we provide a detailed discussion of current policy interventions. In this section, however, we briefly consider the effect of prices changes on the demand for drugs using the Rational Addiction framework. Suppose the individual is at point $E_2$ on the steady state line in Figure 2.1, with consumption $c_2$ and stock $S_2$. Now consider what happens if the retail price (or effective cost) of the addictive drug falls significantly, say, as a consequence of legalisation. The fall in price causes demand to increase for every possible stock of consumption, which shifts the demand curve up to $A_2$, ceteris paribus. Initially, for a given stock of consumption, the individual will raise consumption up to the point $E'_2$ on the new demand curve. However, since $E'_2$ is above the steady state line, the increase in consumption more than off-sets the depreciation of the stock, and thus consumption grows until the new

steady state equilibrium is reached at $E_3$ with the higher consumption level $c_3$. This is in stark contrast to conventional thinking, which suggests that addicts are typically un-responsive to changes in price. Becker et al. (1991), conclude: 'if anything, rational addicts respond more to price changes in the long run than do nonadicts' (p. 239).

## 2.3 Implementing Rational Addiction Empirically

In the previous section we saw that the Rational Addiction model allows us to predict the impact of price changes on consumption and hence evaluate policy proposals. In this section we consider how the model has been tested empirically. The Rational Addiction model has been implemented in a number of contexts, including cigarette consumption (Bardsley and Olekalns, 1999; Becker et al., 1994; Cameron, 1997; Chaloupka, 1991; Labeaga, 1999); illicit drug use (Grossman and Chaloupka, 1998); alcohol consumption (Grossman et al., 1998b; Waters and Sloan, 1995); coffee consumption (Olekalns and Bardsley, 1996); and the demand for cinema (Cameron, 1999). A brief summary of the empirical applications of the Rational Addiction model is given in Grossman et al. (1998b). The majority of these studies provide supporting evidence for rational addiction in that they report negative and significant price effects and positive and significant past and future consumption effects. In this section we will focus on the practicalities of implementing the model and consider the empirical finding later in Section 2.5 when we look at the effect of drug prices on consumption. We will focus in particular on using the Rational Addiction model in the context of analysing illicit drug use, although it was first used to consider cigarette consumption (Chaloupka, 1991).

Unfortunately, due to difficulties in obtaining data, there are very few studies that have considered the demand for illicit drugs in the context of the Rational Addiction model. As such, we will concentrate on a unique study by Grossman and Chaloupka (1998), that focuses on the price elasticity of demand for cocaine. Assuming a quadratic utility function and a rate of time preference for the present equal to the market rate of interest, Becker at al. (1994) show that Equation (1) generates a linear difference equation for current consumption (termed a structural demand function by Grossman and Chaloupka) of the form :[4]

$$c_t = \gamma c_{t-1} + b\gamma c_{t+1} + \alpha_1 P_t + \varepsilon_t . \qquad (4)$$

[4] Chaloupka (1991) provides an alternative specification for the demand for cigarettes that includes a consumption stock term, generated empirically on the basis of observed lifetime smoking patterns.

In (4) $c_{t-1}$ and $c_{t+1}$ are past and future consumption respectively (see below for how the latter is observed), $P_t$ is the current price of $c_t$, (other determinants of current consumption are suppressed), $b$ is the time discount factor (equal to the reciprocal of one plus the rate of time preference for the present, and assumed to be less than one)[5], $q_1$ captures the effect of price on demand, and $e_t$ is an error term capturing unobservable life-cycle experiences that affect consumption. The parameter $q$ measures the effect of a change in past consumption on the marginal utility of current consumption, and by symmetry, the effect of a change in future consumption on the marginal utility of current consumption. In other words, this parameter relates to the reinforcement effect, the greater the value of $q$, the larger is the degree of reinforcement. This specification also embeds the idea of adjacent complementarity, as changes in past or future consumption will result in a change in current consumption. In terms of testing the plausibility of the model, if addiction is ignored then only $q_1$ will be significant. If however, consumption is addictive, but addicts are myopic in the sense that they ignore future consumption, then only $q_1$ and coefficient estimate for past consumption will be significant. In the context of the Rational Addiction model we expect all the parameters to be significant (and positive except for $q_1$).

Estimation of (4) is relatively straightforward, although OLS estimation will result in biased estimates of the parameters of interest because the unobservable components that affect utility in each period will most likely be correlated. Grossman and Chaloupka (1998) get around this problem of endogeneity of past and future consumption by estimating the demand function using two-stage least squares. As stated, equation (2.4) implies that $c_t$ is independent of past and future prices, their effect only coming indirectly through changes in past or future consumption. Thus, provided the unobservable components are uncorrelated with prices, past and future prices can be used as instruments for past and future consumption, respectively.

The last empirical issue to consider concerns data and a considerable proportion of the Grossman and Chaloupka paper is dedicated to a lengthy discussion of how they generated data appropriate for estimating the model. Grossman and Chaloupka use panel data from the University of Michigan's Monitoring the Future research program. Data on a representative sample of between 15,000 and 19,000 high school seniors have been collected for this program every year since 1975 (see Johnston et al. (1995) for more details). Interviewees are asked about their use of marijuana (cannabis) and a number of other commonly abused drugs

[5] Note that if individuals are totally myopic then $b = 0$ and the term in future consumption disappears.

including cocaine, and follow-up surveys are carried out periodically (providing up to five observations on each individual in the data used by Grossman and Chaloupka). This periodic review effectively provides information on past, current and future consumption by allowing the lags and leads of the middle observation to coincide with past and future consumption, respectively. Price information is taken from the System to Retrieve Information from Drug Evidence (STRIDE), which is maintained by the US Drug Enforcement Administration (see Caulkins (1995a) or DiNardo (1993) for more details). Grossman and Chaloupka focus on cocaine in their study and proceed to estimate the full cost of cocaine by geographic location over time.[6] Again, as with consumption, lags and leads are used to create past and future real cocaine prices, and similar measures are used for time-varying socio-economic variables.

The results of Grossman and Chaloupka's study provide broad support for the Rational Addiction model. The authors present numerous estimates corresponding to the technique used (OLS or two-stage least squares), the various measures of drug use, including participation, and whether time-varying socio-economic variables are included in the structural demand equation and past and future values of these variables included in the set of instruments. Regardless of how the model is specified, the estimated coefficient of future consumption is always positive and statistically significant, and the coefficient on past consumption is mostly positive and significant. The estimates for past consumption are only at odds with the Rational Addiction model when potentially endogenous socio-economic variables are excluded from the two-stage least squares estimates, and this is possibly due to the imprecision introduced by reducing the set of instruments. In terms of the discount factor, $b$, which is calculated as the ratio of the coefficient of future consumption to the coefficient of past consumption, the results are less impressive. The estimated discount rates correspond to interest rates in the range of -3% to 4% (discount factors ranging from 1.03 to 0.98). Cameron (1999) is highly critical of the discount rates found in applied work, singling out the discount rates presented in Becker et al. (1994) that imply interest rates ranging from 56.3% to 222.6% (although Cameron actually finds quite plausible discount rates in his study of the demand for cinema). Whether or not this is a weakness in this applied work is open to debate. However, Grossman and Chaloupka conclude that:

> ... These results, combined with the detailed analysis in Becker et al. (1994) and in Grossman et al. (1998) suggest that data on cocaine, cigarette, or alcohol

[6] The actual process of generating the appropriate price series is very detailed and involves numerous steps to take account of purity, location, etc. For more details see Grossman and Chaloupka (1998).

> consumption may not be rich enough to pin down the discount factor with precision, even if the rational addiction model is accepted.
> (Grossman and Chaloupka, 1998, p.448).

Finally, in terms of price elasticities, Grossman and Chaloupka report estimates that suggest that drug users are likely to be sensitive to price changes, a result which is consistent with the Rational Addiction model. They find a long-run price elasticity of demand for cocaine of −1.35 and a smaller short-run elasticity of −0.96. This is also consistent with the Rational Addiction model. As we discussed in the previous section, the model predicts that the initial reaction to a price change is represented by a move to a different demand curve (from $A_1$ to $A_2$ in Figure 2.1 in the case of a price drop), followed by a movement along the new curve to the stable steady state equilibrium (point $E_3$ in Figure 1).

## 2.4 Beyond Rational Addiction

Although there have been a number of reportedly successful attempts to implement the Rational Addiction model empirically (although rarely in the context of illicit drug use due to lack of appropriate data), the model itself attracts many critics, albeit from mainly non-economists. In this section we briefly consider some of the criticisms that have been levelled at the model and mention some of the extensions to the model that have been proposed.[7] We do not focus on the fundamental debate between proponents of the rational choice view of addiction and those that consider addicts to be totally myopic with time-inconsistent preferences and only interested in immediate gratification (see Mochrie, 1996; O'Donoghue and Rabin, 1999, 2000). Rather, we will focus on criticisms and extensions to the Rational Addiction model that are based on economic rather than behavioural science considerations.

One criticism of the Rational Addiction model is that it takes no account of individuals' regret about their addictive consumption. Critics claim that it is unreasonable to assume that addicts choose to risk addiction in the knowledge that it presents potential future harm (typically the non-rational approach assumes that addiction arises from a compulsive act carried out without any consideration of the future). Orphanides and Zervos (1995) attempt to overcome this problem by incorporating the process of learning and regret into the Rational

[7] Modifications of the model that are specific to certain goods are not considered here. For example, Suranovic et al. (1999), and in response, Jones (1999), have developed models of cigarette addiction that are based on the Rational Addiction model but reinterpret some of the assumptions to incorporate the adjustment cost approach to addiction.

Addiction model. The basic premise is that individuals do not know their addictive tendencies until they have actually experimented with the potentially addictive good (learning), but that for some individuals this experimentation alters the stock of consumption capital such that they eventually follow an addictive path. Had these individuals known this addictive outcome before they started experimenting (i.e. they had accurately formulated their prior probability of addiction before experimenting) then they would probably not have started in the first place (regret). This involves separating the individual's utility function into two parts:

$$u(t) = u[y(t), c(t)] + qx_t v[c(t), S(t)]. \tag{5}$$

Here, the first term, $u[y(t), c(t)]$, is the positive impact of consumption of both goods on utility whilst the second term, $v[c(t), S(t)]$, represents the possible detrimental effects from past consumption of the addictive good. These effects occur with probability $x_t$, which depends on the level of past consumption and is distributed as:

$$x_t = \begin{cases} 1 & \text{with probability } p(S(t)) \\ 0 & \text{with probability } 1 - p(S(t)) \end{cases} \tag{6}$$

The parameter $q$ is initially unknown, and represents the addictive tendencies of the individual that vary between 0 (non-addict) and 1 (potential addict). This parameter is updated by the individual on observing the affect on utility subsequent to consumption. On continuing consumption, $S(t)$ is increased until addiction occurs, which can be before the true value of $q$ is recognised.

This extension of the Rational Addiction model yields a modified version of the demand curve shown earlier in Figure 1. In effect, the modified demand curve is split at some critical value of the consumption stock, with the curve much higher after this critical point (the model still retains two equilibrium points, one on the lower portion and one on the higher portion of the demand curve). Provided the consumption stock remains below this critical level then the optimal path always leads eventually to abstention. However, if an individual builds up a stock greater than this critical level before realising his or her true probability of addiction, then the individual will be drawn into a harmful addiction. This modification of the Rational Addiction model is valuable as it helps explain some behaviour that would otherwise be considered as completely irrational:

> ... We show that the bulk of the objections concerning earlier rational models can be attributed not to rational decision making, but rather to the common implicit assumption of perfect foresight. The essential feature lacking from these models is the recognition that inexperienced individuals are initially uncertain of the exact potential harm associated with consuming an addictive good. Once uncertainty and a process of learning through experimentation are incorporated into the earlier rational framework, the process of rationally getting "hooked" into an addiction becomes evident, and our understanding of the determinants of addiction is substantially improved.
> (Orphanides and Zervos, 1995, p.740).

The integration of learning and regret into the Rational Addiction model represents a subtle modification of the basic model that appears to counter the arguments put forward by critics who claim that the rational framework cannot explain initiation into addiction. However, a more fundamental criticism of the model concerns its assumption that individual rate of time preferences are fixed and time-consistent.[8] If the rate of time preference is fixed, this means that there is a constant trade-off between the pleasure of current consumption and future utility, which would imply that there is no difference between the way addicts and non-addicts look to the future. Unfortunately this is incompatible with the observed behaviour of addicts that appears to suggest that they focus on immediate gratification without concern for the future. In response to this criticism, Orphanides and Zervos (1998) present an extension to the basic model that appears to reconcile this problem. They reject the non-rational approach that has myopia as the cause of addiction, and retain the idea of utility maximisation. The key to their extension of the Rational Addiction model is to allow the rate of time preference to be determined endogenously. Thus, increases in past consumption of the addictive good will have a positive impact on the individual's rate of time preference and induce a form of myopia. In this context, the initiation into addiction increases the desirability of current consumption and thus increases the reinforcement effect. This extension retains the properties of the basic model: multiple steady states corresponding to high consumption and abstention, and the potential for cycles of addiction (from experimentation, to binges, to withdrawal, to

[8] There is also some debate in the literature about whether we can actually know what addicts' preferences look like. In this respect, Fehr and Zych (1998) present the results of an experimental study in which addictive preferences were induced. The authors suggest that addicts appear to consume too much in comparison with the optimal consumption path implied by the rational addiction framework.

abstention, and to reoccurrence). Ultimately, the effect of allowing the rate of time preference to be affected by addictive behaviour is that myopic behaviour is a consequence of addiction, rather than its cause (as is the case of the non-rational approach).

This area has also been considered empirically. In a unique study, Bretteville-Jensen (1999) has explored empirically the assumption of stable rate of time preferences, which requires that although drug users and non-users should exhibit differences in their discount rates, current users and ex-users should not. The differences between non-users and users is that the latter will have a higher rate of time preference and thus heavily discount the future adverse consequences of their consumption in favour of current gratification. However, the distinction between users and ex-users should not be due to differences in the discount rate. As already discussed, in the Rational Addiction model preferences for an individual are assumed constant, and individuals only change between drug use and non-use when current consumption falls below the unstable steady state. This leads to a decline in the addictive stock, and hence further reductions in the next period level of consumption, until abstinence occurs. Contrary to this, Bretteville-Jensen shows that there is an observable difference between the time preference rates of current and former addicts.

The Bretteville-Jensen study uses data collected from heroin addicts, non-users and former users in Oslo. To test individuals' rate of time preference, the participants in the Oslo study were asked for how much they would sell a winning lottery ticket for if the prize money were not to be paid out until either one week later or one year later. A comparison of the two selling prices then provides an estimate of the individual's discount rate. Additional checks were made to see whether the particular financial circumstances of drug users affected time preference. In this case, the participants were asked to choose a method of payment that either emphasised early payment or a payment that was spread out, with the former having a smaller present value. Although the sample used in the study was small (50 ex-users[9], 110 non-users and 110 addicts), Bretteville-Jensen found a significant difference between the discount rates of current and ex-users, and between users and non-users. The second result is consistent with the Rational Addiction model, but the former is not.[10] This is problem for the Rational Addiction model as it emphasises that individual differences in discount rates can help explain addiction, but as preferences are assumed stable, transitions between addiction and non-use

[9] An ex user is defined as someone who had previously been a long-term abuser of heroin or amphetamines, although no information is given on how long they last used the drug.

[10] Although you could argue that ex-users are just another self-selected group who on average have different (fixed) discount rates.

are a consequence of the change in addictive stock only. Bretteville-Jensen suggests that the assumption of stable preferences does not hold and that it is quite likely that rate of time preferences are actually endogenously determined. The modification to the Rational Addiction model presented by Orphanides and Zervos (1998) does appear to address this problem and suggest that future implementations of the model should take this into account.

We have seen that a number of criticisms and extensions of the Rational Addiction model have been put forward since the publication of the theory. It is easy to dismiss the model based on casual observation of addictive behaviour: common sense suggests that addicts are not rational. However, the Rational Addiction model simply uses a rational choice framework to describe and predict the actions of addicts. To this extent it appears to work rather well. The model predicts that few people will be partially addicted, they either abstain or consume regularly; it shows that addicts are likely to respond to price changes particularly in the long-run, and finally, the model does provide an explanation of cycles of addiction and abstinence based on the response of individuals to exogenous events (Mochrie, 1996).[11] We have also seen that with some minor modifications, the basic rational addiction model remains robust to the criticisms of those advocating non-rational approaches. Empirically there is a lack of evidence in either direction, but this is understandable given the paucity of data. However, it is quite evident that despite some unanswered questions about uncertainty and endogenous lifetimes, the Rational Addiction model represents a major advance in economic theory towards understanding the problem of addictive drug use, which allows policy makers to generate predictions concerning observable actions.

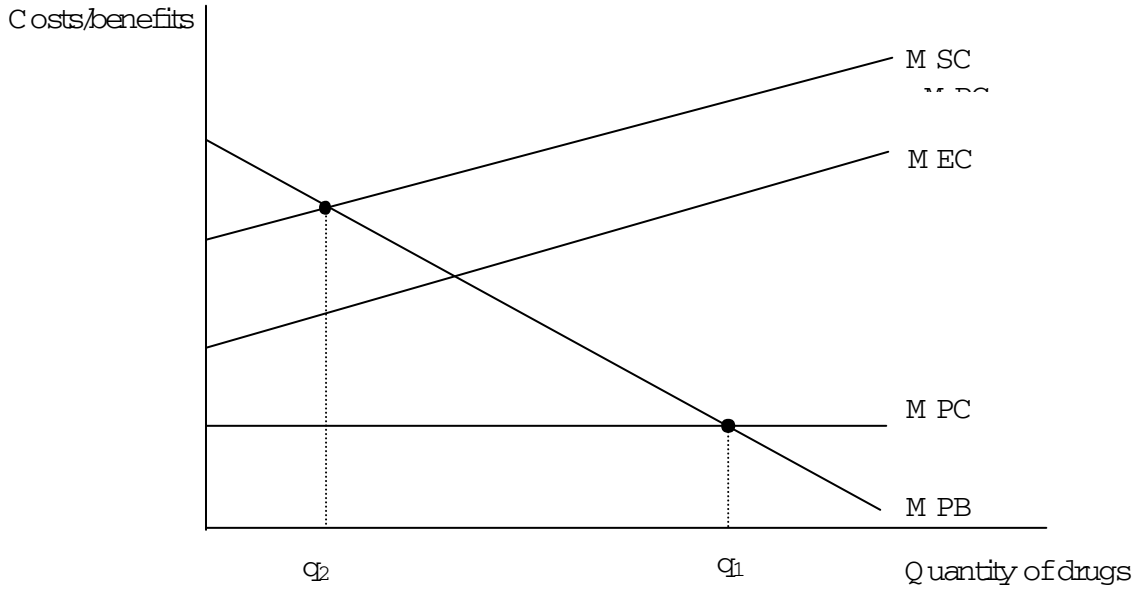
## 3. The Welfare Economics of Drug Prohibition

In the previous section we considered the economics of addiction and how the Rational Addiction model provides an economic framework for thinking about addictive behaviour. In this section we turn our attention to welfare economics. The basic issue here is whether or not drug use imposes welfare losses on individual consumers and society as a whole. In simple terms, any resources used to enforce drug policy incur an opportunity cost that has to be balanced with the benefits derived from a drug enforcement program. The benefits of drug policies are the resulting reductions in the social costs that were being imposed by drug users

[11] It should be noted that Mochrie (1996) is not a supporter of the Rational Addiction model, rather he refutes the whole economic methodology that underpins rational choice models and presents an alternative model grounded in behavioural psychology.

on third parties. These external costs, which might include an increased burden on a publicly provided health care system or the impact of acquisitive crime, create a divergence between the marginal private costs of the individual decision maker (the drug user) and the marginal social costs borne by society as a whole. The welfare economics framework is depicted simply in Figure 2.

Figure 2. The social costs of illicit drug use




In Figure 2, we assume individuals have a downward sloping demand curve for drugs (MPB), and face a constant private marginal cost (MPC), although a variable cost function leads to the same conclusions. The marginal private cost reflects the effective costs faced by the individual drug taker (including the risk of trading in the illegal drugs market), which he or she will equate with the private benefits of consumption to yield an optimal consumption level at $q_1$. From the point of view of society, the consumption of illicit drugs generates the previously mentioned external costs, which are represented by the marginal external cost curve (MEC). These are the costs of drug use that are not taken into account by the individual in making the privately optimal consumption choice $q_1$. Adding the private costs and the social costs together we get the total social costs of drug use, represented by the marginal social cost curve (MSC). From the point of view of society, the allocation of resources resulting from the private choice of $q_1$ is Pareto inefficient. The efficient level of consumption will be at $q_2$ where, assuming that there are no benefits to the rest of society from individual

drug use, the social costs of drug use are equated with the benefits (at every point between $q_2$ and $q_1$ the total costs of drug use are greater than the benefits). In this sense, efficiency can be improved by government intervention that reduces consumption from $q_1$ to $q_2$ (note that if the external costs are big enough, $q_2$ will correspond to the origin, that is, zero consumption or absolute prohibition).

However, given this simple framework, it is difficult to find a convincing case for drug prohibition in the literature of welfare economics. On the contrary, economists are more likely to argue that the externalities and merit goods (paternalistic) frameworks of welfare economics are simply inadequate as a means for explaining the prohibition of drug consumption. Culyer (1973) suggests six principal propositions upon which prohibition arguments should be based. These include:

- one individual's use of drugs imposes costs on others in society, either through anti-social behaviour or acquisitive crime;
- drug users impose an additional burden on a publicly provided health service either through treatment or rehabilitation;
- Society simply finds the use of drugs undesirable;
- drug users should be protected as they do not act in their own best interests;
- an individual's choice to consume drugs may lead to an escalation in society of an undesired activity;
- drug users are less productive members of society.

These propositions encapsulate the externalities and merit goods frameworks of welfare economics and many economists subsequent to Culyer have revisited them in one form or another for further investigation (see for example, Block, 1996; Littlechild & Wiseman, 1988; Miron & Zwiebel, 1995; Stevenson, 1994a; Wagstaff & Maynard, 1988). Typically these authors have all put forward convincing arguments to suggest that due to information problems and some fundamental flaws in these propositions, welfare economics is unlikely to predict the gains of prohibition over legalisation. It is worth considering some of the more contentious propositions in greater detail, although the aim of this section is not to test prohibition-legalisation issues, rather it is to consider how welfare economics can inform the debate.

## 3.1 Drugs and Crime

Of all the propositions, the first, that drug users impose costs upon others (and hence cause a divergence between private and social costs) is perhaps the most widely cited and debated in the literature. There is considerable evidence to indicate a correlation between drug use and income-generating crime (see Coid et al. (2000) for a summary of recent UK evidence and Bennett (1991) for a review of the non-economics literature on the link between drugs and crime). For example, using data from Florida's 76 counties for 1986 and 1987, Benson et al. (1992) found a significant correlation between the size of a drug market and the level of property crime. More recently, urine-analysis on a sample of 506 arrestees in England and Wales has been used to study the link between crime and drugs (Bennett, 2000).[12] This research, carried out through the New English and Welsh Arrestee Drug Abuse Monitoring (NEW-ADAM) programme, found that almost 70% of the arrestees that were eventually selected for analysis tested positive for at least one drug, excluding alcohol. In addition, average expenditure by arrestees testing positive for drugs was £129 per week, averaged over the past 12 months. In terms of crime, the report suggests that:

> ... The results have shown that drug users have higher levels of illegal income and higher rates of self-reported crime than non users. The results also have shown a strong correlation between a wide range of measures of drug use and a wide range of measures of crime. Almost half of arrestees believe that there is a connection between their own drug use and offending. The research findings so far suggest that drug use (especially heroin and crack/cocaine use) is associated with higher levels of both prevalence (the proportion of the population involved) and incidence (the rate of offending of those involved) of offending.
> (Bennett, 2000, p. 85).

There is perhaps little doubt that there is some correlation between drug use and crime. However, there is very little evidence to support any notion of causality between drug use and crime (or vice versa). Benson et al. (1992) conclude that it is the illegality of drugs use that can lead to crime, not the drug use itself. In other words, rather than there being a psycho-

[12] It is worth noting that the sample of 506 arrestees used in the NEW-ADAM research is derived from an available population of 2971 arrestees that passed through the custody blocks in the four police stations studied over a 30-day period. This represents a loss of 83%, over half of which was due to the short stay of the arrestee at the police station that meant that the interviewer had insufficient time to make contact. This in itself raises some doubts about the representative nature of the sample.

pharmacological explanation of the correlation between drug use and crime (e.g. "most burglars are on drugs"), it is more likely that it can be explained by a financing-consumption explanation. In this context, many authors in addition to Benson et al have questioned the supposed link between drug use and crime. In a systematic review of the costs and benefits of drug prohibition, Miron and Zwiebel (1995) conclude that as drugs prices are typically raised as a result of prohibition, it is prohibition itself that is the primary cause of crime associated with drug use. This point is strongly reinforced by Stevenson (1994a):

> ... All legal systems offer economic, social, political and medical advantage over prohibition. The economic case for legalisation is particularly strong. Cheap legal drugs will reduce the external costs of drug use which are found in acquisitive (sometimes violent) crime and risks to public health. (Stevenson, 1994a, p.68).

Indeed, Culyer (1973) concludes:

> ... One immediate possibility that may well be less costly than any other method in reducing the crime associated with drug abuse would be to legalise drug trafficking!.
> (Culyer, 1973, p.452).

That drugs policies may be the 'cause' of crime due to drug users' difficulties in legally financing their habit presents a problem for the welfare economics framework. The external cost of crime is only relevant if the crime is a direct result of the drug use, and not as a consequence of interventions designed to tackle drug use. Unfortunately, it is somewhat difficult to prove the financing-consumption explanation empirically given that there have been few instances, if any, in which the same cohort of drug users has experienced legal and illegal drugs markets. Another difficulty with this hypothesis is with regards to the impact of enforcement policies upon price. The arguments discussed above assume (understandably) that drug prices are higher in the prohibited market than they would be in a legal market. However, this is another area of debate (see later) in which there are few empirical results to provide guidance.

## 3.2 Increased burden on publicly provided health care

It would seem appropriate that if a society collectively pays for health care so that the marginal cost to the patient is (effectively) zero, then the state has a legitimate interest in the

health of every individual in that society. This suggests that where an individual's consumption choices are imposing an additional burden on publicly provided health care then that activity should be discouraged. Such is the case with drug consumption if we accept that there are certain health risks associated with that choice (although it is by no means certain that this is the case with all drugs and/or individuals).

With respect to empirical work in the area of increased burdens upon health care, Model (1993) presents an analysis of a rather fortunate experiment in the US. Between 1973 and 1978 12 US states enacted state laws that effectively decriminalised the use of cannabis. Model used data from the Drug Abuse Warning Network (DAWN) concerning drug-related emergency room episodes to consider the impact of this decriminalisation on Hospital resources. Model's results suggest that those cities that enacted decriminalisation experienced a statistically significant increase in cannabis-related episodes but a simultaneously significant reduction in other drug-related episodes compared to the non-decriminalised area. These results suggest that, assuming the drug using population to be stable over the period, a pure substitution effect between cannabis and other drugs was taking place resulting in a change of burden upon the health authorities concerned. Unfortunately, Model does not then go on to discuss the change in financial burden resulting in the shift in episode type. Nonetheless, the work does highlight the possibility that drug use imposes some burden on the health system. However, one can quickly draw up a list of activities that individuals may freely choose to pursue that impose other burdens on a publicly provided health system. For example, smoking and alcohol consumption clearly result in health problems for which society has to bear the cost of treatment, but so do many other activities such as mountaineering, pot-holing, road accidents, fatty diets, etc. (Block, 1993). Culyer (1973) suggests that this argument implies that, as with smoking or bad diets, drug use should be discouraged rather than made illegal. Whether this is the case or not very much depends upon the magnitude of the burdens generated by drug use (which could include indirect burdens such as accidents, etc.) and in this area there is very little research to guide policy interventions. A final point to bear in mind with respect to health costs is made by Block (1993), who concedes that the health effects of drug use are only a concern due to the means of medical provision. In other words, if there was a free market in medicine accompanied by a market for medical insurance, the health-related arguments for prohibition virtually disappear.

## 3.3 'Demerit' Goods

That individuals should be discouraged from certain consumption choices because they are

not acting in their own best interest is the classic paternalist argument for prohibition of drugs. Excluding any potential external costs arising from consumption of drugs, however, the proposition that drug users are not acting in their own best interests is difficult to contend with for many reasons. Culyer (1973) argues that if you assume that the individual, whose behaviour society wishes to control, is a part of that society, then either their welfare counts in the same way as everyone else's or it does not. In the former case economics cannot provide a means of judging whether one individual's assessment of another's self interest is any better than that individual's own assessment. In the latter case, we have a situation where one set of individuals' assessment of welfare is presumed 'superior' to another set of individuals' (the drug users) assessment of their welfare. In other words an externality is being created in which the choices of the former set of individuals are being imposed upon the latter. An example of this type of distinction is the model of drug consumption and crime presented by Doyle and Smith (1997). The authors refer to the majority of individuals who hold preferences where drug consumption yields zero utility as 'society', who are responsible for determining drug policy. It is also assumed that it is non-drug users who are adversely affected by the externalities created by addictive drug users. Such arguments appear to suggest that drug users are in some way not part of a society, they do not suffer from drug related acquisitive crime, do not contribute towards health care provision and their preferences are somehow inferior to the majority.

A simpler argument can be extended from this. One simply has to wonder why it is that the 'rest of society' knows about the problems associated with drug use whereas the individual drug user does not. Clearly this is not the case if, as with smokers, individuals make their choices in the knowledge (or at least part knowledge) of the risks associated with their consumption (this is the essence of the Rational Addiction model). In effect what we are considering are issues of personal choice and the restriction of that choice embodied in arguments concerning merit or 'demerit' goods. In reference to individuals who choose to take stimulants, Mill (1991/1859, p. 111) concludes that 'their choice of pleasures, and their mode of expending their income, after satisfying their legal and moral obligations to the State and to individuals, are their own concern, and must rest with their own judgement'. Block (1996) formalises this argument with reference to the gains in welfare resulting from two individuals trading in currently prohibited goods. Block argues that the welfare of third parties, assuming their rights to person and property are not being violated, should be disregarded in this context:

> ... A third party can verbally oppose any given trade. But that opposition cannot be revealed through market choices in the same way that trade between the two parties indicates a positive evaluation of the transaction.
> (Block, 1996, p. 434).

The problem economists face with respect to these arguments is that there are no tools for 'measuring' subjective values such that the externalities and merit goods frameworks are compatible. Indeed, even if there existed such a measure, the philosophical and ethical problems would still remain.

## 3.4 Productivity and Labour Supply

A frequently cited consequence of illicit drug use is its impact on labour force participation, particularly with respect to chronic absenteeism. The primary concern in this respect is that reduced labour market experience of drug users will ultimately result in a lower aggregate level of human capital accumulation which will tend to reduce overall productivity and hence living standards in a competitive global market. In other words, there is an external cost being imposed on the rest of society when drug users do not invest in human capital formation. That drug use renders individuals less economically productive is very difficult to establish empirically. Miron & Zwiebel (1995) refute the argument referring to work by Normand et al. (1994) and Winick (1991), which suggests that if anything, except for the heaviest users, there exists a positive relationship between individual earnings and self-reported drug use or at least no negative relationship. The motivation for questioning the relationship between drug use and labour market outcomes is the recognition of the possible simultaneity of drug use and wages, and the existence of unobserved heterogeneity, which raise questions about the direction of causality in a wage equation involving a measure of drug use as an explanatory variable.

The relationship between substance abuse and labour market status tends not to generate any consensus in the literature. For example, although most economists would argue that substance abuse will impact on labour supply, perhaps through some detrimental effect on health, there are some that argue that it is unemployment that tends to foster drug use, rather than the reverse (Peck and Plant, 1987). Where there is agreement over the likely direction of causality, there is a mixture of results that leave the impact of substance use on labour supply open to question. For example, in considering alcohol abuse and labour supply, Mullahy and Sindelar (1991) and Mullahy and Sindelar (1996) find a statistically significant negative

association between these variables, whereas Kenkel and Ribar (1994) do not (although they find a small statistically significant negative association between heavy drinking and the labour supply of males). The different conclusions that are drawn from these studies may relate to the different definitions of labour supply that are used. Kenkel and Ribar focus on the hours of labour supplied whereas both the Mullahy and Sindelar papers focus on participation. However, Kaestner (1994a), using the same data set as Kenkel and Ribar (the US National Longitudinal Survey of Youth – NLSY), finds a negative association between marijuana (cannabis) or cocaine use and the hours of labour supplied by young males.

All these studies deal with the issue of endogeneity of substance abuse and labour market outcomes in standard ways, yet there appears to be a lack of consensus in the results. Against this, Zarkin et al. (1998a) suggest that substance abuse and hours worked are not endogenously determined. Following extensive tests for exogeneity of substance abuse variables, they estimate a single equation model of labour supply for a sample of 18 to 24 year old men taken from the US National Household Survey on Drug Abuse. They find no significant relationship between past month labour supply and the use of cigarettes, alcohol or cocaine in the past month. Although they find a significant positive association with past month cannabis use, they conclude that there is little evidence to support a robust labour supply-drug use relationship. Similarly, although Kaestner's (1994a) cross sectional results support a negative relationship between drug use and hours of labour supplied, his longitudinal estimates do not support any systematic effect of drug use on labour supply. Kaestner concludes:

> ... There does not appear to be a common experience with regard to drug use and labour supply, and public policies should reflect this fact if they are to be effective and cost efficient. The goal of policy would be to identify those individuals for which illicit drug use does become problematic."
> (Kaestner, 1994a, p. 145).

In addition to the association between drug use and unemployment, there is a growing body of empirical evidence in the labour economics literature that suggests that once endogeneity is accounted for, one rarely finds a significant negative relationship between substance abuse and wages. Kaestner (1991), using data from the NLSY, finds that, if anything, increased frequency of illicit drug use (in this case cocaine or marijuana) is associated with higher wages. This result, consistent across gender and age groups, was found using a Heckman two-stage estimate of a wage equation. Likewise, Gill and Michaels (1992)

and Register and Williams (1992), using the same data as Kaestner but slightly different approaches to control for the self-selection of individuals into drug use and the labour market, find very similar results. These findings echo the results that have been found for the relationship between alcohol and wages. For example Berger and Leigh (1988), using data from the US Quality of Employment Survey and taking account of self-selection, found that drinkers receive higher wages, on average, compared to non-drinkers. More recent work has recognised a non-linear relationship between alcohol consumption and wages. For example, using different sources of data, French and Zarkin (1995), Heien (1996), Hamilton and Hamilton (1997) and MacDonald and Shields (1998, 2001) present results that support an inverse U-shaped relationship between drinking intensity and wages (although Zarkin et al. (1998b) reject their previous results in support of a positive return to wages across a wide range of alcohol consumption levels).

There is, however, some research that questions this general view. As a follow-up to previous results, Kaestner (1994b) presents cross-sectional and longitudinal estimates using two waves of the NLSY. The cross sectional results are generally consistent with the previous studies, but the longitudinal estimates only provide partial support for the positive relationship between drug use and wages. The results suggest that the wage-drug use relationship varies according to the type of drug and individual: for example a positive relationship between cocaine use and wages for females, but a negative relationship between marijuana use and wages for males. Moreover, Kandel et al. (1995) suggest that the relationship between drug use and wages will vary with the stage of an individual's career. Using a follow-up cohort of the NLSY, they find a positive relationship between drug use and wages in the early stages of an individual's career, but a negative relationship later on in the career (in the mid-thirties). However, Burgess and Proper (1998), using the same data source, are not able to replicate this finding. In their analysis they consider the effects of early life behaviour (such as drug and alcohol consumption) and later life outcomes, including productivity. Their results suggest that adolescent alcohol and soft drug use has little or no effect on the earnings of men in their late twenties or thirties, although they do find that early hard drug use has a significant negative impact. Age differences have also been found by Buchmueller and Zuvekas (1998), who analysed data from the US National Institute of Mental Health's Epidemiological Catchment Area (ECA) survey that was collected in the early eighties. Buchmueller and Zuvekas make the same criticism of NLSY studies as Kandel et al., in that compared the NLSY, the ECA covers prime-age (30-45 years old) workers as well as young people. Their results suggest that whilst there is evidence of a positive relationship between drug use and

income for young workers, there is strong evidence to suggest that 'problematic' drug use by prime-age workers is associated with lower incomes.

In concluding this section we note that apart from MacDonald and Pudney (2000a,b,c) there is little work in this area that is set in a British context. MacDonald and Pudney (2000a,b) find little evidence to support the Kandel et al. (1995) life-span hypothesis, indeed, like Burgess and Propper (1998), if anything their results contradict it. The authors find that this result is also gender specific, and only relevant to the past use of recreational or soft drugs. In particular, MacDonald and Pudney (2000b) only find a positive association between past recreational drug use and the wages of older women. There is practically no evidence to suggest any positive returns to drug use for the younger cohort, particularly for men (in all cases the estimated coefficients are negative for men). What the authors are able to find is a highly significant relationship between dependency drug use and unemployment (for younger women, older men, and young men and women when considered together). This represents long-term harm to employment prospects, particularly for young people who will miss out on vital human capital investment. MacDonald and Pudney (2000c) suggest that taking the relationship between drug use and unemployment into account may help explain why recent work has failed to find any significant negative relationship between drug use (except for recreational drug use in older men) and earnings. They show that drug use (particularly dependency drugs) greatly increases the risk of unemployment, and any association with earnings for those in work therefore misses much of the impact.

Clearly the empirical evidence on the labour market outcomes of illicit drug use is mixed, but there would appear to be some evidence of negative human capital effects in relation to drug users, and hence the labour market effects of illicit drug use are a genuine concern for policy makers.

## 4. The Legislative Debate

So far we have considered two areas of the economics literature that allow us to further understand illicit drug use and its consequences. In economics, there is also a literature that focuses on the consequences of legalising currently prohibited drugs. The majority of this literature draws upon the theories outlined in the previous section to present a case that is typically in favour of repealing the current prohibition laws. A major drawback with much of this work, however, is the apparent lack of detail concerning the operation of legal drugs markets. Whereas many commentators rely on a discussion of the failures of prohibition to argue for legalisation, very few (perhaps understandably) consider the practicalities of legal

(regulated) drugs markets. There are of course some exceptions, and these are the focus of this brief section. Perhaps one of the most vocal of the protagonists in this arena is Stevenson (1990, 1991a,b, 1994a,b). Stevenson's argument is quite straightforward. He envisages a free market for all drugs with a bare minimum of regulation along the lines of that for alcohol. This regulation would be used to safeguard children, restrict advertising, licence retail outlets, and provide restrictions for the operation of machinery. Stevenson argues that a free market with minimum regulation would operate in a socially acceptable manner, bringing about lower prices, increased quality and much product differentiation. These conclusions are mainly drawn from observations about the workings of the prohibited market and how legalisation will remove many of the negative consequences of enforcement. The main issues are presented below; in particular those relating to the supply side of a legal market and the process of adjustment towards market equilibrium.

## 4.1 Supply in the Legal Drugs market

One of the concerns about drug use highlighted in the previous section is the impact upon the health of users (and the subsequent burden upon publicly provided health services). Stevenson (1994a) suggests that legalisation will result in the orderly marketing of safe products by specialist drug firms (or existing companies who already supply tobacco or alcohol) operating in a competitive international market. The author draws an analogy with the pharmaceutical industry where corporate profitability depends on continuous innovations so that ultimately, legalisation would stimulate research for synthesised drugs that are safe (in terms of health effects) but share the same characteristics as existing drugs. Stevenson's general argument is that legalisation would take the distribution of drugs out of the hands of dubious dealers in favour of large companies with brand names to protect, who would thus view product safety as a high priority.[13] Block (1996) presents a similar argument:

> ... Legalization will likely reduce drug-related problems. Impurities in narcotics would be better dealt with by legitimate businesses than the present fly-by-night operations created by prohibition.
> (Block, 1996, p.434).

[13] Although, presumably the companies would have to overcome the stigma of supplying previously illegal substances.

Of course, one might argue that this already exists in illegal markets, as dealers are unlikely to want to intentionally poison their customers (c.f. Nadelmann (1988), who contrasts the small number of narcotic-related deaths with the huge numbers of deaths associated with alcohol and tobacco abuse). In relation to this issue, the legal sanction of tobacco supply has certainly not resulted in a 'safe' product, although producers have reacted to demand by supplying 'lower tar' cigarettes. However, Stevenson (1991, 1994a) and Clark (1992) both draw a comparison with the alcohol industry to conclude that consumers are more likely to be certain about the quality of legally supplied drugs than they would be with those from an illicit supply (e.g. compare 'moonshine' with branded whisky).

Chesher and Wodak (1990) also concede the likelihood of quality maintenance within a free market for drugs, but make reference to the market for alcohol to suggest one possible problem with this model. As a result of the legal marketing of alcohol and tobacco these products have become firmly entrenched in Western cultures. What has followed as a result of the size of legal alcohol and tobacco markets are governments who are financially dependent on these legal drugs. Given that few governments are willing to take any real action to redress the associated health problems these drugs present, the authors advocate caution with respect to following the same route with currently prohibited drugs. As an alternative, Chesher and Wodak advocate the supply of currently illegal drugs through a government monopoly. Under this system a 'use pays' principle would be adopted whereby governments continue to discourage drug use but provide drugs that are taxed proportionately according to the health and social costs their use generates. The revenues from supply above cost can then be allocated to welfare and health programs aimed at preventing and treating drug related problems. With respect to these tax revenues, Caputo and Ostrom (1994) have estimated that the marijuana industry in the US in 1991 generated between 5.09 to 9.0 billion dollars of untaxed revenue.[14] Although this estimate is produced assuming a unitary price elasticity of demand (see later), the figures are considered a lower bound. It is also worth noting that a recent estimate for the UK market (Sleator and Allen, 2000), suggests that legalisation of cannabis would result in a one billion pound increase in government revenues per year.

The purpose of this brief section was to highlight some of the debate in the economics literature concerning alternatives to the prohibition of drugs. There is no empirical work in

[14] This estimate is based on an analysis of seizure data, information on consumption form the National Institute of Drug Abuse national household survey, and Drug Enforcement Agency estimates of street prices (with data on tobacco production and selling costs used as a proxy for cannabis).

this area, and the conclusions that have been drawn cannot be tested under current conditions. In this sense, the contribution to the debate on legalisation represented by this work is limited, but it is based on basic economic principles. In the next section we consider the contribution of economics to understanding the consequences of current drugs policy.

## 4.2 Current Policy Interventions

The use of a welfare economics framework to analyse the problem of drug misuse often results in a quite persuasive case against prohibition, or at least no compelling case in its favour. However, apart from the Dutch policy of decriminalisation (see de Kort 1994) and the South Australian Cannabis Expiation Notice (CEN) system (see Sutton & Sarre 1992), there are very few governments world-wide that advocate anything other than outright prohibition. If one takes as given the policy that drug consumption is to be reduced (the typical public policy), then it is with respect to the optimal use of policies that economic analysis can be of great value. A brief review of the economics of drug enforcement policies is presented in Wagstaff and Maynard (1988). The authors highlight the debate between advocates of supply-side policies and those who favour demand-side policies. The theoretical debate in this respect is perhaps hindered by a lack of information; however, there are a number of recent papers that have attempted to address that problem. Before considering these further it is appropriate to outline the options available to policy makers where the ultimate goal is to reduce consumption and to highlight the debates that have taken place in this context.

### 4.2.1 Supply-Side Enforcement Policies

The classic view of drug consumption is that demand is completely price inelastic with respect to addictive goods (Rottenburg 1968). If this is the case then there are numerous implications for public policy intended to target the supply side. Supply-side policies (such as seizures, large-scale purchase or destruction of crops, increased severity of penalties for dealing, etc.) are implemented in order to reduce the available supply to users and push up the market price of a drug so as to reduce consumption. Whether or not this occurs in practice is a matter for debate (see later), but if this type of intervention affects prices, and demand tends to be price inelastic, the likely outcome is that supply-side policies are self-defeating. Silverman and Spruill (1977) highlight this dilemma quite succinctly:

> ... If the number of addicts who do not adjust their habit [in reaction to price changes], but commit crime to maintain it is large, society is caught in a vicious

> spiral: More crime leads to more vigorous suppression of the heroin supply, and the resulting rise in prices aggravates the crime problem further.
> (Silverman and Spruill, 1977, p. 81).

In other words, supply-side policies that push up prices in the face of inelastic demand do no more than put more money in the hands of suppliers. Such arguments have led commentators to suggest that demand-side policies are likely to be more (cost) effective than supply-side control. Indeed, Holahan (1973) had earlier commented that:

> ... Since the demand for heroin is most likely price-inelastic, at least over a wide range, it is probably more worthwhile to operate directly on demand by affecting such variables as tastes, the prices and availability of alternative drugs, treatment availability, and so on.
> (Holahan, 1973, p. 467).

This discussion highlights two key debates that need to be addressed empirically. Firstly, is it the case that supply side enforcement policies, such as seizures, push the price of drugs upwards? If this is the case, then do increases in price reduce the level of consumption of drugs? Answers to these questions are fundamental to our assessment of current supply side policies. In the following sections we consider how economists have gone about addressing these issues.

### 4.2.2 The Effect of Supply-Side Enforcement Policies on Price

As already mentioned, the primary aim of supply-side enforcement policies is to push up illicit drug prices so that they become prohibitive. Although there has been some theoretical debate over the impact of enforcement policies on prices, there is very little empirical work in this area. Two noteworthy exceptions stand out. DiNardo (1993) has studied the effect of cocaine seizures on price and, building on this work, Yuan (1994) has considered the effect of enforcement policies on the price of heroin and cocaine. The motivation for this area of research is driven by the possibility that although the typical enforcement policy of seizure may have some impact on price, it is quite possible that variations in seizures are actually driven by changes in quantity available, which affect price at the same time. In other words the causal relationship between enforcement and prices is not necessary obvious. What is more, as suggested by Holahan (1973), it is open to debate as to whether even large-scale seizures can have any effect on price given the potentially large number of suppliers and the

lucrative profits that attract them into the market.

DiNardo (1993) investigates this issue by considering data available from the US Drug Enforcement Administration's (DEA) System to Retrieve Information from Drug Evidence (STRIDE) and data from the Monitoring the Future (MTF) sample of US high school seniors. STRIDE is used to produce price series for cocaine and seizure information, whereas the MTF data are used to provide information on consumption. DiNardo uses a variety of estimation techniques and quasi-experiments to test whether variations (over time or by region) in DEA seizures of cocaine can help explain variations in either demand or the price of cocaine. Regardless of the technique used, DiNardo finds little evidence to suggest that law enforcement has a statistically significant positive impact on the price of cocaine. If anything, there appears to be a negative relationship between seizures and cocaine prices. On the other hand, DiNardo finds that the relationship between seizures and quantity demanded is actually positive (i.e. higher seizures tend to occur where the drug problem is greatest). The author suggests that this finding is consistent with the hypothesis that seizures are directed where the drug problem is most noticeable and thus they tend to mirror demand. Thus, seizures will be lowest where the demand for cocaine, and hence prices, is lowest. In other words, variations in price reflect variations in demand; whereas enforcement and supply are endogenously determined.

Yuan's (1994) approach amounts to an extension of DiNardo's work, taking into account the need to identify the direction of any causal relationship between enforcement and prices. As with DiNardo, Yuan uses data produced from STRIDE and estimates a vector autoregression model to test the Granger-causality between enforcement and drug prices. The author also considers the effect of very large seizures by comparing prices pre and post seizure. In effect Granger-causality from enforcement to prices would be a correlation between prices in the current period and enforcement of previous periods. However, it is quite possible that any Granger-causality observed through autoregression tests is actually driven by a third unmeasured variable that relates to the two variables under investigation. As such, Yuan suggests that finding no Granger-causality is a more robust result than finding Granger-causality. Using time series data for 135 months, Yuan firmly rejects the null hypothesis that changes in enforcement do not Granger-cause changes in prices (although this is only significant when seizures are measured in number, not weight or value). In other words, Yuan does find a link between enforcement and prices, but his results suggest that the relationship is negative. In addition to this, Yuan also finds that changes in cocaine prices respond negatively to changes in heroin seizures, and changes in heroin prices respond negatively to changes in

cocaine seizures. Yuan confirms these results from an analysis of very large cocaine and heroin seizures and price variations before and after the seizures. The implications arising from the work of Yuan and DiNardo are mixed and require further research. These results could be revealing more about what is happening on the demand-side than the supply-side, whereby demand is being reduced (as a result of the increase in perceived risk following observed seizures)[15] more than supply is being reduced and hence price is falling.

### 4.2.3 The Effect of Price Changes on Consumption

We have already seen that there is some debate over whether enforcement actually has any effect on prices. However, assuming that higher prices are still a policy goal, it is clearly essential to understand how prices affect consumer behaviour. Indeed, not only are price elasticities of demand important for evaluating enforcement policies, such information is relevant for assessing the impact of alternative policies to prohibition (Lee, 1993). The speculation about the own price elasticity of demand for drugs highlighted earlier is not well entrenched in empirical research. Whereas there has been considerable research into the demand elasticities of alcohol and tobacco (as discussed earlier in section 2), research in the area of illicit drugs is somewhat patchy. Of course the main obstacle to progress in this area is the lack of available data. There are however some notable exceptions to the general lack of activity in this important research area. Before we consider these, we should first discuss the theoretical debate about price responsiveness of drug users.

There has been considerable debate as to whether demand behaviour in illicit drug markets is particularly price inelastic. Moore (1973, 1990) suggests that it is the 'effective price' that is of relevance to drug users not the market price and that any reduction in consumption following a price rise is sufficient to justify supply-side policies. This effective price might be defined by an index including the market price, the purity of the drug, risk of the market, etc. As such, different users will react in different ways according to the knowledge they have to determine an effective price. This might well be true for, say, experimental users, who would have weak knowledge of the market and subsequently be somewhat price responsive. Becker et al. (1991) extend the theoretical debate about the possibility of different price responses for different users by recourse to the Rational Addiction model discussed earlier. Their argument is that the young and poor are more likely to react to money price changes because typically they place a smaller monetary value on

[15] Although this could be a policy aim in itself.

health and other future harmful effects, which in theory should form part of the total cost of an addictive good. Therefore, as price becomes a bigger share of total cost (as in the case of younger or poorer users), long-run changes in demand brought about by changes in price become larger relative to changes that might be brought about by changes in total future cost. In other words, lower income people (or younger people) tend to respond more to changes in price than do higher income people (or older people), who tend to react more to changes in future harmful effects.

Wagstaff and Maynard (1988) provide an alternative view of demand elasticities. The authors present a 'double-kinked' demand curve at the aggregate level that is a synthesis of two diametrically opposed views originally suggested by Blair and Vogel (1973) and White and Luksetich (1983). The result is a market demand curve that exhibits two elastic segments, one at low prices and one at high prices, and a general inelastic segment covering the middle range of prices. Blair and Vogel (1973) argue that at low prices the market will consist of both addicts and recreational users. When prices increase demand will fall as recreational users leave the market (in favour of substitutes) and addicts curtail their consumption towards maintenance doses. Beyond some price the market will only consist of addictive users who exhibit price inelastic demand. White and Luksetich (1983), on the other hand, consider the effect of very high prices; suggesting that after a certain price the efforts to raise funds become prohibitive and addicts will leave the market (to enrol on treatment programmes or due to arrest and conviction). If Wagstaff and Maynard's synthesised shape of contemporaneous demand curve were found to exist then there are considerable implications for public policy, depending on the location of market equilibrium. Unfortunately there is little or no evidence to support such a hypothesis, although there have been some attempts to estimate the price elasticity of demand for some drugs which we will now consider.

One of the earliest attempts at 'measuring' the price elasticity of demand for a drug is presented in Silverman and Spruill (1977). The focus of this research is an investigation into the relationship between a price index for retail heroin and monthly-recorded crimes, the assumption being that heroin expenditure is a function of the retail price and quantity consumed. This relationship between expenditure and consumption can be simply expressed as:

$$D_t = H(P_t).P_t, \qquad (7)$$

where, $P_t$ is the price of heroin and $H(P_t)$ is the quantity consumed at this price. In this case, heroin consumption is assumed the following function form:

$$H_t = h_0 P_t^h, \tag{8}$$

where $h$ is the elasticity of heroin consumption with respect to price. This yields an expenditure function of the form:

$$D_t = h_0 P_t^{1+h} \tag{9}$$

Unfortunately, appropriate data to estimate (9) directly were not available to the authors, so an alternative approach was taken. Silverman and Spruill, suggest that the willingness of an addict to adjust consumption in reaction to price changes is related to the tolerance built up and the availability of substitutes (e.g. methadone). As such, they model price elasticity as a nonstochastic function of the potency of heroin and its price relative to recent prices. This relationship is given as:

$$h = l_1 e^{-S_t} + l_2 e^{-(\bar{P}_t/P_t)}, \tag{10}$$

where $\bar{P}_t$ is the average price of heroin in the 4 months prior to month t, $P_t$ is the price of heroin in month t and $S_t$ is the potency (purity) of the average retail sale in month t. The model was estimated using monthly data from Detroit during the period November 1970 through July 1973. As we will see, from this equation inferences can be made about the elasticity of heroin demand based on heroin prices and crime data only. There are some caveats that should be observed nevertheless. Firstly $h$ in (10) will only truly represent elasticity of demand under the condition where $\bar{P}_t/P_t = 1$ and hence it is a measure of 'long-run' elasticity. A second requirement is that price changes are caused by shifts in exogenous supply i.e. the demand curve is stable. Another caveat is that the price and potency data used by Silverman and Spruill reflect conditions in only one heroin market (Detroit) and were estimated from data acquired by the DEA. The final results were estimated using least squares regression on a log linear crime model incorporating (10). The estimates suggest significant values of $l_1$ and $l_2$ of 0.251 and 0.670 respectively. Thus, for a relative price level of 1

$(\overline{P}_t/P_t = 1)$ and a potency of 2.5% , the long-run elasticity of consumption is −0.267 (reducing to −0.247 for 10% potency). This suggests that a 10% price increase in retail heroin will result in only a 2.7% reduction in consumption.

Although the Silverman and Spruill results can only be viewed as tentative, their work stood alone in the literature until the subject was revisited by Caulkins (1995b), Bretteville-Jensen and Sutton (1996), and Grossman and Chaloupka (1998). The approach taken by Caulkins is to circumvent the lack of reliable data on quantity and price by partitioning the price elasticity into the product of two elasticities that involve an intermediate quantity whose relationship with market quantity can be modelled. Using data from the US Drug Use Forecasting System,[16] Caulkins includes the percentage of arrestees testing positive for the drug in question as an intermediate variable. The model breaks the problem into a series of simpler estimation problems that includes the arrests of drug users and non-users (both unrelated to drug use and as a function of drug use) and a function of spending on drugs. Using data from the STRIDE to produce price series, Caulkins combines this with the arrest data from the Drug Use Forecasting System to produce a number of price elasticity estimates via two stage least squares regression. In particular, he estimates the elasticity of demand for cocaine to be −2.5 and that for heroin to be −1.5. Although these are in sharp contrast to the results for Silverman and Spruill (1977), the error bands around the point estimates are quite large due to the many data uncertainties and, conceivably, the estimate for cocaine could be as small as −0.5.

The empirical debate over the true nature of demand elasticities is further muddled by the work of Bretteville-Jensen and Sutton (1996) who introduce a new distinction between 'ordinary' drug users and dealer-users. The authors use data on 500 individuals collected via questionnaire from attendants at a needle exchange service in Oslo, Norway. The data includes information concerning income (and its sources), heroin consumption, dealing activity (recognising that drug users will often switch to dealing to finance their consumption) and prices paid. In addition to this information, the authors also include data regarding attitudes toward risk, the effect of arrest on status and information on exchange visits and syringe distribution. Using this data Bretteville-Jensen and Sutton estimate three models in turn. The first is a switching regression model of heroin consumption with endogenous switching on dealing status. Observing that the consumption of dealers and non-dealers could

[16] This programme was recently re-launched as the Arrestee Drug Abuse Monitoring Programme (ADAM), which was the basis of the NEW-ADAM programme currently running in England and Wales.

be derived from a two-equation latent structure, the authors jointly estimate these with an auxiliary equation that allows for self-selection of dealing status. The second model is a self-selection model of the quantity of heroin sold by dealers, jointly estimated with the participation equation from the first model. Finally, spline functions are introduced into the switching regression model to test for different forms of the relationship between price and consumption. Bretteville-Jensen and Sutton find that the price elasticity of demand for dealers is much smaller (in magnitude) than that of non-dealers (–0.20 compared to –1.23). The caveat to be observed here though is that the results also suggest that individuals do not make the choice to deal independently of their consumption. In other words, if dealers are heavier consumers they are more likely to be less price-responsive. However, although the estimate for dealers is similar to the Silverman and Spruill (1977) estimate, the market conditions in Detroit during the early seventies are likely to be quite different from those prevailing in early nineties Oslo. The other important result Bretteville-Jensen and Sutton report is on the hypothesised 'double-kinked' demand curve, originally proposed by Wagstaff and Maynard (1988). The results of the estimated spline functions (which allow for varying elasticity in different segments of the demand curve) offer no evidence to support the hypothesis. Although these results are only based on a range of prices quoted in Oslo over one year (and Wagstaff and Maynard offer no indication of the price ranges at which the slope of demand might change) they do cast doubt on the practical existence of a multi-segmented demand curve for addictive drugs.

Other estimates worthy of consideration are Nisbet and Vakil (1972) and van Ours (1995). Nisbet and Vakil (1972) consider the price elasticity of demand for marijuana (cannabis) using data collected via an anonymous postal questionnaire of students. Although the methodology is potentially objectionable, the researchers asked the students to trace their own demand functions and this information, coupled with other actual data, were used to estimate a linear and a double log demand function. Using simple regression techniques, the authors suggest price elasticities of demand for cannabis at the going markets prices of between –0.36 to –1.51. There are of course many caveats to these results, not least the nature of data collection, but they are useful indicators of price sensitivity of cannabis demand. A quite different approach is presented in Van Ours (1995), who takes a retrospective look at Opium demand in the Dutch East Indies (Indonesia) for the period 1923 to 1938. The data were collected during the so-called Opiumregie, a system by which the importation, production and sale of opiates was operated via a state monopoly. The Dutch government intended to use the system to reduce criminality, guarantee purity and ultimately reduce

opium use. To estimate price elasticities, van Ours used consumption data from 22 regions for the period under consideration and constructed series for the real opium price and real income. Using two stage least squares, the elasticity of demand for opium in the period is estimated at −0.7 and −1.0 for the short and long-run respectively.

Clearly there is not yet a consensus on the possible range of price elasticities for certain drugs. The various empirical estimates found in the literature are summarised in Table 1. Although these figures illustrate the wide range of estimates that have been presented, the general conclusion must be that for many drugs consumer demand is to some extent responsive to changes in market price and therefore policy interventions need to be devised with this in mind. Indeed, these results suggest that illicit drug users are on average just as, or even more responsive to price changes than cigarette smokers, although one must bear in mind the error bands on all these estimates (see Labeaga (1999) for a discussion of recent estimates of the price elasticity of demand for cigarettes).

Table 1. Summary of price elasticity estimates for various drugs

| Author(s) | Drug(s) | Data | Elasticity |
|---|---|---|---|
| Bretteville-Jensen & Sutton (1996) | Heroin | Questionnaire of Norwegian addicts | -0.20 (dealers)<br>-1.23 (non-dealers) |
| Caulkins (1995b) | Heroin & Cocaine | Drug Use Forecasting System and STRIDE | -2.5 (Cocaine)<br>-1.5 (Heroin) |
| Grossman & Chaloupka (1998) | Cocaine | Monitoring the Future Survey and STRIDE | -0.96 (short run)<br>-1.35 (long run) |
| Nisbet & Vakil (1972) | Cannabis | Questionnaire of UCLA students | -0.36 (lower bound)<br>-1.51 (upper bound) |
| Silverman & Spruill (1977) | Heroin | Monthly data (1970–1973) from Detroit | -0.27 |
| van Ours (1995) | Opium | Government data from 1923–38 | -0.7 (short run)<br>-1.0 (long run) |

### 4.2.4 Demand-Side Policies

In the previous section we considered how policies aimed at affecting drug supply might be evaluated. We now turn our attention to the policies aimed at changing consumer demand for drugs. There tends not to be a great deal of discussion in the economics literature about the

efficacy or desirability of so-called demand-side policies. This is perhaps understandable, as the typical aim of these policies is to reduce the consumption of illicit drugs through education, rehabilitation or harm reduction programmes, whereas economists have been concerned with the more general consequences of addictive behaviour (Buck et al. 1996). We have already seen that drug users are likely to respond to price changes, particularly in the long run and that policies that bring about long-term changes in drugs prices will have a more lasting affect than temporary 'wars on drugs'. However, we also need to consider policies that are aimed at addicts directly. In this respect, we can reflect on two opposing outcomes in the literature: one that comes from the Rational Addiction framework and one that is based on empirical evidence, albeit at a local level.

When analysed in the context of the Rational Addiction model, harm reduction programmes have been criticised for being counter productive (Neri and Heather, 1995; Stevenson, 1994a). The reason for this conclusion is that harm-reduction initiatives, such as needle exchanges and information centres, effectively reduce the expected cost of addiction. This is because rational addicts will take account of the total cost of drugs, which includes the extra cost and risk (or future harm) associated with illegal activity (e.g. impurities, violence, the risk of AIDS from sharing needles, search costs, etc.). Harm reduction programmes typically reduce mortality and the expected future harmful consequences of addiction, and hence the total cost. As a consequence, the reduction in expected future costs of addiction could result in greater drug use (although arguably it is the harm caused by drug use that is the point of concern, not the amount per se). The same argument can be used about the role of information when set in the context of harm reduction. For example, Stevenson (1994b) argues that if purely factual information is provided (as opposed to government "Just say No!" campaigns), this could lead to addicts believing that drug use is not as dangerous as they might have first thought. Again, this reduces the expected total cost of drug use and is likely to increase demand.

Contrary to this theoretical prediction, there is some evidence that harm-reduction programmes can be beneficial. Coid et al. (2000) report the results of a study into 221 opiate addicts that sought methadone treatment in the inner-city area of London between 1995 and 1998. The key finding in this research was that during a six-month study period for the 116 of these subjects that were followed up, heroin use decreased by around 50%. In addition, this reduced drug use was associated with lower levels of crime. In terms of the economic impact, the authors estimate that the benefits of six months methadone treatment (a reduction in illegal earning of between £2,000 and £7,8000 per addict) compared favourably with the costs

of the programme (approximately £960 per addict). Of course, there are a number of caveats that should be mentioned. Firstly, from this small sample we cannot assume that all methadone treatment programmes will be as successful: not all heroin addicts will respond in the same way, and over three quarters of the addicts in the study were self-presenting.

Whether or not demand-side policies have the desired effect remains to be resolved. Typically these policies have not received as much public money as enforcement policies aimed at reducing imports of drugs into the UK. However, since the publication of the Ten-year Strategy more emphasis has been placed on harm reduction and general demand side interventions. To help young people resist drug misuse, the United Kingdom Anti-Drugs Co-ordination Unit (UKADCU), via the Strategy, has initiated the delivery of drug education in schools through Personal, Social and Health Education (PSHE), which is included in the National Curriculum, and the National Healthy Schools programme which is designed to implement PSHE. In terms of meeting the objective of protecting communities from drug-related anti-social and criminal behaviour, two initiatives have been implemented. The first, the arrest referral scheme, seeks to reduce drug-related crime by encouraging problem drug users who are arrested to take up appropriate treatment or other effective programmes of help. The second initiative was the piloting of Drug Treatment and Testing Orders (DTTO). A DTTO enables a court, with the offender's consent, to make an order requiring the offender to undergo treatment for drug misuse. There are many other demand-side initiatives being implemented by UKADCU, but as yet conclusive evaluation of their effectiveness is not available. However, although the Rational Addiction model predicts that the likely consequence of these programmes is an increase in drug use, one could argue that 'managed' drug users will probably impose lower external costs on society.

## 5. Concluding Remarks

We began this review by considering the contribution of the economic model of Rational Addiction to the study of addictive behaviour. Becker and Murphy's (1988) theory is an important starting point in the economics literature as the authors show that addictive, and typically harmful, behaviour is quite rational in the sense that it involves forward-looking utility maximisation with stable preferences. Although this might appear at odds with what we know about addictive behaviour, the model appears to adequately describe patterns of drug use that have been observed. Empirically, the Rational Addiction model has been applied in a number of contexts. In the majority of cases, the properties of the model appear to hold true,

with the coefficients on past and future consumption found to be statistically significant and positive, and the coefficient on current price negative and significant.

Beyond the Rational Addiction model, we considered the welfare economics framework and saw how it is a valuable tool for identifying the relevant social costs of illicit drug use. It is perhaps best thought of as a framework for thought, and clearly it provides a rationale for government intervention. For example, the framework suggest that there are a number of external costs of drug use, such as crime and health care costs, that are not taken into account by the individual when making his or her decision to consume drugs. Thus by intervening in the drugs market and bringing about a decrease in consumption, the subsequent reduction in society's costs exceed the reduction in individuals' benefits and overall welfare is improved. One of the difficulties with this approach to policy recommendations, however, is that it is a normative framework that accepts idea of consumer sovereignty. This makes it incompatible with the rationale for intervention that comes from the idea of 'demerit goods', whereby individuals are thought not to act in their own best interests when they make the decision to consume potentially harmful drugs.

Finally in this review we have seen that economists have attempted to further our understanding of the relationship between enforcement policies, prices, and consumer behaviour. This work represents a fundamental contribution to furthering our understanding of illicit drug use. However, echoing the concern of Bridges (1999), quoted in the introduction to this paper, policy makers and drug researchers do not appear to have fully recognised this in their work. This concern was reflected in a recent editorial of the journal Addiction:

> ... It is not only better price data, but also better analysis that are needed. Prices can only be understood in the context of market dynamics. Too often the term "demand" is used when consumption is more appropriate, and supply is equated simply with the total quantity produced, thus suppressing important behavioral issues. This is obviously a task for economists, who are trained in, and obsessed by, such analysis, although not nearly so good at or interested in data collection... Prices are central to understanding drug policy, but they are poorly measured and analytically marginalised. The development of better price data, along with their analysis, would serve well both researchers and policy makers. (Caulkins and Reuter, 1999, p. 1263).

In conclusion, it would appear that economics has a vital role in drug policy and drug research, although one clear omission from the economics literature is any substantial research into the nature of drugs 'firms'. Clearly, economists need to make advances in this area, as we need to understand how drug suppliers react to policy interventions. We have a better understanding of how consumers react to prices (although we still have very poor price data), but we do not know how suppliers react to changing costs, especially non-direct costs such as the risk associated with supplying in an illegal market. There is also one final observation we can make about the review we have presented here: that virtually none of the empirical work in the area of the economics of illicit drug use is set in a British context. The reason for this is simple: in the UK, data collection is incredibly sparse. That which exists is typically generated by small, localised projects, often funded by the Home Office. The only truly national drug use information comes from the British Crime Survey (BCS), but this has been criticised as it is severely limited in its applications (see MacDonald (2000) and MacDonald and Pudney (2000a)).

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