Economic incentives and GPs as purchasers of elective surgery: an empirical appraisal

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Abstract

In the 1990s, purchasing (or 'commissioning') as a function of primary care was introduced as a fundamental instrument to improve the efficiency of the British National Health System. It was expected that this policy would motivate primary care physicians to refer patients in a cost-effective way. However, there has been remarkably little robust research on the impact that purchasing has had on referral patterns. The introduction of General Practitioner (GP) fundholding followed by the creation of Primary Care Trusts in England constitutes an important setting for researching this area. In this paper we model GP referral behaviour under a purchasing scheme and we test the model using data on admission rates for procedures from four specialities covered by the scheme. We use pooled OLS and Random Effect techniques on panels from UK Contract Minimum Data Set data for patients from a local Health Authority area over a twelve-year period. The results support the contention that GPs did respond to the economic incentives, rationalizing referrals. However, the direction and magnitude of the effects differed between procedures. In particular, we found an increase in referral rates for more cost effective procedures within the practices that participated in the fundholding scheme. This suggests that GPs are not wholly motivated by financial incentives, but that they behave in semi-altruistic manner.

Introduction

Many of the recent reforms of the British National Health Service (NHS) have focused on the change of incentives and motivation structure for primary care professionals. Since patients in Britain see their GPs first (except in emergencies), GPs inevitably have a key role in making relevant decisions at the primary and secondary care interface. One of the more frequently posed questions concerns how incentives should operate at this interface so as to achieve the best possible health outcomes in the most efficient way.

A key change in the incentives for GPs in the last decade has been the introduction of purchasing (or 'commissioning') of secondary health care services as a new role. Purchasing by GPs was first implemented in 1991 with the fundholding scheme (Department of Health (DoH), 1989b). With fundholding, GPs were able to apply to hold a budget to purchase a range of diagnostic tests and elective procedures for their patients from secondary care providers. The scheme was expanded to include 50% of

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GPs by 1997, when it was abolished with the arrival of the Labour Government (DOH, 1997). It was replaced by new conglomerations of GP organisations: initially Primary Care Groups (PCGs) (DOH, 1998) with limited responsibilities and budgets, and then Primary Care Trusts (PCTs) (DOH, 1999) with larger budgets and a much broader remit. The PCTs are executive bodies with unified budgets for primary care, secondary care and community services and clearly defined legal roles that charge them with a wider locality commissioning (planning) role. They are responsible for managing the local health economy and cover almost all types of services for a population of 100,000 (around 20 practices corresponding to 50 GPs), although in some cases the population can be as large as 350,000.

The aim of this paper is to analyse, from an economic perspective, the effect that the incentives introduced by these schemes have had on GP's behaviour. The phenomenon we want to investigate is how GPs responded to being allocated fixed budgets for purchasing secondary care services for their patients. Specifically, we are interested in finding whether there exists a change in a particular aspect of GPs behaviour: the decision to refer to hospitals.

As PCGs/PCTs have been introduced only recently and are still at an experimental stage, we prefer to concentrate on the effect that the fundholding scheme (1991-1997) might have had on referrals. Fundholding lasted for a time long enough to fully explicate its effects. Further, as fundholding was not universal, by comparing the admission rates of fundholding and non-fundholding practices we can investigate the response of practices to being given budgets for purchasing health care. Even though fundholding was abolished in 1997, analysis of the impact of the scheme offers important lessons for PCTs, as the new model will introduce practice budgets linked to financial incentives allowing practices to spend savings on improving care for their patients.

The early studies of the scheme were purely descriptive, examining areas such as variation in fundholding budgets (Day and Klein, 1991); views of GPs on fundholding (Glynn, et al 1992; Newton et al, 1993); and the experiences of GPs and regions in instituting the scheme (Glennerster, et al 1994). These studies gave little indication of how incentives introduced by fundholding affected GPs' referral patterns. Later

studies were more analytical and examined the effects of fundholding on GPs referral rates (Coulter and Bradlow, 1993; Dixon and Glennester 1995, Gosden and Torgenson 1997). However, these studies can be criticised for the use of inappropriate models to measure the effect of fundholding on referral patterns and/or for failing to adequately control for other factors influencing referrals. This may have been due to the lack of good quality data. One of the latest studies (Croxson *et al* 2001), using a strong methodological framework, has shed some light on the area. In their study, Croxson *et al.,* analyse at a specialty level the effect of fundholding on referral patterns, finding an increase in hospital-based activity prior to entry, and so inflating their budget upwards for the duration of the fundholding scheme. More recently Gravelle *et al*. (2002), using data on a single procedure over a three-year period, found that fundholding practices had lower admission rates than non-fundholders. In this paper we aim to improve the robustness of these findings by analysing disaggregated data for a range of procedures and looking for the effect of fundholding over the whole period the scheme lasted.

Data Sources

The main data used in this study is taken from the Contract Minimum Data Set (CMDS). This dataset contains information on individual records for each finished consultant episode, including: sex; age; dates of admission and discharge; dates of episode start and end; GP and GP practice identification; type of admission (emergency/routine); consultant; specialty; and details of diagnoses and surgical operations (defined by the Primary Operation Procedure Code (OPCS)).

We use data for Enfield and Haringey Health Authority (HA). Enfield and Haringey HA had, by 1999, an estimated population of 484,900, with 265,100 (55%) living in Enfield and 219,800 (45%) in Haringey. The area has a higher proportion of children (7.5%) compared to England and Wales as a whole (6.4%), and a lower proportion of people aged 65 and over (12.7% compared to 15.8%). The diversity of the area is illustrated by the range of Jarman scores from 45.1 in the most deprived areas to 13.8 in the more affluent areas (Enfield and Haringey Initial Local Implementation Strategy, 1999).

Our data covers twelve financial years 1989/90-2000/01, for four specialities and comprises patient admissions from 133 GPs to 200 different providers. The numbers of episodes per specialty are given in table 1.

Table 1. Number of episodes per specialty

Specialty	Number of episodes
General surgery	109,136
Gynaecology	106,322
Ophthalmology	27,079
Orthopaedics	52,232

Enfield and Haringey Health Authority provided access to this data, subject to confidentiality and ethical agreements. Consent was obtained from the local research ethics committee. We also obtained details about GPs and GP practice characteristics such as list size split by age strata, number of GPs per practice, fundholding status, the fundholding wave GPs belonged to, and location of practice premises by electoral ward.

Data on population characteristics was obtained from the Neighbourhood Statistics Dataset (Department of Transport, Local Government and the Regions, Indices of Deprivation, 2000). From this data set we extracted deprivation indices by practice electoral ward.

Before analysing the relationships in a regression framework, we report descriptive statistics for some variables that are part of our model (table 2). The reported means and standard errors are calculated for the overall sample (including all the episodes in the four specialties considered over the twelve-year period). From this table we can observe interesting relationships. For instance: (a) the higher percentage of admissions that can be attributed to wave 1 and 2 (as a proportion of list size); (b) the practices on the first two waves were larger, as shown by the average number of GPs per practice, compared with practices in later waves or non fundholders. This is to be expected as initially only practices with more than 9,000 patients could apply for fundholding status.

Overall, we can see from table 2 that fundholders referred more than non-fundholders. However, due to the dynamics and the characteristics of the data it is difficult to reach any conclusions from a simple descriptive analysis of the data. As the objective is to identify whether fundholding had any effect on referral rates and whether this effect was directed towards more cost-effective patterns of referral, we need to correct for potentially confounding variables and use a methodological framework that allows for the dynamics in the data (i.e. considering the periods of change from non-fundholding to fundholding of the practices). In the next section we explore in depth the relationship between the dependent and the independent variables with econometric techniques, in particular with the use of panel data techniques that allow us to control for different confounding factors, heterogeneity and dynamics of the data.

Table 2.Descriptive Statistics of Practices

Fundholding Status	No. of GPs per practice Mean (S.E.)	Percentage of admissions per year* Mean (S.E.)	Percentage of patients aged 65 and over * Mean (S.E)	Total number of practices
Non-fundholders	2.68 (1.9)	0.04 (0.02)	0.12 (0.04)	105
Wave 1	7.42 (1.1)	0.06 (0.01	0.15 (0.02)	2
Wave 2	8.00 (2.1)	0.07 (0.01)	0.14 (0.00)	1
Wave 3	6.00 (1.1)	0.05 (0.02)	0.14 (0.04)	2
Wave 5	4.06 (1.6)	0.05 (0.01)	0.13 (0.01)	3
Wave 6	2.85 (1.7)	0.04 (0.02)	0.13 (0.02)	8
Wave 7	1.58 (0.9)	0.04 (0.02)	0.08 (0.03)	12

The descriptive statistics in this table cover the 4 specialties mentioned above and cover the 12 year period

* As a proportion of list size

The Model

Basic Assumptions and Hypotheses

Hausman *et al* (1999) argued that purchasing at the primary care level gave fundholders a greater scope for making choices in the interest of patients: GPs could, for example, seek more efficient hospital services to get patients treated quickly, or use their market power to generate a better quality service. Fundholding, however, also created a greater scope for more selfish income maximiser behaviour. This

behaviour is feasible given the existing doctor-patient relationship that can be seen from an economic perspective as one of agency, characterised by asymmetric information between patients (principals) and doctors (agents). Depending on the nature of the incentive structure, agency and asymmetric information can facilitate undesirable behaviours like risk selection, and supply-induced demand**.** This study aims to clarify some of the questions in this area departing from a set of assumptions from which we derive a set of specific hypotheses that give direction to the research.

We start by assuming that GPs are quasi-altruistic agents, meaning that GPs' utility increases with both profits and patient welfare. The consequence of this fundamental assumption is that we cannot equate incentives just with material incentives. Therefore, we cannot readily deduce (as the traditional economic wisdom suggests) that GPs, as income maximisers, would reduce referral patterns to increase profits. Fundholding GPs did have an incentive to be *economical* in their referrals, since savings on practice budgets could be invested in building up the practice business or improving their premises, hence increasing the GP partners' future income streams and the value of their assets. However, this incentive would be balanced by their altruistic and caring concerns. We then assume, that the marginal utility for GPs of referring patients in need of 'high priority' procedures, for which there is a strong evidence base of good patient outcomes, is bigger than the marginal utility received from the funds saved as a result of a decision not to refer. Conversely, the GPs' marginal utility of referring for 'low priority' procedures, with a poor evidence base, is not high, and so the incentive to economise in this type of procedure is higher. Therefore, we should expect to see an improvement in the 'appropriateness' of fundholders referrals: with an increase in 'high priority' procedures and no change or even a decrease in 'low priority' procedures. In this case we denote 'appropriate' as the number of referrals that maximizes patient welfare as defined by GPs, as in the approach adopted by Woodward and Warren-Boulton (1984). It seems likely that GPs will be most concerned with the effectiveness of procedures (their utility for individual patients), though they might also consider their cost-effectiveness (their utility for the whole patient population).

The profit maximiser behaviour of fundholders can be tested by analysis of referrals for the year prior to joining the scheme, since GPs' fundholding budgets were

strongly determined by the referrals made in this year. We would thus expect to observe an overall rise in referrals in the year preceding fundholding- if we assume that increasing referrals in this year meant an increase in funds and no decrease in patient's health.

In summary and under the assumptions above, we can make the following hypotheses about fundholders behaviour in relation to that of non-fundholders:

a) During fundholding, GPs increase the number of referrals for those procedures that are considered highly appropriate (based on clinical evidence)
b) During fundholding, GPs decrease the number of referrals for those procedures considered not appropriate.
c) Fundholders increase referrals the year before they enter the scheme (as already tested by Croxson *et al*, 2001).

The empirical model

It is well established that the market of health care services can be affected by demand characteristics - such as population age, education, income and housing - and supply characteristics - such as the number of professionals and the number of health care facilities (Grossman, 2000; Cullis *et al.*, 2000). Also, government policy and institutional regulations may have a strong impact on both demand and supply of health services (OECD, 1994). If we want to understand what determines the decision to refer, we need to control for these variables. Failing to do so potentially implies model misspecification that would produce biased estimates. Therefore, we propose to analyse admissions[2] standardised by list size as the unit of analysis (Y), as a function of vectors of GP practice characteristics (G), population characteristics (S), and policy and institutional characteristics in particular the fundholding reform (F).

Formally,

$$Y=f(G, S, F)$$

In the following section we describe the variables of the model in greater detail.

[2]We use admissions as a proxy for referrals, given the close relationship between the two.

Dependent Variables

The selection of episodes was based on the following criteria:

a) Treatments considered by contemporary guidelines to be of high priority. In this case we chose hip and knee replacements and cataracts (Maynard A.1991; Cleary, P.D., *et al.*, 1993; Snellingen T. *et al.*, 2002 (from the Cochrane Library)). We decided to aggregate these three to minimize random variation. Though they are relatively high-activity procedures, the number of patients referred from any one GP practice in a year will be quite small.
b) Treatments considered by contemporary guidelines to be of low priority. We selected insertion of grommets, varicose veins, dilation and curettage and tonsillectomy (Chris Mihil, 1999). As for criterion a), and for the same reasons we aggregated these procedures.
c) Procedures expected to reflect the overall effects of fundholding according to the weight they had in the budget for hospital services. We selected all the inpatient procedures covered by the GP Fundholding scheme, as set out in Regulation 17 (2) March 1993.

From the above criteria we specified our three dependent variables. The econometric model is estimated separately for these categories.

Independent Variables

A) Socio- economic vector

The independent variables composing the vector of population socio-economic factors were constructed mainly from the indices of deprivation from the Department of Transport, Local Government and the Regions (2000). Each practice was first assigned to an electoral ward depending on its location and then we related the wards to the deprivation indices. We selected four indices of deprivation that, according to previous empirical and theoretical studies (Grossman, 1972a, 1972b; Strauss *et al*, 1993; Gravelle *et al*, 2002), are relevant in the generation of demand for hospital services. These indices included: a score for education deprivation, a score for housing deprivation; a score for poor access to services; and a score for income deprivation. In each case, a higher score indicates a higher level of deprivation (see

annex for details on indices). Another variable included in this vector of socio-economic variables is the percentage of people in the GPs' practice lists aged 65 or older.

B) Practice characteristics vector

Various studies suggest that the number of referrals and hospital admissions can be influenced by practice characteristics (Hippisley-Cox *et al*, 1997; Whynes and Baines, 1996; Gravelle *et al*, 2002). We controlled for two important variables in the econometric analysis: the number of GPs per practice and single-handed status.

The number of GPs per practice was estimated for each year directly from the CMDS data. We considered the possibility of error in measurement as minimal, given that it would be extremely rare that a GP would not make any referral for any inpatient procedure within the four specialties covered in this study. Information on single-handed practices was also extracted from the CMDS data set from which we construct a dummy variable.

C) Fundholding status vector

The Fundholding effect, the main focus of this study, was analysed through a set of dummy variables: a) a dummy variable indicating a period a practice was in the fundholding scheme; b) a dummy variable indicating whether a practice was in the preparatory year before becoming fundholder; and c) a set of Dummy variables indicating the wave a practice belonged to.

Econometric model

From the CMDS data we aggregated the number of admissions per practice for a period of time. In this case we aggregated the data per financial year, given that practices always joined the fundholding scheme at the beginning of a financial year. It is sensible to analyse the generated set using panel data techniques, since estimation by Ordinary Least Squares (OLS) may lead to inconsistent estimates, with bias from unobserved practice characteristics – for example, practice style - that affect the number of admissions. One possible solution for this bias is to assume that these factors are constant over time and to apply either fixed effect (FE) or random effect models (RE). These panel data estimations allow for year effects and heterogeneity

and may be able to identify dynamic effects, such as the effect of a change in fundholding status (Hsiao (1985,1986), Kleverman (1989), Solon (1989) and Baltagi (1995)). The general form of the model to be estimated is:

$$Y_{it} = G_{it}\beta_0 + S_{it}\beta_1 + F_{it}\beta_3 + z_i'\alpha + E_{it.}$$

where the index i relates to the practice and the index t relates to the year. The heterogeneity or practice effect characterized on this panel is $z_i'\alpha$. In order to get as much information as possible from the panel, we ran many possible regression specifications, including pooled OLS regression, and Random Effects. We used Hausman tests (Hausman *et al*., 1991) and Breusch Pagan LM tests (Breusch, T., and Pagan A., 1980) in order to test the sensitivity of the model results. In the light of the results from these tests, we report the Random Effects results below (pooled OLS results are presented in table A1 of the annex).

Results

The estimated results for the main models proposed are shown in Table 3. Columns 1 to 3 of the table are the results for models exploring the total effect of fundholding without considering the effect of the wave of entry. Columns 4 to 6 explore possible wave effects.

Columns 1 and 4 show the results for all inpatient procedures covered by the GP fundholding scheme (as set out in regulation 17 (2) March 1993). Croxson *et al*. (2001) and Gravelle *et al*. (2002) have correspondingly analysed the effect in fundholding either at a specialty aggregate level or at a single procedure level. However, we consider that analysing the referrals of procedures that strictly constituted the *complete basket* of inpatient activities fundholders could buy, will shed some light on this area of study, eliminating possible bias and confounding factors that can emerge from studying the data at high level of aggregation (like at a specialty level) or at a very low level of aggregation (considering only one procedure). Columns 2 and 5 describe the results for the model considering only high priority procedures, and columns 3 and 6 show the results for the low priority procedures.

Fundholding effects: the complete basket

Columns 1 and 4 support the contention that GPs did respond to the incentives induced by fundholding. In particular, we found that, when considering the complete basket of procedures, the scheme had a positive and significant effect on referrals – as shown by the *fundholding* variable in column 1. Also, we found that GPs behaved as economic agents (income maximisers), as there were positive and statistically significant increases in overall referrals in the year before entry to the scheme - as shown by the *prev_year* variable in column 1. This supports other studies' findings (Croxson *et al*, 2001).

The impact of fundholding on referrals did not appear to be equal among waves; column 4 shows the effects for different waves compared with non-fundholders. We can see that the effect was stronger in some waves than in others. In particular, waves 1 and 5 did not have a statistically significant effect.

Fundholding high priority procedures vs. low priority

Models 2, 3, 5 and 6 in table 3 shed light on the direction and magnitude of the fundholding effects and how these effects differed between procedures. In the models on high priority procedures (model 2 and 5), we found that the fundholding effect is positive and significant - as shown by *fundholding* (model 2) - and slightly bigger than in model 1. Further, it is clear from column 5 that the wave effect is positive and significant for all the waves at the 10 percent significance level and for 4 of them at the 5 percent significance level. It is interesting to notice that the previous year effect is non significant in the high priority models (although the sign is positive). This could be explained by the long waiting lists for these procedures, implying that they are less responsive in the short run to policy change. Model 3 shows that fundholding had a negative and significant effect on low priority referral rates, supporting the hypothesis that fundholding direction and magnitude effects differed between procedures. Model 6 shows that, even if none of the wave effects were statistically significant for low priority referrals, most of them presented a negative sign.

Practice and socio-economic effects

Table 3 also shows that practice population and GP characteristics are related to admissions. We can see that these effects are stronger when we consider models 1 and 4, where there is a larger level of aggregation. This is reasonable: the more procedures included in the dependent variable, the better we can control for random and independent effects corresponding to each event.

In particular, the findings in columns 1 and 4 suggest, as we would expect, that a higher proportion of old people in the practice list increases referral rates in a significant way. Results also show that practice size, as measured by number of GPs, is positively associated with overall hospital admissions. A possible explanation for this may be that larger practices have more sophisticated and favourable cost and volume contracts with hospitals, although no systematic evidence for this exists. The dummy variable for single-handed practices was never significant and thus was not considered for the analysis.

The four measures of deprivation used showed different effects on admission rates. As expected, access deprivation was shown to be negatively associated with admission rates, in line with previous studies' findings (Croxson *et al*, 2001). Education deprivation showed a positive association with admissions. This can be explained by the widely observed correlation between health status and education (Folland *et al*, 1997). Furthermore, according to Grossman's model of health production (Grossman, 1972a,b), health can be generated at less cost for an educated person. As a result, the more educated the person is, the higher the health stock the person will choose. Further, according to this model, educated people are more likely to recognize the benefits of a healthy lifestyle.

Income deprivation showed a negative association with admission rates. One possible explanation for this observation is that persons with better income may exert more influence on the GP's decision to refer, as they demand more and faster access to services. However, this is a hypothesis that needs testing and further research is required in this area.

Practice and population characteristics had different effects in the high priority and low priority models. Specifically, we can see that in the high priority models, the

practice size and the proportion of old people in the list size are still associated in a positive way with hospital admissions. However, for the low priority models, the practice size is no longer significant. This is not surprising as there is no reason to believe that bigger practices do not consider the evidence base for their referral decisions. None of the deprivation variables were significant for the high priority model, while income and education were still significant in the low priority models.

Table 3. Random effects regression

Dependent variable: log standardised admissions						
	1 All procedures	2 High priority procedures	3 Low priority procedures	4 All procedures	5 High priority procedures	6 Low priority procedures
Fundholding	.0109732** (.001713)	.0111106** (.0013748)	-.0010524** (.0005217)			
Wave 1				.0058126 (.0055028)	.0071037 (.0041321)	.0049666 (.0038464)
Wave2				.0213975** (.0077348)	.0176344** (.005949)	.005652 (.0054235)
Wave 3				.00118814** (.0056144)	.0096301** (.0044329)	-.0011065 (.0039528)
Wave 5				.0088075 (.0053357)	.007863* (.00543615)	-.0040155 (.0037677)
Wave 6				.0143914** (.0040848)	.0061008* (.0003401)	-.0024708 (.0029025)
Wave 7				.0089508** (.0044082)	.007863** (.0037316)	-.0015083 (.0031311)
Previous year	.0090076** (.0024277)	.0014791 (.0020181)	-.0017368 (.0017157)	.0080176** (.0024255)	.0003132 (.0020488)	-.0017456 (.0020582)
Proportion of patients 65 or over	.2660514** (.0370287)	.1708043** (.0171339)	.1014242** (.0238308)	.2638899** (.0382927)	.1651918** (.00175957)	.0982061** (.0241211)
GPs per practice	.0031145** (.0004166)	.0023013** (.0003152)	-.0000753 (.0002932)	.0028302** (.0003749)	-.0023504** (.0003225)	-.0000993 (.0002955)
Access deprivation	-.0099182** (.0044508)	-.0011677 (.0020303)	-.0045225 (.0027938)	-.0093504** (.0045321)	-.0004338 (.0020892)	-.004049 (.0028323)
Education deprivation	.0064123** (.0023414)	.0005306 (.001072)	.0054195** (.0014695)	.0064962** (.0024265)	-.0005223 (.001102)	.0051192** (.0014887)
Income deprivation	-.0004981** (.0002003)	-.000043 (.0000914)	-.0004503** (.0001256)	-.0004834** (.0002067)	-.0000321 .0000941	-.0004233** (.0001273)
Housing deprivation	-.0024237 (.002477)	.0011652 (.0011245)	.003173 (.0015747)	-.0018291 (.0025356)	-.0011468 (.001149)	.0002916 (.001592)
Constant	-.8294286 (.00887766)	-.8837276 (.0041095)	-.8674437 (.0056316)	-.8321251 (.00089208)	-.8822985 (.0042229)	-.8667519 (.0056998)
Between R^2	.5695	.6692	.2960	.5849	.6726	.3024
Overall R^2	.3848	.3092	.1400	.3933	.2877	.1437

Standard errors in parenthesis *P<0.1; **P<0.05

Conclusions

The introduction of purchasing/commissioning as a function of primary care has been a fundamental instrument to improve the efficiency of health care systems. The structure of fundholding in the British NHS engendered different type of incentives, both financial and non-financial. In this paper we analysed how GP's objectives interacted with these incentives to affect one of the most important actions in the interface between primary and secondary health care: the decision to refer.

We used panel data techniques to model admissions (as a proxy for referral rates) as a function of fundholder status and a set of variables controlling for population socio-economic and practice characteristics. To summarise the results: we found an overall increase in GP's referral rates for procedures covered by the scheme in the year before entry; following entry, there was an increase in referral rates for more cost-effective or effective procedures and a decrease in procedures of low cost-effectiveness or effectiveness. These results support the contention that GPs did respond to the fundholding incentives both as income maximising agents and as altruistic ones.

By increasing referrals in the year prior to join the fundholding scheme, GPs managed to inflate the budget that would be allocated to them for the period the scheme lasted. This type of behaviour seems to provide support for the hypothesis of GPs as profit maximisers, although one might also argue that it could be consistent with GPs seeking to increase their ability to provide good quality care for their patients in future years (though possibly at the expense of other GPs patients). Clearly, if the GPs were pursuing a pure income maximising strategy, we would have observed an overall decrease in the rate of referrals during the fundholding period in the attempt to save funds. However, this income maximising behaviour was offset by GPs 'caring' or 'professional' motivations. Empirical evidence supports the view that fundholding produced a more appropriate pattern of referrals within their practice population. Though we might have expected the fundholding scheme to have functioned as an incentive for the GPs to save funds (and reinvest them in their practice) through the reduction of referrals, it seems that overall, this reduction did not occur. It appears that if the scheme did achieve the target of saving funds, it did so through motivating a better pattern of referrals.

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ANNEX .

Description on domain and data sources of deprivation indices.

a) Score of education deprivation. Domain and data sources:

- Working age adults with no qualifications (3 years aggregated LFS data at district level, modelled to ward level) for 1995-1998
- Children aged 16 and over who are not in full-time education (Child Benefit data – DSS) for 1999
- Proportions of 17-19 year old population who have not successfully applied for HE (UCAS data)or 1997 and 1998
- KS2 primary school performance data (DfEE, converted to ward level estimates) for 1998
- Primary school children with English as an additional language (DfEE) for 1998
- Absenteeism at primary level (all absences, not just unauthorised) (DfEE) for 1998

b) Housing deprivation score. Domain and data sources:

- Homeless households in temporary accommodation (Local Authority HIP Returns) for 1997-98
- Household overcrowding (1991 Census)
- Poor private sector housing (modelled from 1996 English House Condition Survey and
- RESIDATA)

d) Income deprivation score. Summary of indicators

- Adults in Income Support households (DSS) for 1998
- Children in Income Support households (DSS) for 1998
- Adults in Income Based Job Seekers Allowance households (DSS) for 1998
- Children in Income Based Job Seekers Allowance households (DSS) for 1998
- Adults in Family Credit households (DSS) for 1999
- Children in Family Credit households (DSS) for 1999
- Adults in Disability Working Allowance households (DSS) for 1999
- Children in Disability Working Allowance households (DSS) for 1999
- •Non-earning, non-IS pensioner and disabled Council Tax Benefit recipients (DSS) for 1998 apportioned to wards

e) Access to services deprivation score. Domain and data sources:

- Access to a post office (General Post Office Counters) for April 1998
- Access to food shops (Data Consultancy) 1998
- Access to a GP, Hospitals, other health care facilities (NHS, BMA, Scottish Health Service) for October 1997
- Access to a primary school (DFEE) for 1999

Table A1. Pooled OLS results.

Dependent variable: log standardised admissions			
	1 All procedures	2 High priority procedures	3 Low priority procedures
Fundholding	.010015 (0.0020393)	0.0109903 (.0010299)	-.0004669 (.0004241)
Previous year	.008457 (.002456)	.0012859 (.0015995)	.008198 (.0019355)
Proportion of patients 65 or over	.259189 (.0378432)	.1691307 (.0147351)	.0809433 (.0246646)
GPs per practice	.0039533 (.000745)	.0022437 (.0003498)	.0011563 (.0005284)
Access deprivation	-.0091485 (.0048227)	-.0011475 (.0018581)	-.0036499 (.003185)
Education deprivation	.0066099 (.0021405)	.0006861 (.0009599)	.0057427 (.0015055)
Income deprivation	-.0004995 (.0001679)	-.0000523 (.0000756)	-.0004502 (.0001194)
Housing deprivation	-.0021354 (.0023111)	.0011001 (.009048)	.000132 (.0013076)
Constant	-.8278653 (.0091771)	-.8832212 (.0037112)	-.8635797 (.0062423)
R^2	.3980	.2882	.1560
Robust standard errors in parenthesis			