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Estimating the effects of health service charges :

Evidence on the utilisation of prescriptions

by MANDY RYAN and STEPHEN BIRCH

DISCUSSION PAPER 37

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Acknowledgements

The Authors would like to acknowledge the financial support of the Department of Health and Social Security.

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The Centre for Health Economics is a Designated Research Centre of the Economic and Social Research Council and the Department of Health and Social Security.

Contents

Abstract

The effects of regular and frequent increases in NHS patient charges on patient utilisation and average net ingredient costs of prescription items are analysed using data on NHS prescribed drugs in England for the period 1979-1985. Separate equations are estimated for non-exempt and exempt adult non-elderly patient groups. The estimates suggest that the prescription charge policy has led to a significant reduction in utilisation during a period when the underlying trend for prescription utilisation was increasing. While the policy has generated an increase in available resources by far the greater proportion of these resource consequences has arisen from the reduction in service use, the opportunity costs of which cannot be estimated from available data. However there is no *a priori* reason to believe that deterred or delayed utilisation is confined to frivolous or unwarranted consumption of prescribed drugs. Indeed if such utilisation does occur it is unlikely to be confined to the non-exempt population and is the result of frivolous prescribing by general practitioners. Increasing prescription charges may therefore be reducing as opposed to enhancing the efficiency of use of primary care resources. Alternative policy options are considered for promoting greater efficiency in resource use in primary care provision.

1. Introduction

The financing of health care in the UK is once again the subject of a considerable number of inquiries, working groups and reports. From our reading of the existing, and extensive, literature on the subject we tend to agree with Klein (1987) that there are "... no new ideas about alternative ways of funding health care waiting to be discovered ... only old ideas in a new context." In this paper we consider one of these "old ideas", the use or extension of user charges, which will undoubtedly receive considerable attention from the protaganists of the 'crisis in health care' hypothesis and features predominantly in the Government White Paper on Primary Care. In particular we shall seek to shed light on the effects of such a policy on health care utilisation by reference to observed trends in the utilisation of NHS prescribed drugs over the period 1979-1985, during which a noticeable change in policy on user charges occurred. We are unaware of any existing published evidence of the effects on utilisation of regular and frequent increases in the real value of prescription charges over this period. The Department of Health and Social Security (DHSS) performs its own analysis (DHSS personal communication) although the findings remain unpublished. As a result debates concerning the use or extension of user charges tend to be dominated by the ideologically based prejudices of politicians and pressure groups with the usual lack of concern for the facts.

The recent history and current position of the prescription charge is considered in section 2. The limited empirical evidence on the effects of the charge is reviewed and consideration is given to how the present study enhances the existing work. The empirical analysis is reported in section 3 with particular attention being paid to the elasticities of prescription numbers and prescription content with respect to the prescription charge for patients who are respectively exempt and not exempt from the charge. Section 4 discusses the results of the empirical analysis in the context of the current debate on NHS finances.

2. The prescription charge as a barrier to utilisation

The prescription charge was first introduced in 1952 at a level of one shilling (five pence). The charge was raised on three occasions over the next 27 years. (In addition there was a short period, 1965-8, when the charge was abolished altogether). While the level of charge increased by 400 per cent in nominal terms over this period in real terms the charge fell slightly; if charges had risen in line with the retail prices index (RPI) the 1979 level would have been 24p compared with the actual charge of 20p.

Since coming to office in 1979 the present government has adopted a policy of continually increasing the real value of patient charges. In July 1979 the charge was increased to 45p. By 1985 it had risen to £2.00. This represents an increase of 590 per cent after allowing for inflation (it has since increased further to £2.40 per item).

Applying standard economic theory to the market for prescriptions implies that the demand should have fallen over the period 1979-1985 or at least risen at a rate less than would have occurred in the absence of the charge increases. The Government's rationale for this policy is two fold; to raise additional revenue and hence reduce the net exchequer cost of the service; and to improve efficiency by deterring the frivolous or unwarranted use of the service. The success of the policy therefore depends upon the size and nature of the response to the charge increases. However on *a priori* grounds the policy is seriously flawed. In particular, the additional opportunity cost to the patient generated by the charge is not related to the expected health outcome and hence cannot discriminate between frivolous and non-frivolous demands. Furthermore exemption from the charge is granted to large sections of the population, some of which are related to means, others to demographic factors. Only a small minority of exemptions (around 7.5 per cent in 1986) are related to expected outcomes and then only loosely (e.g. prescriptions for certain chronic conditions). As for patients subject to the charge, there is no differential opportunity cost between frivolous and non-frivolous use for the exempt groups.

Given the patients lack of information on the effectiveness and efficiency of prescribed drugs there is no reason why patient charges should have a greater effect on frivolous use than on non-frivolous use. As a consequence charges may be inhibiting, as opposed to promoting, improvements in the efficiency of use of scarce health care resources.

Furthermore the revenue implications of the policy are not determined solely by the effect on the numbers of prescriptions dispensed but also depend on the policy's impact on future demands for health care and the supplier response.

There is extensive evidence in the literature showing that user charges are associated with reductions in utilisation of health care services (for reviews of the evidence see Cairns and Snell 1978, van der Ven 1983; for more recent evidence see Newhouse et al 1981, Manning et al 1984, Soumerai et al 1987). However most of this work is based on North American experiences. Consideration of the effect of prescription charges on the utilisation of NHS prescribed drugs appears to be limited to two studies, neither of which has received wide publication.

O'Brien (1981) estimated demand equations for exempt and non-exempt prescriptions separately using quarterly data for the period 1969-80. The estimated own-price elasticity of demand was -0.105 ($p<0.01$) for non-exempt prescriptions. For exempt prescriptions demand was unresponsive to price as expected, since a price is not charged for these items. Lavers (1983) estimated an own price elasticity of demand of -0.18 ($p<0.01$) for non exempt prescriptions using monthly data for the period 1970-81.

A limitation of both studies is their failure to distinguish between demand and utilisation. Individuals consult their doctors to seek improvements in health. The doctor translates this demand for health into a derived demand for health care (Grossman 1972). The observed consumption of prescribed drugs is therefore not only dependent upon patient demand characteristics but also upon factors determining doctor behaviour. This point was emphasised by Stoddart and Barer (1981) who suggested that

> "While the specification in most demand studies may be appropriate in a world of perfect agents, they are likely to be inappropriate wherever physicians exercise discretionary power over any utilisation which deviates from that of a fully informed patient."

Thus health care utilisation may bear only a second or third generation resemblance to the economist's notion of demand. If the agency relationship is perfect, demand and utilisation are identical. Since in the health care market there is imperfect information, the observed levels of consumption represent utilisation as distinct from patient demand.

Lavers and O'Brien both failed to distinguish demand from utilisation in their models. In the case of Lavers this occurred even though cost equations were also estimated in order to test for supply side (i.e. doctor) responses to price changes. In both studies demand equations were specified from a conventional neoclassical model of consumer sovereignty. In this study supply side effects are considered explicitly since the revenue consequences and efficiency implications may differ according to the size of the demand side and supply side effects. The failure to distinguish demand from utilisation may therefore seriously undermine the usefulness of these existing studies.

A second feature of this study is that the period covered is one of substantial price change. Both Lavers and O'Brien used data for long periods of constant nominal prices with short periods of considerable price changes towards the end. As a result they may be unsuitable for considering the implications of regular and dramatic increases in prescription charges as observed over the last 8 years.

A third feature of this study is that separate equations are estimated for each category of charge status using data specific to each group. Although O'Brien estimated separate equations for exempt and non-exempt demand he did not consider the effects of prepayment certificates which are essentially a means of insuring against the cost of prescriptions carrying a charge. However in the past they have been placed in the same category as exempt prescriptions. Attempts to compare trends in utilisation of prescriptions by charge status of patients have been inhibited as a result (Birch 1986). Lavers' study is restricted to the analysis of non-exempt prescriptions. The observed effects of charge increases may therefore be explained by unobserved factors correlated with, but not caused by, movements in price. While O'Brien overcomes this problem by comparing the estimated coefficients on price for exempt and non-exempt demand equations he is restricted by his data in considering possible alternative explanations of the observed relationship. For example trends in morbidity, not represented by the proxy variables used, could explain the observations. Where he attempts to allow for such effects, by comparing the size of the relationships for non-exempt and exempt groups (i.e. using the exempt group as a 'control group' with respect to price) he does so inadequately since the control group differs from the non-exempt in ways which will influence demand for and cost of prescriptions (i.e. the young and the elderly have automatic exemptions, but they are likely to differ from the adult non-elderly for, *inter alia*, epidemiological reasons).

In this present study equations for adult non-elderly exempt patients only are estimated and used as a comparison (or control) group for the non-exempt in order to remove this source of bias.

3. Empirical analysis

The objective of this section is to estimate the effect of increased prescription charges on utilisation and average NICs of NHS prescribed drugs for the period 1979-1985. Separate cost and utilisation equations are estimated for exempt and non-exempt groups.

Several variables are included in the estimated equations which, *a priori*, are expected to influence the dependent variables. Our primary interest is with the price variable. Since the exempt group is exempt from charges, *a priori* price is not expected to effect utilisation or costs of prescriptions. However since price may be correlated with other factors which influence the dependent variable but which are not identified in this model, the estimation of the exempt equation allows us to control for any such unidentified effects by comparing the coefficients on price in non-exempt and exempt equations.

The equations to be estimated are as follows:

(i) $$Q = K_Q + a_Q P + \sum_i b_{Qi} X_i + U_Q$$

(ii) $$C = K_C + a_C P + \sum_i b_{Ci} X_i + U_C$$

where Q is the log of prescription utilisation per 1,000 population per month

C is the log of the average NICs of prescriptions expressed in real terms

P is the log of the real price of NHS prescriptions

X_i are the other independent variables (see below)

K_Q and K_C are constants

a_Q, a_C, b_Q, b_C are the estimated regression coefficients

U_Q, U_C, are the error terms.

The null hypotheses to be tested are

(a) H_0: $a_{Q,NE} > 0$ H_0: $a_{C,NE} < 0$

(b) H_0: $a_{Q,NE} = a_{Q,E}$ H_0: $a_{C,NE} = a_{C,E}$

Rejection of the hypotheses in (a) would imply that there are significant statistical relationship between the dependent variables and price. Rejection of the hypotheses in (b) would imply that there is a significant difference between the size of the relationships for exempt and non-exempt groups indicating that price influences utilisation and costs differently among the two groups.

Monthly data were provided by the DHSS giving estimated numbers of exempt, non-exempt and prepayment prescriptions dispensed in England for the period January 1979 - December 1985 along with a breakdown of exempt prescriptions by exemption category based upon prescriptions submitted to the Prescription Pricing Authority by a 2½ per cent sample of chemists. Children and the elderly (females over 60, males over 65) are automatically exempt from charges. Since these groups differ in their health experiences from the adult non-elderly, in this study the exempt group is restricted to the adult non-elderly exemptions on the grounds of low income to control for such epidemiological influences on utilisation and costs. Prescriptions for contraceptive drugs were also excluded since these are exempt from charge for all patients. In order to allow for changes in the sizes of exempt and non-exempt groups over the period, utilisation by charge status is expressed as a rate per capita within each group. However, data on the number of persons eligible for exemption and the numbers holding prepayment certificates are no longer published by the DHSS. The exempt population is therefore estimated by summing the number of claimants of Supplementary Benefit and Family Income Supplement. Although this underestimates the numbers eligible, for the purpose of this analysis it is the trends in the exempt and non-exempt populations that is of importance, not their absolute size. Prepayment and non-exempt utilisation were grouped together to generate data on aggregate non-exempt utilisation. The aggregate non-exempt population was simply the adult non-elderly population of England minus the estimated exempt population. In order to control for variation in the monthly incidence of non-working days, which may generate an artefacutal reduction in the dispensation rate of prescriptions, prescription items dispensed per month were divided by the number of working days in the appropriate month and multiplied by 24 to get utilisation in a standard working month. This figure was divided by the population estimates to generate utilisation per 1,000 population per standard month.

Cost equations are estimated using data on monthly average net ingredient costs of prescriptions. These were recorded separately for exempt, non-exempt and prepayment groups. The nominal cost data are divided by the retail price index (RPI) to obtain real average cost per prescription data .

The explanatory variables used for both cost and utilisation equations are as follows; firstly the real price of prescribed drugs as given by the nominal price divided by the RPI. In the case of the non-exempt, price is expected to have a negative effect on utilisation and a positive effect on costs _a priori_; real income is obtained by deflating the index of monthly average earnings of all employees by the RPI. If prescription drugs are normal goods we might expect income to have a positive effect on utilisation. However, since health tends to be positively associated with income (DHSS 1980, Le Grand 1982) _a priori_ a negative relationship between income and utilisation is expected.

The relative price of substitutes is derived by dividing the RPI for medicines, surgical goods and toilet requisites by the RPI for all items. A positive correlation with utilisation is expected _a priori_ since, as the relative price of substitutes increases, individuals can be expected to substitute the relatively less expensive NHS drugs.

Morbidity is proxied by the number of new claims for sickness and invalidity benefit which, _a priori_, are expected to have a positive effect on utilisation and costs. The morbidity proxy has two major limitations.

Firstly it relates to morbidity among the working population only. However, the exempt population includes a substantial proportion of individuals out of work whose trends in morbidity may not be reflected by morbidity trends among the working population. Secondly, sickness payment legislation changed in April 1983, extending the period of work absence before GP certification of sickness is required. As a result of the change, recorded sickness absence fell by 1 million and hence the proxy is less useful as an indicator of morbidity. Its use in the present study is substantiated in terms of the lack of any better proxy for morbidity being available.

Because consultation with a GP is a precondition of consuming prescribed drugs, an access variable of GPs per 1,000 population is included. A positive relationship is expected _a priori_, between access and utilisation, but a negative relationship between cost and availability since patients will consult sooner in an illness episode as accessibility to GPs increases.

The monthly unemployment rate is included to take account of any relationship between unemployment and morbidity. A seasonal dummy is included for the months November to February inclusive to allow for differences in the prevalence and nature of illness in winter months. Finally, a dummy variable is included to take account of the introduction of the Limited List of drugs available for NHS prescription in April 1985. The introduction of this list was an attempt to reduce the costs of prescribing by limiting the range of drugs available for prescription. If the policy has been successful then the dummy variable should have a negative coefficient on both costs and utilisation as GPs substitute less expensive for more expensive drugs and stop prescribing drugs for minor conditions which may be dealt with by the purchase of non-prescribed drugs.

Unless stated otherwise these data were taken from the UK Monthly Digest of Statistics (Central Statistical Office 1980-1986).

The equations were estimated using multiple regression analysis, applying the Ordinary Least Squares (OLS) estimation technique. A log linear model was used to allow for multiplicative effects of the independent variables, i.e. the size of the relationship between one independent variable and the dependent variable may depend upon the size of one or more other independent variables. Actual values of the dummy variables were used since zero values of the dummies were recorded for some observations.

All equations were estimated using real values of the money variables in order to reduce the level of multicollinearity between the variables. The validity of this imposition of the homogeneity assumption was established following the method of Thomas (1985) (see appendix 1).

The original results of estimating the equations suffered from serial correlation as indicated by low values of the Durbin Watson statistics (appendix 2). As a consequence, the parameter estimates are not maximum likelihood estimators and their sampling variances are likely to be seriously underestimated (Johnston 1972). In response to this all equations were re-estimated using the Cochrane-Orcutt iterative technique (Maddala 1979) which imposes a first order autoregressive scheme on the errors, i.e.

$$U_t = U_{t-1} + e_t$$

where e_t satisfies all the classical assumptions. This procedure involves re-estimating the equation using first differences and thus helps overcome the problems of spurious correlation inherent in any time series analysis. The results of these re-estimations are recorded in tables 1 and 2.

Utilisation of Prescriptions

The estimated coefficients for the utilisation equations are recorded in table 1.

(a) Non-Exempt Of the independent variables used only own price and the limited list are significant ($p < 0.05$, one tailed test).

The negative effect of price is consistent with *a priori* expectations and with the results of previous work by Lavers (1983) and O'Brien (1981). This implies that the null hypothesis that utilisation is independent of price can be rejected. The size of the coefficient indicates that a 10% increase in price gives rise to a 1% reduction in utilisation. This result is further strengthened when compared with the estimated own price coefficient in the exempt group (see below).

The negative coefficient of the limited list is also consistent with *a priori* expectations. It implies that in some cases over the counter substitution or reduced consumption has been generated by the 'black list' of certain drugs as opposed to the substitution of cheaper NHS prescribed drugs. Irwin *et al* (1986) reports a similar result from a survey set up to monitor the list by a panel of 200 pharmacists throughout Britain. There was a decrease of 25% in the number of drugs prescribed in the categories affected by the list.

The coefficient of morbidity is insignificant, which is inconsistent with *a priori* expectations and with the results of Lavers (1983) and O'Brien (1981). This may be due to the changes in sickness payment legislation in April 1983 which reduced the number of sickness claims overnight by one million. As a result the short term changes in minor illnesses, which may give rise to prescription utilisation, and which were previously identified by Lavers (1983) and O'Brien (1981), are not included in post 1983 sickness payment claims. Clearly future research on the utilisation of prescriptions would benefit from an improved proxy for morbidity.

The supply of GPs is insignificant providing no evidence of easing of access to GPs among the non-exempt group as aggregate GP provision increases. Also insignificant are the price of substitutes, the seasonal dummy and the level of unemployment.

Table 1 Regression coefficients for prescription utilisation per 1,000 population per month after adjusting for serial correlation

Independent Variable	Regression Coefficients Non-Exempt	Regression Coefficients Exempt
Price of prescriptions	-0.097*	0.081*
Price of substitutes	0.060	0.219
Level of income	0.079	-0.506**
Sickpay numbers	0.009	-0.050**
Level of GPs	-0.124	3.027**
Level of unemployment	-0.131	0.246**
Seasonal dummy	0.021	0.044**
Limited list dummy	-0.127**	-0.053*
	$\bar{R}^2 = 0.53$	$\bar{R}^2 = 0.66$
	F = 12.43	F = 20.69
	DW = 1.87	DW = 1.90

* $p < 0.05$

** $p < 0.01$

(b) Exempt All of the independent variables used are significant with the exception of the relative price of substitutes.

The positive effect of price reinforces the findings for the non-exempt group and rejects the null hypothesis that H_0: $a_{Q,NE} = a_{Q,E}$. It suggests there is some underlying or unspecified trend of increasing utilisation which is swamped in the case of non-exempt prescriptions by the effect of price. That is to say, the observed positive correlation between utilisation and price is due to spurious correlations between price and other variables which have been inadequately controlled for in the analysis (e.g. morbidity) and which may also be expected, a priori to have applied to the non-exempt group. Hence, the results suggest that the elasticity of utilisation with respect to price is underestimated for the non-exempt. Since the a priori expectation of the price coefficient is ambiguous a more appropriate null hypothesis to be tested would be H_0: $a_{Q,E} = 0$ in which case a two tailed test of significance is appropriate. In this case the coefficient of price is not significant. Nevertheless the two tailed confidence interval (-0.013, 0.174) does not overlap the confidence interval for the coefficient of price in the non-exempt group. Hence the rejection of the supplementary hypothesis H_0: $a_{Q,E} = a_{Q,E}$ is robust to the use of a two tailed test. In addition, the observed positive elasticity of utilisation for exempt patients may be explained by an increased 'take-up' among those eligible for exemption as price rises. The inconsistency of this result with O'Brien (1981), who found price to be insignificant, may be due to the fact that the period he studied was not one of substantial price change and thus such changes in take-up prevalence did not occur. However, the spurious correlation argument would appear to be the more likely and dominant explanation.

The positive effect of GP supply is consistent with a priori expectations and also with O'Brien's results. This may be explained by the increased per capita supply of GPs reducing the access costs or shadow price of attending the GP, particularly for the exempt group. Although per capita

GP supply was found to be insignificant for the non-exempt group, this can be explained by (i) the elasticity of utilisation with respect to access costs being greater for exempt groups and/or (ii) elasticity of access costs with respect to GP supply being greater for exempt groups and hence a greater impact on utilisation would be expected among the exempt group.

The negative income effect can be explained by a negative correlation between morbidity and income (DHSS 1980, Le Grand 1982). However the income variable is proxied by earnings data which are more likely to reflect changing circumstances of non-exempt rather than exempt populations. As a result the observed correlation probably reflects a spurious correlation between earnings and changes in the size of the adult non-elderly exempt group.

The negative coefficient of morbidity is inconsistent with _a priori_ expectations and with the results of O'Brien (1981). However, this may be explained by the limitations of registered sickness absence from work as a morbidity proxy. Its limitations are increased when we look at the exempt population since such a group consists of a substantial proportion of individuals out of work.

The significance of the seasonal dummy suggests that utilisation is higher in the winter months among exempt groups. It is interesting to compare this result with that for the non-exempt group, where the dummy variable was insignificant. One interpretation of this finding is that the exempt population are more susceptible to adverse health effects of the winter months.

The coefficient of the limited list dummy is found to be significantly less than zero but further testing shows it to be significantly greater than the corresponding coefficient for the non-exempt group. It therefore appears that the limited list policy has resulted in less items of drugs being prescribed with the impact being greater among non-exempt patients.
Whether this is the result of the 'black listed' drugs having previously been prescribed more often for non-exempt patients, or that the GPs have

substituted other, possibly more expensive, higher quality drugs for exempt patients cannot be determined. Nevertheless, the policy has had a significantly greater effect on non-exempt utilisation.

The positive effect of unemployment is consistent with a priori expectations and with the results of O'Brien (1981). While this appears to support the unemployment-health relationship hypothesised by Brenner (1979) it might also reflect the fact that being unemployed reduces the time costs involved in consulting a GP and hence may give rise to more morbidity being presented to the GP.

Average prescription costs

The estimated coefficients for the cost equations are recorded in table 2.

(a) Non-Exempt The coefficient on price is insignificant, contrary to a priori expectations. Hence there is no evidence that GPs have responded to higher prices by prescribing significantly higher quantities and/or more expensive drugs. Whilst Benjamin and Ash (1964) found the opposite result, Lavers (1983) also failed to find support for this hypothesis.

Of the remaining independent variables only coefficients for morbidity and income are significant. Income is the most important variable in explaining the variation in average costs. The positive coefficient was also observed by Lavers (1983) and may be explained by increasing income giving rise to more costly forms of treatment either due to the types of illnesses occurring or the types of drugs being used to treat the illnesses.

The negative effect of morbidity is consistent with a priori expectations and with the results of Lavers (1983). However the observation should be treated with caution given the limitations of the morbidity proxy. Nevertheless it may imply that the marginal cost of illnesses for which drugs are prescribed is falling and may reflect increased dependence on the medical profession (Illich 1975) reflected in an increase

Table 2 Regression coefficients for average net ingredient costs of prescriptions after adjusting for serial correlation

	Regression Coefficient		
Independent Variable	Non-Exempt	Exempt	Prepayment
Price of prescriptions	-0.029	0.045*	0.016
Price of substitute	0.037	0.079*	0.174**
Level of income	0.815**	0.752**	0.656**
Sickpay numbers	-0.052**	-0.041**	-0.017**
Level of GPs	-0.215	-0.902*	0.101
Level of unemployment	0.069	0.003	-0.018
Seasonal dummy	0.008	0.001	-0.002
Limited list dummy	0.005	-0.014	-0.023**
	$\bar{R}^2$ = 0.88	$\bar{R}^2$ = 0.86	$\bar{R}^2$ = 0.91
	F = 66.8	F = 60.39	F = 109.32
	DW = 1.95	DW = 2.19	DW = 1.87

* $p < 0.05$

** $p < 0.01$

in the number of more trivial GP consultations (Mechanic 1970, Dunnell and Cartwright 1972) with GPs responding by prescribing low cost drugs.

The introduction of the limited list appears to have had no significant effect on costs. Since its intention was to reduce costs by restricting prescribing in certain categories of drugs, the policy appears to have failed as far as prescription content for non-exempt patients are concerned. Irwin et al (1986) also found that the limited list had little effect on costs. They showed that whilst there had been a reduction in the prescribing of some drugs affected by the list, the prescribing of iron and penicillin which are not affected by the list, had increased, i.e. simultaneous reductions in quantity but increases in quality of drugs prescribed.

Also insignificant are the price of substitutes, level of unemployment, supply of GPs and the seasonal dummy.

(**b**) Exempt Of the independent variables used own price, price of substitutes, level of income, morbidity and supply of GPs are all significant ($p < 0.05$).

The positive coefficient of price rejects the null hypothesis that cost is independent of price. Although price was found to be insignificant for non-exempt patients the 95 per cent confidence intervals for the respective coefficients on price overlap and hence we cannot reject the supplementary null hypothesis H_0: $a_{C,NE} = a_{C,E}$. Since the analysis includes only exemption on low income grounds, a high proportion of which don't qualify automatically for exemption but have to apply, the effect of price on content among exempt groups might be explained by an increase in take-up of exemption, particularly among those individuals with chronic conditions which tend to be treated by relatively expensive drugs.

The negative coefficient of GP supply is consistent with a priori expectations. As supply increases access costs fall and hence those on the margin of attending, which are likely to be those with 'below average' needs and hence by implication below average costs, now attend. An alternative explanation is that prescribed drugs may be a substitute for GP time spent in consultation. The depressed housewife who was once prescribed expensive drugs in a short consultation may now be prescribed a less expensive drug (maybe as a means to terminate the consultation) but given more GP time to discuss her condition. That supply of GPs was not significant for non-exempt prescription content implies that it is the least well off who are affected most by the costs of access. This result replicates the findings for supply elasticities of utilisation reported above.

The positive effect of the price of substitutes is probably explained by a general trend of both substitutes and prescribed drugs increasing in costs at a rate in excess of the RPI. Income and morbidity are again significant with the same interpretation as for the non-exempt group.

The limited list, the seasonal dummy and the level of unemployment are all insignificant.

(c) Prepayment The coefficient on price is insignificant, contrary to *a priori* expectations. Thus, as in the case of the non-exempt group, we can reject the hypothesis that GPs respond to higher prices by prescribing significantly higher quantities and/or more expensive drugs. Given that there is no reason why GPs should know whether a patient holds a prepayment certificate, *a priori* expectations are the same as for the non-exempt group.

Of the remaining independent variables the price of substitutes, level of income, morbidity and the Limited List are all significant ($p < 0.01$). The positive coefficient of price of substitutes again suggests that both NHS prescribed and over the counter drugs have increased in price at a rate faster than the RPI.

The limited list appears to have reduced costs as expected *a priori*, though why this should be so for this group and not for the exempt and non-exempt (although the confidence intervals for the coefficients overlap) is not clear. It may be that the limited list had a greater impact on drugs associated with chronic conditions and that it is people with chronic conditions who tend to purchase prepayment certificates.

Income and morbidity are again highly significant with the same signs and interpretation as for exempt and non-exempt prescriptions. The level of unemployment, the seasonal dummy and the per capita supply of GPs are all insignificant.

4. Discussion

The purpose of this study was to estimate the effects of a sustained policy of increasing the real value of the prescription charge on the utilisation of the NHS pharmaceutical service. A particular feature of the analysis is the use of a quasi-control group based on the utilisation patterns of adult non-elderly exempt population. While the choice of this particular group as a basis for comparison with non-exempt utilisation rates excludes from the analysis demographic influences on utilisation patterns the two groups may still differ in available resources. While it could be argued that such a factor is also likely to affect the rate of utilisation the present analysis is only concerned with changes in rates of utilisation over a limited time period, not the absolute levels of utilisation. Hence provided the difference in resources relative to needs between the groups did not influence post 1979 trends in utilisation rates the use of the comparison group is valid.

A second feature of the analysis is the attempt to identify three separate charge categories within the adult non-elderly group where possible. As far as we are aware this represents the first attempt to identify utilisation under prepayment arrangements as a distinct group. Yet prepayment arrangements present an entirely different type of incentive structure to the patient and evidence from North America suggests that it generates significantly different behavioural responses (Manning et al 1984).

While prepayment certificate holders represent a self selected group, and hence present particular difficulties for interpretation of estimated coefficients, it is important that they be excluded from comparisons between exempt and non-exempt utilisation patterns. However their exclusion is complicated by the available data being restricted to utilisation levels and average costs per item, with no information available on the size of the prepayment group. Yet such information is required in order to estimate per capita rates. This would require the reintroduction of the DHSS collection of data on prepayment certificate sales, as was done until the late 1970's. Otherwise attempts to improve upon the provisions made in this analysis for prepayment arrangements, will be necessarily restricted to less aggregate levels for which data on prepayment certificate numbers are available (e.g. individual FPCs). Nevertheless, we would expect a priori that the elasticity of utilisation for holders of prepayment certificates to be less than that among those patients incurring the per item charge. Hence the combination of prepayment with non-exempt utilisation produces an underestimate of the response of non-prepayment, non-exempt utilisation to charge increases.

Similarly the DHSS no longer records the estimated sizes of exempt populations either in aggregate or by particular exemption class. As a consequence attempts to estimate per capita rates are restricted to the use of data on particular social security benefit claimants which although carrying automatic exemption do not include other categories of population also exempt from charges (i.e. DHSS exemption status on the grounds of low income). Provided this residual group is relatively small and does not change in proportion to the exempt group as a whole over the period of analysis this does not give rise to serious problems since the study is concerned only with changes in rates of utilisation over a limited period.

Finally recognition should be given to the extreme crudity of the morbidity proxy. It is inappropriate to use a proxy based only on a subgroup of the population under analysis as an indicator of morbidity for the whole population. Furthermore the changes in national insurance legislation noted above severely inhibit its use as a proxy for morbidity among the subgroup to which it does apply. As with the other limitations, the bias introduced by this problem is limited to the extent by which trends in morbidity have differed between the different groups. However this would be an equally valid defence of excluding morbidity and hence consideration might be given to whether the morbidity proxy justifies inclusion.

Notwithstanding these limitations the main findings of this analysis can be summarised as;-

a) the policy of regular and frequent increases in the real value of the prescription charge has been associated with a reduction in the relative rate of utilisation of prescribed drugs carrying a charge,

b) the charges policy appears to have had little if any effect on supplier behaviour in terms of average prescription content. Where a significant price elasticity of prescription content is observed (exempt prescriptions) the finding may have more to do with exemption take up rates than supplier responses.

Turning to the limited list the finding should be treated with caution since the policy was introduced only towards the end of the study period. Hence the full effects of the policy may not have occurred during this period. Given this proviso the limited list policy appears to have had a greater effect on prescription numbers than on prescription content. The reduction in the rate of utilisation is common to exempt and non-exempt groups. However only in the case of prescriptions dispensed against prepayment certificates is a significant relationship observed for prescription content. The estimated negative response of content may imply that substitution between drugs has been concentrated among chronic conditions requiring the sorts of levels of drug consumption which make prepayment arrangements attractive.

While these findings imply that utilisation is deterred by increasing the prescription charge it is not possible to estimate the opportunity costs of the present policy, in terms of the health improvements forgone, using available data. Brook et al (1983) claim to show that utilisation deterred by user charges has minimal, if any, adverse effects on health although their study design suffers from a number of serious limitations (Relman 1983). It was argued above that there is no a priori reason why utilisation deterred by price, which does not discriminate between needs, should be frivolous utilisation. Furthermore, since over 70 per cent of all prescriptions are exempt from charge, any frivolous utilisation that is deterred is only likely to represent a small proportion of total frivolous utilisation in as much as it occurs at all.

The main message for those involved with the present debate concerning the funding of the NHS is that charges may generate additional revenue but not without opportunity costs. Indeed in the case of NHS prescribed drugs the main source of the revenue effects is not the increased per item charge, which is estimated to have produced an extra £90m revenue in 1985, but the resources released as a result of reduced utilisation, estimated to have saved around £290 million in 1985 (Ryan 1987). Provided that revenue is not the only objective of the policy makers (and if it was large parts, if not all, of the NHS should be closed immediately) then the current enquiries should avoid the temptation to adopt and extend the 'old idea' of user charges and extend their considerations to other policy options which offer potential net revenue savings but in a way consistent with the efficient allocation of scarce NHS resources. For example a more cost effective method of reducing abuse might be to provide incentives to suppliers (i.e. GPs) which, unlike a charges policy, is able to discriminate between competing demands on the basis of expected outcome, albeit imperfectly. Clearly if abuse exists, it does so as a result of GP prescribing behaviour. The introduction of budgetary controls on GP prescribing would provide such an incentive. Furthermore the incentive would extend to prescribing for all patients not just to a subgroup who impose a relatively small demand on the service anyway.

In addition budgetary control of prescribing would provide a far more effective control on the exchequer costs of the pharmaceutical service than a policy of per item charge with no upper limit on utilisation and hence cost. The potential revenue savings could be enhanced by the extension of generic substitution to primary care provision (DHSS 1983). While these policies are primarily concerned with efficient rationing of provision between existing needs they could be complemented by policies aimed at reducing needs such as considerable increases in excise taxes on tobacco and alcohol products.

It is important that the current debate over NHS finance does not lose sight of NHS objectives, namely maximisation of health outcomes subject to equity considerations. Otherwise the proposals emerging from the debate risk incurring opportunity costs, in terms of adverse health consequences, which far outweigh the benefits of additional revenues generated for health care services or reduced dependence on exchequer finance. The existing evidence suggests that to pursue NHS objectives we should avoid the erection of further barriers to health care utilisation. On the contrary we should look to reduce existing barriers to health and health care, in order to minimise health care needs, and complement this with incentive systems for suppliers which encourage rationing of scarce resources among remaining needs in line with objectives.

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APPENDIX 1

Homogeneity Test

The estimation of utilisation equations in terms of real values of money variables (incomes and price) involves imposing the restriction of linear homogeneity of degree zero onto the utilisation equation in nominal values

$$LNQ = a_0 + a_1 LNP + a_2 LNS + a_3 LNY + a_4 LNRPI + \ldots\ldots. \quad (1)$$

That is to say, we assume that $a_1 + a_2 + a_3 + a_4 = 0$. This generates the restricted equation in real values of money variables given by

$$LNQ = a_0 + a_1 LNRP + a_2 LNRS + a_3 LNRY + \ldots\ldots. \quad (2)$$

which assumes that money illusion does not affect utilisation.

Following Thomas (1985) the validity of this linear restriction can be tested using the ratio of the difference in sum of square residuals for the unrestricted, (1), and restricted, (2), estimates to the sum of squares residual of the unrestricted equation i.e.

$$\frac{(SSR_R - SSR_U)/d}{SSR_U/(n-k)}$$

where
d = number of restrictions
n = number of observations
k = number of explanatory variables

which has an F distribution with (d, n-k) degrees of freedom.

Applying this test to our data

Non-Exempt Category $\frac{.26689 - .26269}{.26269} \times 75 = 1.19$

Exempt Category $\frac{.26861 - .26254}{.26254} \times 75 = 1.73$

with $F_{0.01}(1,75) = 7.011$ the linear restriction is valid for both the exempt and non-exempt groups and the postulate of homogeneity can be accepted.

APPENDIX 2

Table 3 Results of estimating the model by OLS. Dependent variable = Average Net Ingredient Costs of Prescriptions

	Regression Coefficient		
Independent Variable	Non-Exempt	Exempt	Prepayment
Price of prescriptions	-0.391*	-0.053**	0.010
Price of substitute	0.293**	0.302**	0.208**
Level of income	0.539**	0.497**	0.628**
Morbidity	-0.043**	-0.036**	-0.016**
Supply of GPs	0.298	-0.445*	-0.125
Level of unemployment	0.143**	0.100**	-0.011
Seasonal dummy	-0.139*	-0.006	-0.003
Limited list dummy	0.007	-0.011	-0.023**
	$\bar{R}^2$ = 0.94	$\bar{R}^2$ = 0.85	$\bar{R}^2$ = 0.93
	F = 152.15	F = 53.65	F = 130.33
	DW = 1.21	DW = 1.09	DW = 1.76

* $p < 0.05$

** $p < 0.01$

APPENDIX 2 cont.

Table 4 Results of estimating the model by OLS. Dependent variable = prescription utilisation per 1,000 population per month

Independent Variable	Regression Coefficients: Non-Exempt	Regression Coefficients: Exempt
Price of prescriptions	-0.165**	0.069
Price of substitutes	0.090	0.236*
Level of income	0.016	-0.525**
Morbidity	0.018	-0.479**
Supply of GPs	-0.719	3.170**
Level of unemployment	-0.113	0.240**
Seasonal dummy	0.031**	0.045**
Limited list dummy	-0.128**	-0.052*
	$\bar{R}^2$ = 0.79	$\bar{R}^2$ = 0.70
	F = 41.44	F = 25.54
	DW = 1.24	DW = 1.77

* $p < 0.05$

** $p < 0.01$