

Does quality affect patient choice of general practice?

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Abstract. We examine the factors which influence the choice of general practice by patients. We estimate conditional logit models using a rich data set on 3.379M patients aged 25+ in 2875 LSOAs who registered with 994 practices. We find that the probability of choosing a practice decreases with distance to the practice and increases with the proportion of female GPs in the practice. The probability of choosing a practice is lower if the practice has a higher proportion of Asian qualified GPs. Patients are also more likely to choose a practice with higher clinical quality. Choices by patients from areas which are more deprived, have less well educated populations or a higher proportion of Asian origin are more affected by distance and less by other practice characteristics.

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1 Introduction

To receive primary medical care in the British National Health Service (NHS) a patients must register with a general practice, which also acts as a gatekeeper for elective hospital care. The NHS is financed almost entirely from general taxation and patients face no charges for NHS health care, apart from a small charge for dispensed medicines.

In this paper we investigate the factors which influence patients' choice of general practice. In addition to examining the effects of distance to the practice and practice characteristics such as the gender of practice GPs and their country of qualification we focus on the effect of the quality of the practice on choices by patients.

One of the strands in policy in the English National Health Service (NHS) in recent years has been the promotion of competition amongst hospitals in the secondary care sector and amongst general practices in primary medical care. In general practice the national body which controlled entry of new practices was abolished in 2002 and the Department of Health (DH) introduced a tendering process to make it easier for new practices to be set up, especially in under-doctored areas. Restrictions on patients' choice of practice are to be removed and patients are to be given the right to register with any practice in England (Department of Health, 2010). A website, NHS Choices, has been set up by the DH containing information on the characteristics of practices, such as the clinics they offer and their performance under a national quality incentive scheme. The rationale for promoting greater competition is that, especially when prices are regulated, health care providers respond to greater competition by improving their quality in order to attract patients.

A number of authors have examined the empirical relationship between competition and quality in health care markets. Most studies find that when providers face fixed prices greater competition is associated with higher quality. See Gaynor and Town (2011) for a comprehensive review and Cooper et al, 2011; Gaynor et al, 2011; Pike, 2010) for recent studies of competition and quality in the English NHS. Pike (2010) is the only study to examine competition practices and quality. He finds, using cross section data, that practices with more rivals within 500m have higher quality, as measured by lower admissions for conditions that should be amenable to treatment in primary care and by patient satisfaction.

The results in our paper provide another approach to the question of whether competition promotes quality by testing the crucial assumption that quality affects demand.

1.1 Literature

Hospital demand. US: Tay (2003), Howard (2005), Gaynor and Town (2011). UK. Sivey (2011). Gaynor et al (2011). Netherlands: Varkevisser, M. and van der Geest, S. (2007).

GP demand. Norway: Godegar and Biorn (2008), Iversen and Luras (2011), Grytten and Sorensen (2009). UK: Lewis et al (2009), Dixon et al (1997), Salisbury (1989). Netherlands: Schers et al (2004).

2 General practice in the NHS

The doctors in general practices (general practitioners – GPs) are not employees of the NHS, apart from a small proportion directly employed by local primary care organisations (Primary Care Trusts - PCTs). The NHS contracts with general practices for the supply of services, not

with the individual GPs. Nearly all general practices are legal limited liability partnerships owned by the GPs. English practices have on average 4.2 general practitioners (GPs) and around 6,600 patients (Information Centre, 2011b).

Under the GMS contract practices must provide *essential* services to their registered patients, defined, rather vaguely, as the management of patients who are terminally ill, or ill with conditions from which recovery is generally expected, or who have chronic disease. These services are paid for by capitation payments which vary with the age/gender mix of the practice and the morbidity of the local population. Capitation payments account for around 60% of practice revenue. Practices can choose to provide various *additional* services, such as cervical screening, vaccinations and immunisations, minor surgery and out of hours services for which they receive additional remuneration. Some of these payments also vary with the size of the relevant population and hence with practice list. Practice They can also opt to provide *enhanced* services

Practice contracts with the NHS to supply services to patients are of two types. Just over half of general practices have the General Medical Services (GMS) contract whose terms are set by national negotiations between the NHS and the British Medical Association (the doctors' trade union). GMS practices are paid a mixture of lump sums, capitation, quality incentive payments, and items of service. Over 80% of practice revenue varies with the number of patients on the practice revenue. Most of practice revenue (over 60%) is generated by capitation payments which are determined by a national formula which takes account of the demographic mix of practice patients and local morbidity measures. Quality incentives from the Quality and Outcomes Framework (QOF) (Roland, 2004) generate over 20% of practice revenue. For a given quality level, QOF revenue increases with the number of patients. Practice payments for vaccinating and screening specified target proportions of the relevant practice population will also increase with the total list. Practices are reimbursed for the costs of their premises but have to fund all other expenses, such as hiring practice nurses and clerical staff, from their revenue.

Around 48% of practices are paid under a Primary Medical Services (PMS) contract. These contracts are negotiated between the practice and their local primary care organisation (Primary Care Trust – PCT). Under the PMS contract, the practice receives a lump sum in exchange for agreeing to provide the services they would have provided under the GMS contract, plus additional services for particular patient groups. The amount received is typically the amount the practice would have received under GMS, plus an addition intended to cover the cost of the extra services. PMS practices also receive QOF payments, though they are paid less than GMS practices for the same quality achievement because some of the QOF payments relate to activities which are also paid for directly under PMS contracts. As under GMS, the practice has to meet its expenses from its revenue.

The method of payment for practices ensures that, whether they have GMS or PMS contracts, their revenue will increase with the number of patients. The question we address is whether practices can attract more patients by improving their quality.

3 Data

We construct a rich data set on patients and practices by linking a number of NHS administrative data sets (Attribution Data Set, General Medical Statistics, Quality and

Outcomes Framework, Hospital Episode Statistics) with census and socio-economic data from the Office of National Statistics Neighbourhood Statistic.

3.1 Patients

The Attribution Data Set (ADS) for 2010 records, for each Lower Super Output Area (LSOA), the number of patients by age/sex band who are registered with each general practice at 1 April 2010. There are 32,482 LSOAs in England, with a minimum population of 1000 and a mean population of 1500.

To reduce computational burden we limit our analysis to the choice of practice by patients resident in one of 10 Strategic Health Authorities (SHAs) in England which have administrative responsibility for the 152 lower level Primary Care Trusts. We use the 2875 LSOAs in the East Midlands SHA (Figure 1). The SHA has a mixture of densely populated urban areas and rural areas. It has a relatively high proportion of non-UK qualified GPs who are sometimes argued to be perceived as of lower quality than UK qualified doctors. It has a relatively high proportion of the population who are of Asian origin and we want to investigate the possible effects of ethnicity and other socio-economic characteristics on patients' tastes for various practice characteristics. It is also far from the English-Welsh and English-Scottish borders so that we do not have to drop any LSOAs whose patients are registered in Welsh or Scottish practices whose characteristics we do not observe.¹

We consider only patients aged 25 or over. Children are excluded because their choices are made by their parents and we cannot distinguish in our between patients with and without children. We exclude those age 18-25 because students in post-secondary education may continue to be registered at their parents' general practice despite living away from home. We therefore analyse the choice of practice by 3.379M individuals in the East Midlands SHA who are aged 25+.

We know the age (in bands) and gender of each patient. We attribute socio-economic data to them by their LSOA of residence. We are interested in whether different types of patient have different preferences over practice characteristics, especially practice quality. The socio-economic variables are the overall level of deprivation from the Index of Multiple Deprivation² which summarises deprivation in seven domains, the proportion of LSOA residents of Asian ethnicity, and the proportion of adult LSOA residents with no educational qualifications. Table 1 has descriptive statistics for patients and their attributed LSOA characteristics.

3.2 Practice characteristics

We have data from the General Medical Services census (on 30 September 2010 and 2009) to measure the average age of GPs, the proportion of female GPs, the proportion of GPs qualified in the UK, in Europe, in Asia, and elsewhere. We also have data on the type of practice contract (PMS or GMS), and whether the practice has opted out of providing out of hours care for its patients. See Table 1.

¹ The ADS includes patients resident in England but registered in practices located in Wales and Scotland as well as England.

² <http://www.communities.gov.uk/publications/communities/indicesdeprivation07>

Office of National Statistics Neighbourhood Statistics website <http://www.neighbourhood.statistics.gov.uk/dissemination/MetadataDownloadPDF.do?downloadId=22491>.

3.3 Practice quality

We use two measures of the quality of disease management. The first is the number of points earned by the practice in the Quality and Outcomes Framework (QOF) for clinical quality indicators. The QOF is a pay for performance scheme under which practices receive points for their performance against quality indicators and are paid £125 per point achieved. We measure practice quality by the number of points achieved on 81 clinical indicators for 20 disease areas in the financial year 2009/10. The total points available for these indicators was 697 and the mean number earned by practices was 671 (Table 1).

The QOF clinical indicators are a mixture of how well practices monitor aspects of patient conditions (for example, the proportion of patients with coronary heart disease (CHD) for whom there is a record of blood pressure in the previous 15 months) and of practice achievement of intermediate outcomes (for example, the proportion of patients with CHD whose blood pressure was 150/90 or less). Our second clinical quality measure is a more direct outcome measure: the practice's total emergency admission rate between April 2008 and March 2009 for six Ambulatory Care Sensitive Conditions (ACSCs): asthma, blood pressure, stroke, chronic obstructive pulmonary disease, epilepsy and congestive heart failure.³ ACSCs are conditions for which good quality management in general practice should prevent emergency admissions for complications (AHRQ, 2004; Purdy et al., 2009). ACSCs admission rates are widely used as measures of access to good quality primary care. As Table 1 shows ACSC admission rates have much greater variation across practices than QOF clinical points.

We also use three patient satisfaction measures from the GP Patient Survey which is sent to a 5.7M random sample of patients in all practices in England.⁴ We use the answers to three questions. One question is about general satisfaction ("In general, how satisfied are you with the care you get at your GP surgery or health centre?") and a second is about satisfaction with opening hours ("How satisfied are you with the hours that your GP surgery or health centre is open?"). We use the proportion of the respondents who say they were "Very satisfied" or "Fairly satisfied" with these aspects of the practice, as opposed to reporting being "Neither satisfied or dissatisfied", "Fairly dissatisfied", "Very dissatisfied" (or not knowing the practice opening hours). The third question asks patients "Would you recommend your GP surgery or health centre to someone who has just moved to your local area?" and we use the proportion of respondents who report "Yes, would definitely recommend" or "Yes, might recommend", as opposed to "Not sure", "No, would probably not recommend", "No, would definitely not recommend" or "Don't know".

Table 1 suggests that patients are generally satisfied with their practices and the variation across practices in satisfaction scores is quite small.

3.4 Distance measurement and choice sets

Figure 1 shows the practices and LSOAs in the East Midlands. The 994 practices with which East Midlands patients are registered have 1232 surgery locations. We assume that a patient considers the distance to the nearest branch of a practice when choosing amongst practices. We obtained the practice branch post codes (and hence grid references) and calculated the straight line distance between the centroid of each LSOA and the GP surgeries within 50km

³ This data was derived from Hospital Episode Statistics (HES)

⁴ <http://www.gp-patient.co.uk/results/weighted/practicereport/> (July 2011)

of LSOAs in the East Midlands SHA. We use the distance to the nearest surgery of a practice as the LSOA centroid to practice distance.

Since over 99% of the patients were registered with practice with a surgery within 10km of their LSOA centroid we restrict the choice set for an LSOA to practices within 10km. In some urban areas there are more than 100 practices within 10km. To reduce the computation burden in these cases we further restricted the choice set to the 30 practices with the largest number of patients from the LSOA. When practices had the same number of patients from the LSOA we broke the ties by distance, taking the practices which were nearest to the LSOA centroid.

Distance data are reported in Table 1 and Figures 2 and 3. The mean distance to the nearest practice is 1.2km, the mean distance to practices within the LSOA choice set is 3.88km, and the mean distance to the chosen practice is 3.53km. 40% of East Midlands SHA patients are registered with the nearest GP practice.

Although patients are not required to register with practices located in the same PCT it is possible that they will be less likely to choose practices in a different PCT. First, patients have easier access to information about practices in the same PCT. Second, PCT boundaries are in part determined by physical features such as railway lines and rivers in a PCT which may make it more difficult to access a practice than is suggested by the straight line distance. We therefore take account of whether practices are in the same PCT as the LSOA. Around 27% of practices in LSOA choice sets are located in a different PCT but, as Table 1, indicates only 2% of patients choose a practice in a different PCT.

4 Estimation

We use McFadden's (1974) random utility choice model and estimate conditional logit models of patients's choice of practice

4.1 Model

The choice sets of practices for individuals are defined by their LSOA of residence and all patients in same LSOA a have the same choice set C_a . There are A LSOAs, and J different practices in total. LSOA a has $n_a = \sum_{j \in C_a} n_{aj}$ residents, where n_{aj} is the number of LSOA a residents who choose practice j . The total practice j patient list is $n_j = \sum_{a=1}^A n_{aj}$. All residents in an LSOA choose some practice and there are $N = \sum_{j=1}^J n_j = \sum_{a=1}^A n_a$ patients in total.

The utility for individual i living in LSOA a if she chooses practice j is

$$U_{iaj} = \beta' z_{iaj} + \varepsilon_{iaj} \quad (1)$$

z_{iaj} is a vector of observed variables and ε_{iaj} is random error term observed by the patient i but not the econometrician. Each patient i in LSOA a chooses the practice in their choice set C_a which yields the highest realised value of U_{iaj} .

Since utility is additive in the variables in z_{iaj} , no variable which is individual specific (for example age) or LSOA specific (for example the proportion of the LSOA residents who are of Asian origin) can affect the differences in utility across practices and hence the choice of practice. Hence, without loss of generality, we restrict z_{iaj} to consist of four types of

variables: those which vary by practice (such as the proportion of female GPs or practice quality); those which vary by LSOA and practice (such as the distance from the LSOA centroid to the practice); those which vary by individual and practice (such as the interaction of patient age and practice quality); and those which vary by individual, LSOA and practice (such as the interaction of patient age and distance from LSOA centroid to the practice).

Assuming that the ε_{iaj} errors are independently and identically distributed according to the type 1 extreme value distribution, the probability that patient i in LSOA a chooses practice j is:

$$P_{iaj} = \exp(\beta' z_{iaj}) \left[\sum_{j' \in C_a} \exp(\beta' z_{iaj'}) \right]^{-1} \quad (2)$$

The log-likelihood for the conditional logit model is

$$\ln \mathcal{L}(\beta) = \sum_{a=1}^A \sum_{j \in C_a} \sum_{i=1}^{n_a} \ln \left[\frac{\exp(\beta' z_{iaj})}{\sum_{j' \in C_a} \exp(\beta' z_{iaj'})} \right]^{y_{iaj}} \quad (3)$$

where $y_{iaj} = 1$ when practice j is chosen by individual i in LSOA a and is zero otherwise.

In our most of models we assume that individual characteristics (such as age) do not affect choices when combined with practice characteristics or when combined with LSOA and practice characteristics.⁵ Thus, only variables which vary by LSOA and practice (z_{aj}) affect choice probabilities and the probability of choice of practice j by an individual in LSOA a is the same for all individuals in LSOA a

$$P_{iaj} = \exp(\beta' z_{aj}) \left[\sum_{j' \in C_a} \exp(\beta' z_{aj'}) \right]^{-1} \quad (4)$$

and the log-likelihood becomes

$$\ln \mathcal{L}(\beta) = \sum_{a=1}^A \sum_{j \in C_a} n_{aj} \ln \left[\frac{\exp(\beta' z_{aj})}{\sum_{j' \in C_a} \exp(\beta' z_{aj'})} \right] \quad (5)$$

so that the log of the choice probability for practice j in choice set C_a is weighted by the number of patients in LSOA a who choose practice j .

4.2 Marginal rates of substitution

The estimated coefficients $\hat{\beta}$ convey information about the sign of the effect of an attribute on patient utility and on the probability of choice since $\partial P_{aj} / \partial z_{aj}^k = \hat{\beta}_k P_{aj} (1 - P_{aj})$ but the magnitudes of the effects on probabilities depend on the practice and the LSOA. To get a more readily interpretable quantitative estimate of patient preference across practice characteristics we calculate marginal rates of substitution between characteristic k and the distance in kilometres between the LSOA centroid and the practice:

$$MRS_{k1} = - \frac{\partial z_{aj}^k}{\partial z_{aj}^1} \bigg|_u = \frac{\partial u_{iaj} / \partial z_{aj}^1}{\partial u_{iaj} / \partial z_{aj}^k} = \frac{\hat{\beta}_k}{\hat{\beta}_1} \quad (6)$$

where $k \neq 1$ denotes one of the elements of the z_{aj} vector and the first element is distance. MRS_{k1} is the additional distance that a patient would be willing to be from a practice if the practice characteristic or quality k increased by one unit. Following the results in Hole (2007), we estimate standard errors on the MRS_{k1} using the delta method.

⁵ When we examine whether choice probabilities vary across age and gender we do so by estimating separate models for patients in each age/gender group. The log likelihood is then of the same form as (3) with the interpretation that a now refers to residents of LSOA a who are in the age/gender group.

5 Results

5.1 Demand models

We estimated the baseline Model 1 which explains practice choice as depending on distance, whether the practice is in the same PCT as the patient LSOA, mean GP age, proportion of female GPs, the proportion of GPs qualified in the UK (baseline category), Europe, Asia, and the rest of the world, the type of contract the practice has (GMS is the baseline category), whether the practice has opted out of providing out of hours cover for its patients, and the clinical quality indicators.

We expect that the probability of choosing a practice will be lower if it is in another PCT and if it is further away. The literature suggests that patients prefer consultations with female GPs so we expect that they are more likely to choose practices with a higher proportion of female GPs. GPs who have qualified outside the UK are less likely to have English as a first language so we expect that practices with a higher proportion of such GPs will have less demand.

When practices opt out of providing services to patients outside normal working hours the responsibility for providing such services passes to the PCT. This need not lead to a reduction in the availability of out of hours care for patients compared to practices which do not opt out because much of the out of hours care is subcontracted by practices to commercial and cooperative deputising services. Since PMS contracts usually require the practice to provide additional services to particular types of patient it is possible that patients will prefer practices with PMS contracts.

These expectations are broadly fulfilled in Model 1. Patients prefer practices in the same PCT, which are closer, with a higher proportion of female GPs, and with a lower average age. They are less likely to choose practices with a higher proportion of Asian qualified GPs (relative to UK qualified). Surprisingly they prefer European qualified GPs to UK qualified ones. They do not appear to care about the contract status of the practice or whether it has opted out of providing out of hours care. Patients do appear to prefer practices with higher quality as measured by higher QOF points and by lower ACSC admissions.

In addition to the baseline model we also estimate Models 2 to 5 which allow for different types of patients to have different preferences over practice characteristics. The patient characteristics of interest are deprivation, education, ethnicity, age and gender. To test whether the first three affect practice choice we construct three dummy variables which take on the value 1 when the LSOAs is in the highest quintile for deprivation, the proportion of adults with no qualifications, and the proportion of the population of Asian ethnicity. The average proportions of the LSOA population who are in the highest quintiles versus the mean proportions are 44.5 vs 20.5 for deprivation, 0.33 vs 0.23 for no educational qualifications, and 0.18 vs 0.04 for Asian ethnicity.

We interact these dummy variables with practice characteristics to test, for example, if patients in LSOAs with a high proportion of the population of Asian origin have different preferences as regards the country of qualification of practice GPs or the proportion of female GPs. We do not interact the three dummy variables with the quality measures because of the possibility that these three characteristics may themselves affect practice quality. For example, the proportion of a practice's list who are admitted for emergency treatment for Ambulatory Care Sensitive Conditions may depend on the proportion of the list who

deprived. Thus if we find a positive coefficient on the interaction of the deprivation dummy and ASCS admission rate it is not possible to tell if this is because deprived patients care less about this aspect of quality or because a practice with more deprived patients will have a higher ASCS admission rate. We discuss this issue in section 6 when considering extensions to the analysis.

The interaction models suggest that deprived, or less well qualified patients, or those of Asian ethnicity care more about distance and less about other practice characteristics.

To investigate the effects of age and gender on patient preferences for practice characteristics and quality we estimated separate models for each age and gender group and report the results in Table 3. The coefficients are stable across the fourteen gender-age groups. Female patients value slightly more distance, and proportion of female GPs than male patients.

Table 4 reports results from models using patient satisfaction with their practice and willingness to recommend it as measures of practice quality. In the first three models we include only distance and being in a different PCT as practice characteristics in addition to three satisfaction measures. In these models distance and being in a different PCT have similar coefficients to those in Table 2 using a larger set of practice characteristics and the clinical quality measures. The overall satisfaction and recommendation measures have highly significant and positive significant coefficients in these models containing only distance and being in a different PCT. However when other practice characteristics are added to the models, overall satisfaction becomes insignificant. This suggests that this measure is summarising the effect of practice characteristics on patient utility. The recommend measure retains its significance but becomes markedly smaller when other patient characteristic are included, suggesting that in recommending a practice to potential patients, existing patients do not just consider how satisfied they are.

Tables 5 and 6 reports marginal effects for practice characteristics and quality measures, showing the change in the probability of choosing practice resulting from a one unit increase in the relevant variable. Because $\partial P_{aj} / \partial z_{aj}^k = \hat{\beta}_k P_{aj} (1 - P_{aj})$ depends on the value of z_{aj} we evaluate it at the mean of the variables, except for the distance effect which is evaluated at the mean distance to the practice chosen, rather than the mean distance to practices in the choice set. A one km increase in distance reduces the probability of a practice being chosen by 18.7%. Although increases in clinical quality measures increase the probability of a practice being chosen the effects are very small. This is also shown by the estimated MRS: patients are only willing to travel very small distances for a one unit in quality.

5.2 Catchment areas and closed lists

A practice may refuse a patient's application to join its list of patients only if the patient lives outside its catchment area or if it has formally closed its list of patients. Because practices have a legal obligation to make home visits if these are medically necessary, they will be reluctant to accept patients who live a considerable distance from the practice. Practices therefore agree catchment areas with their PCTs such that the practice is not obliged to accept patients who live outside the practice catchment area. Thus the observed negative effect of distance on the probability of patients being on the list of a practice may be at least partly due to decisions by practices as well as by patients.

Practices can notify their local PCT that they do not wish to accept new patients. Such list closures are temporary for practice planning to stay in business since around 8% of patients

leave a list (because of change of address or death). A small proportion (1.0%–1.5%) of patients change practice without change of address each year. Our data are a snapshot of the distribution of patients across practices at a given date which reflects decisions over a considerable period since on average patients spend about 10 years in a practice. Thus list is closure unlikely to have major implications for our results.

We undertake robustness tests on our results by estimating models in which the choice set for LSOAs is restricted from 10km down to 8km, 6km, 4km and 2km. We also estimate models in which the choice set for an LSOA is restricted to practices which have at least 0%, 1%, 5% or 10% of their list drawn from that LSOA. By restricting the choice set for an LSOA to practices which have some of their patients from the LSOA we make it less likely that the observed distribution of LSOA patients across practices is due to decisions by GPs rather than patients. However we run the risk of omitting patients making unconstrained choices and thereby biasing the coefficient estimates, particularly if the effects of practice characteristics vary with distance.

Table 7 compares models with different choice set radii. The coefficients are stable across the five different choice sets, with more restricted sets having a smaller (in absolute terms) coefficient for different PCTs, European GPs and QOF points and a higher coefficient for distance and proportion of female GPs. Table 8 reports results from models in which analysis is restricted to LSOAs contributing different minimum percentages of practice patients. For more restricted sets the fact that the GP practice is in a different PCT and the QOF points have smaller effects which are not significant in the more severely restricted case. The ACSCs coefficient is stable but the QOF points coefficient loses significance with any restriction. Note that the 1% restriction is equivalent to requiring that the LSOA has at least 60 patients from an average practice.

6 Conclusion and Discussion

This is work in progress and our tentative conclusion is that practice clinical quality does affect patient choice of practice may not be borne out in future work that we plan. These plans include

- calculation of elasticities to supplement the estimated marginal effects
- refining the set of practice and patient characteristics (eg allowing for whether practices can dispense medicines as well as prescribe them; using a finer set of deprivation variables including income deprivation; allowing for the value of quality to vary with distance; testing whether the allowing for population density in case the effect of distance is different in rural and urban areas; changing the set of Ambulatory Care Sensitive Admissions; using more detailed quality data from the Quality and Outcomes Framework)
- alternative access measures such as road distance and travel time;
- testing the assumption of independence of irrelevant alternatives (Hausman and McFadden, 1984);
- alternative estimation methods to allow for unobserved patient heterogeneity (multinomial logit with distributions of patient preference
- modelling and testing for endogeneity of quality, as in recent work on hospital demand (Seiler et al, 2011). It is possible that practices find it easier to produce high QOF scores or other quality measures when they have healthier or less deprived or better educated patients and that such patients are more sensitive to quality when choosing a practice. We will investigate whether it is possible to model the

determinants of practice quality and then remove possible endogeneity bias using control function methods.

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Figure 1. East Midlands SHA: practice locations and LSOAs

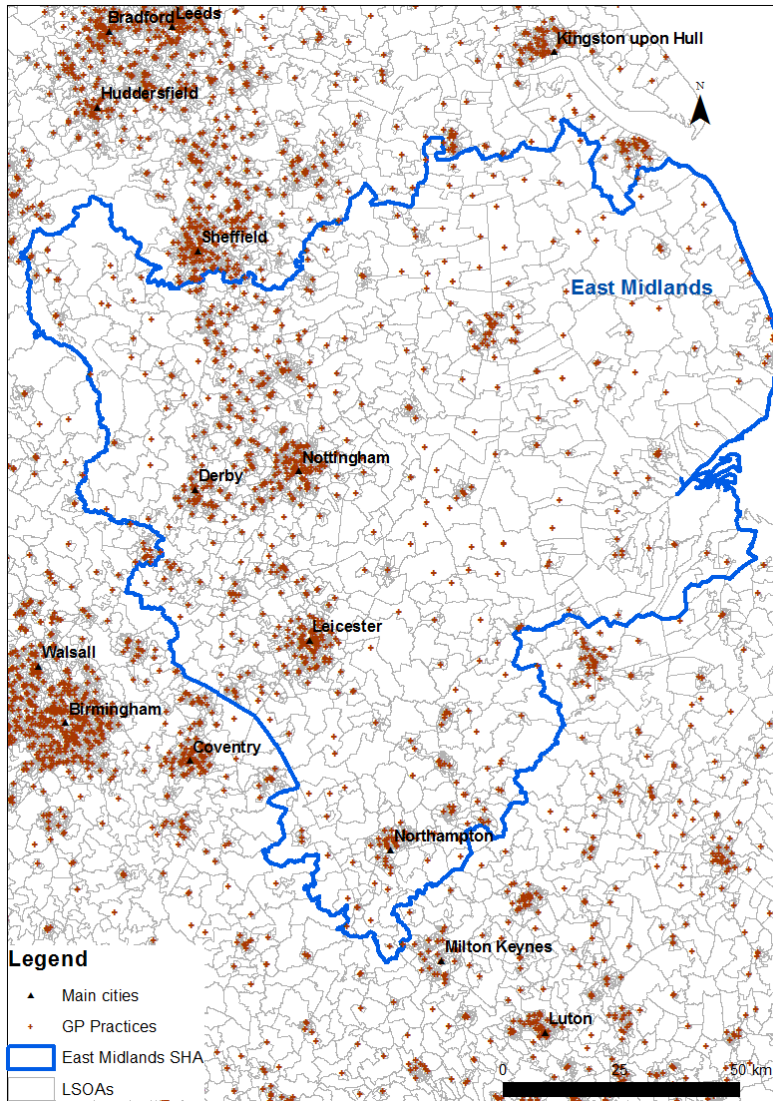


Figure 2. Distance to practices in choice set

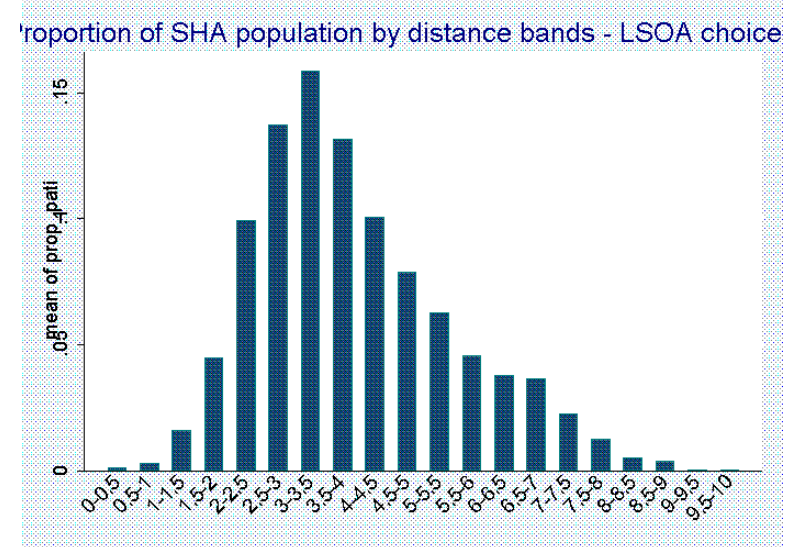


Figure 3. Distance to practices in choice set

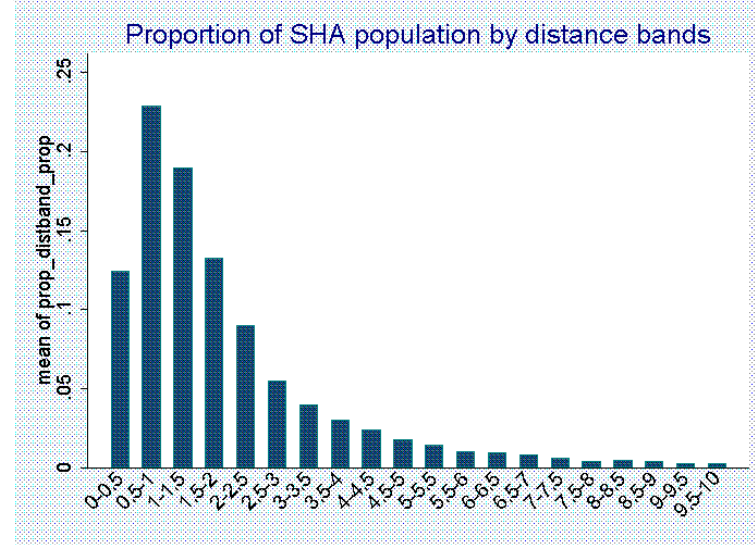


Table 1. Patient and practice characteristics

	Variable name	Mean	SD	Min	Max
<i>Patients</i>					
Age		50.91	3.73	33.97	61.94
Gender		0.50	0.03	0.27	0.77
Index of Multiple Deprivation in LSOA	IMD	20.45	14.59	0.73	78.37
Proportion Asian in LSOA	Asian	0.04	0.12	0.00	0.92
Proportion of Non-qualified Adults in LSOA	Non-qual	0.23	0.07	0.04	0.43
<i>Practice characteristics</i>					
Prop. Of Female GPs	PropFem	0.36	0.25	0.00	1.00
Mean GP age (years)	GPAge	47.89	6.70	31.50	72.50
Prop. of Asian qualified GPs	GPAsian	0.22	0.33	0.00	1.00
Prop. of European qualified GPs	GPEUR	0.04	0.10	0.00	1.00
Prop. of UK qualified GPs	GPUK	0.70	0.36	0.00	1.00
Prop. of GPs qualified in other countries	GPOther	0.05	0.15	0.00	1.00
Practice has opted out of out-of-hours cover	Opted Out	0.61	0.49	0.00	1.00
Practices with a personal medical service contract	PMS	0.48	0.50	0.00	1.00
<i>Practice quality measures</i>					
QOF clinical points earned by practice in 2009/10	QOF points	671	34	386	697
Emergency admissions for ACSCs per 10,000 patients	ACSC	338	270	3	2100
Prop patients very or fairly satisfied overall	SatisOverall	0.89	0.06	0.57	0.99
Prop patients very or fairly satisfied with opening hrs	SatisAccess	0.80	0.06	0.45	0.97
Prop patients would definitely or might recommend practice	SatisRecomend	0.82	0.10	0.38	0.99
<i>Distance and practice choices</i>					
Proportion in LSOA registered at nearest practice		0.40	0.27	0.00	1.00
Proportion in LSOA registered at practice in a different PCT		0.02	0.07	0.00	1.00
Distance to nearest practice from LSOA centroid		1.20	1.16	0.02	9.81
Mean distance to a practice in choice set from LSOA centroid		3.88	1.52	0.33	9.89
Distance to chosen practice from LSOA centroid		1.20	1.16	0.02	9.81

Table 2 – Practice choice models and interactions

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Baseline		Deprivation interactions		Low qualification interactions		Asian interactions		All interactions	
diff PCT 2006	-0.867***	(-20.264)	-0.850***	(-18.900)	-0.841***	(-17.962)	-0.974***	(-18.607)	-0.939***	(-16.658)
Distkm	-0.936***	(-85.104)	-0.885***	(-78.327)	-0.900***	(-75.761)	-0.886***	(-77.444)	-0.841***	(-69.299)
PropFem	0.138***	(4.030)	0.123**	(3.046)	0.132***	(3.371)	0.0927*	(2.241)	0.0837	(1.745)
GPAge	-0.0121***	(-7.788)	-0.0152***	(-8.171)	-0.0144***	(-7.976)	-0.0117***	(-5.886)	-0.0154***	(-6.874)
GPEUR	0.494***	(7.876)	0.412***	(5.522)	0.471***	(6.627)	0.547***	(7.778)	0.479***	(5.621)
GPAsian	-0.280***	(-9.126)	-0.408***	(-11.256)	-0.360***	(-10.178)	-0.342***	(-8.344)	-0.453***	(-9.712)
GPOthernonUK	-0.252***	(-3.797)	-0.274***	(-3.399)	-0.251**	(-3.270)	-0.215*	(-2.477)	-0.214*	(-2.261)
PMS	-0.0168	(-0.575)	-0.0409	(-1.229)	-0.0340	(-1.006)	0.0124	(0.291)	-0.0102	(-0.225)
GP practice Opted Out	0.0125	(0.365)	-0.00182	(-0.046)	-0.00436	(-0.111)	0.0384	(0.822)	0.0185	(0.366)
ACS	-0.00188***	(-35.455)	-0.00191***	(-36.473)	-0.00190***	(-36.079)	-0.00187***	(-35.283)	-0.00190***	(-36.279)
Earned QOF Points	0.00237***	(9.593)	0.00248***	(10.144)	0.00242***	(9.691)	0.00238***	(9.609)	0.00249***	(10.167)
DeprivQ x diff PCT 2006			-0.103	(-0.834)					-0.132	(-1.006)
DeprivQ x Distkm			-0.371***	(-12.747)					-0.268***	(-8.674)
DeprivQ x PropFem			0.0388	(0.573)					-0.00935	(-0.130)
DeprivQ x GPAge			0.0141***	(4.218)					0.0109**	(2.853)
DeprivQ x GPEUR			0.0473	(0.341)					0.202	(1.278)
DeprivQ x GPAsian			0.305***	(4.917)					0.242***	(3.619)
DeprivQ x GPOthernonUK			0.154	(1.183)					0.186	(1.213)
DeprivQ x PMS			0.135*	(2.022)					0.138	(1.723)
DeprivQ x GP practice Opted Out			0.0953	(1.231)					0.0788	(0.853)
NonQualQ x diff PCT 2006					-0.103	(-0.935)			-0.0258	(-0.231)
NonQualQ x Distkm					-0.235***	(-9.052)			-0.0957***	(-3.647)
NonQualQ x PropFem					0.0313	(0.403)			0.0572	(0.684)
NonQualQ x GPAge					0.0137***	(3.773)			0.00831*	(2.058)
NonQualQ x GPEUR					-0.0717	(-0.463)			-0.241	(-1.353)
NonQualQ x GPAsian					0.228***	(3.359)			0.0661	(0.910)

NonQualQ x GPOthernonUK	0.0609	(0.421)			-0.0740	(-0.466)
NonQualQ x PMS	0.0910	(1.374)			0.0254	(0.333)
NonQualQ x GP practice Opted Out	0.0804	(1.020)			0.0552	(0.606)
PropAsianQ x diff PCT 2006				0.483***	(5.938)	0.458*** (5.604)
PropAsianQ x Distkm				-0.349***	(-14.124)	-0.309*** (-13.378)
PropAsianQ x PropFem				0.146*	(2.245)	0.130* (2.042)
PropAsianQ x GPAGE				-0.00132	(-0.422)	-0.00259 (-0.857)
PropAsianQ x GPEUR				-0.402**	(-2.778)	-0.352* (-2.466)
PropAsianQ x GPAsian				0.137*	(2.374)	0.107* (1.971)
PropAsianQ x GPOthernonUK				0.00797	(0.067)	-0.0621 (-0.507)
PropAsianQ x PMS				-0.0554	(-1.015)	-0.0669 (-1.239)
PropAsianQ x GP practice Opted Out				-0.0193	(-0.288)	-0.0142 (-0.212)
Nos patients	3,378,615	3,378,615	3,378,615	3,378,615	3,378,615	3,378,615

t statistics in parentheses, * p <0.05, ** p<0.01, *** p<0.001. Regressions also contained dummies for imputation of PMS status and ACS admission rates

Table 3 – Practice choice models for different age-gender bands

	Female						Male					
	over25yrs	25to34yrs	35to44yrs	45to64yrs	65to74yrs	over75yrs	over25yrs	25to34yrs	35to44yrs	45to64yrs	65to74yrs	over_75yrs
Diff_PCT2006	-0.872	-0.931	-0.913	-0.889	-0.942	-0.943	-0.870	-0.926	-0.911	-0.885	-0.934	-0.948
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Distance	-0.941	-0.988	-0.977	-0.957	-1.004	-1.020	-0.939	-0.984	-0.972	-0.952	-0.999	-1.032
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Prop_Female	0.140	0.151	0.149	0.148	0.151	0.154	0.139	0.140	0.142	0.146	0.153	0.133
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Av_GPAGE	-0.012	-0.013	-0.013	-0.013	-0.014	-0.014	-0.012	-0.013	-0.013	-0.012	-0.014	-0.014
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Prop_EuropeanGPs	0.496	0.524	0.515	0.515	0.555	0.594	0.495	0.533	0.513	0.515	0.563	0.593
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Prop_AsianGPs	-0.283	-0.291	-0.303	-0.286	-0.315	-0.332	-0.280	-0.283	-0.293	-0.288	-0.304	-0.337
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Prop_OtherCountryGPs	-0.254	-0.246	-0.263	-0.271	-0.296	-0.324	-0.253	-0.250	-0.252	-0.267	-0.306	-0.334

	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PMS	-0.017	-0.017	-0.017	-0.015	-0.013	-0.017	-0.017	-0.021	-0.019	-0.016	-0.013	-0.021
	0.561	0.577	0.581	0.608	0.692	0.606	0.564	0.491	0.530	0.585	0.679	0.544
Opted_out	0.013	0.013	0.015	0.015	0.019	0.011	0.012	0.010	0.012	0.014	0.019	0.007
	0.717	0.709	0.670	0.670	0.618	0.770	0.717	0.792	0.742	0.679	0.619	0.860
ACSCs	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
QOF_points	0.002	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.003	0.003	0.003
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nos Patients	1,702,864	297,980	344,065	622,227	218,768	219,824	1,676,332	312,858	361,131	641,866	209,076	151,401

p values are reported below coefficient estimates.

Table 4 - Practice choice models: patient satisfaction

	Overall satisfaction		Satisfaction with access		Would recommend		Overall satisfaction		Satisfaction with access		Would Recommend	
diff PCT 2006	-0.927***	(-19.42)	-0.944***	(-19.66)	-0.918***	(-19.49)	-0.890***	(-19.33)	-0.892***	(-19.39)	-0.886***	(-19.33)
Distkm	-0.943***	(-82.97)	-0.943***	(-82.91)	-0.942***	(-83.18)	-0.941***	(-84.59)	-0.941***	(-84.67)	-0.941***	(-84.62)
PropFem							0.306***	(9.18)	0.311***	(9.29)	0.276***	(8.18)
GPAge							-0.0269***	(-16.98)	-0.0266***	(-16.77)	-0.0270***	(-17.08)
GPEUR							0.172**	(2.91)	0.165**	(2.79)	0.217***	(3.65)
GPAsian							-0.516***	(-16.02)	-0.525***	(-16.78)	-0.450***	(-13.64)
GPOthernonUK							-0.562***	(-9.73)	-0.566***	(-9.84)	-0.512***	(-8.81)
PMS							0.153***	(4.84)	0.150***	(4.75)	0.159***	(5.05)
Practice opt out							0.168***	(4.61)	0.165***	(4.49)	0.173***	(4.73)
OverallSatis	1.544***	(9.40)					0.0793	(0.50)				
AccessSatis			-0.220	(-1.59)					-0.193	(-1.40)		
RecomendSatis					1.640***	(15.77)					0.571***	(5.57)
Nos Patients	3,378,615		3,378,615		3,378,615		3,378,615		3,378,615		3,378,615	

Note: Regressions also contained dummies for imputation of PMS status and ACS admission rates

Table 5 - Marginal effects and marginal rates of substitution with distance: baseline model

	Marginal effect	Z-stat	Mean of variable	Marginal Rate of Substitution	t-stat
diff PCT 2006	-1.343	-5.33	0.269	0.926	18.97
Distkm	-1.450	-11.5	1.19		
PropFem	0.214	3.15	0.356	-0.148	-4.04
GPAge	-0.019	-5.53	47.609	0.013	7.71
GPEUR	0.765	4.35	0.034	-0.527	-7.78
GPAsian	-0.433	-4.61	0.224	0.299	9.07
GPOthernonUK	-0.391	-3.33	0.047	0.269	3.8
PMS	-0.026	-0.58	0.503	0.018	0.57
Practice opt out	0.019	0.36	0.606	-0.013	-0.36
ACS	-0.003	-5.39	329.250	0.002	31.43
Earned QOF Points	0.004	3.57	671.628	-0.003	-9.64

Notes: Proportion variables vary between 0 and 1. Regressions also contained dummies for imputation of PMS status and ACS admission rates

Table 6. Marginal rates of substitution for deprived, no qualifications, Asian

	All patients		Lower deprivation quintiles		Upper deprivation quintile		Lower quintiles Prop. Non-qualified Adults		Upper quintile Prop. Non-qualified Adults		Lower quintiles Prop Asian		Upper quintile Prop Asian	
diff PCT 2006	0.926***	(18.97)	0.960***	(17.67)	0.759***	(7.98)	0.934***	(16.85)	0.831***	(8.96)	1.099***	(17.49)	0.397***	(7.72)
PropFem	-0.148***	(-4.04)	-0.138**	(-3.05)	-0.128**	(-2.93)	-0.146***	(-3.37)	-0.143*	(-2.40)	-0.105*	(-2.24)	-0.193***	(-4.67)
GPAge	0.0129***	(7.71)	0.0172***	(8.11)	0.000923	(0.42)	0.0159***	(7.91)	0.000551	(0.20)	0.0132***	(5.84)	0.0105***	(5.40)
GPEUR	-0.527***	(-7.78)	-0.466***	(-5.50)	-0.366***	(-3.88)	-0.523***	(-6.57)	-0.352**	(-2.88)	-0.618***	(-7.68)	-0.117	(-1.14)
GPAsian	0.299***	(9.07)	0.460***	(11.13)	0.0817*	(2.00)	0.400***	(10.08)	0.117*	(2.24)	0.386***	(8.29)	0.166***	(4.89)
GPOthernonUK	0.269***	(3.80)	0.309***	(3.41)	0.0957	(1.18)	0.279**	(3.28)	0.168	(1.55)	0.243*	(2.48)	0.168*	(2.57)
PMS	0.0180	(0.57)	0.0462	(1.23)	-0.0749	(-1.62)	0.0378	(1.00)	-0.0502	(-1.00)	-0.0140	(-0.29)	0.0348	(1.24)
Practice opt out	-0.0134	(-0.36)	0.00205	(0.05)	-0.0744	(-1.40)	0.00484	(0.11)	-0.0670	(-1.11)	-0.0433	(-0.82)	-0.0154	(-0.39)
ACS	0.00201***	(31.43)	0.00215***	(32.35)			0.00211***	(31.47)			0.00211***	(31.16)		
Earned QOF Points	-0.00253***	(-9.64)	-0.00280***	(-10.17)			-0.00268***	(-9.71)			-0.00269***	(-9.67)		

Notes: Proportion variables vary between 0 and 1. Regressions also contained dummies for imputation of PMS status and ACS admission rates

Table 7 - Sensitivity analysis results: alternative choice set reduce in km - patients over 25yrs

	2 km	4 km	6 km	8 km	10 km					
diff PCT 2006	-0.691***	(0.000)	-0.777***	(0.000)	-0.809***	(0.000)	-0.829***	(0.000)	-0.867***	(0.000)
Distkm	-1.363***	(0.000)	-1.183***	(0.000)	-1.075***	(0.000)	-0.998***	(0.000)	-0.936***	(0.000)
PropFem	0.215***	(0.000)	0.148***	(0.000)	0.143***	(0.000)	0.139***	(0.000)	0.138***	(0.000)
GPAge	-0.00881***	(0.000)	-0.0108***	(0.000)	-0.0115***	(0.000)	-0.0120***	(0.000)	-0.0121***	(0.000)
GPEUR	0.377***	(0.000)	0.470***	(0.000)	0.458***	(0.000)	0.495***	(0.000)	0.494***	(0.000)
GPAsian	-0.219***	(0.000)	-0.285***	(0.000)	-0.294***	(0.000)	-0.287***	(0.000)	-0.280***	(0.000)
GPOthernonUK	-0.0671	(0.342)	-0.257***	(0.000)	-0.275***	(0.000)	-0.249***	(0.000)	-0.252***	(0.000)
PMS	-0.0470	(0.123)	-0.00827	(0.766)	0.0102	(0.725)	0.000732	(0.980)	-0.0168	(0.565)
GP practice Opted Out	0.0118	(0.748)	0.0336	(0.312)	0.0545	(0.108)	0.0303	(0.377)	0.0125	(0.715)
ACS_m	-0.00182***	(0.000)	-0.00187***	(0.000)	-0.00185***	(0.000)	-0.00186***	(0.000)	-0.00188***	(0.000)
Earned QOF Points	0.00240***	(0.000)	0.00256***	(0.000)	0.00240***	(0.000)	0.00232***	(0.000)	0.00237***	(0.000)
Nos patients	2,281,503		3,006,233		3,231,325		3,328,108		3,378,615	
Nos practices										
Nos LSOAs										

t statistics in parentheses, * p <0.05, ** p<0.01, *** p<0.001. Regressions also contained dummies for imputation of PMS status and ACS admission rates

Table 7 – Sensitivity analysis. LSOA choice sets restricted to practices with minimum % of list from LSOA (patients aged 20+)

	0 % from LSOA pop		1% from LSOA pop		5% from LSOA pop		10% from LSOA pop	
diff PCT 2006	-0.854***	(0.000)	-0.335***	(0.000)	-0.189	(0.097)	-0.170	(0.173)
Distkm	-0.942***	(0.000)	-0.468***	(0.000)	-0.198***	(0.000)	-0.110**	(0.005)
PropFem	0.160***	(0.000)	0.177***	(0.000)	0.166**	(0.010)	0.0763	(0.610)
GPAge	-0.0104***	(0.000)	-0.00829***	(0.000)	-0.0123***	(0.000)	-0.0210***	(0.000)
GPEUR	0.442***	(0.000)	0.360***	(0.000)	0.177	(0.087)	0.640	(0.051)
GPAsian	-0.299***	(0.000)	-0.227***	(0.000)	-0.0966	(0.113)	-0.0745	(0.628)
GPOthernonUK	-0.280***	(0.000)	-0.0756	(0.267)	0.00896	(0.939)	-0.232	(0.338)
PMS	-0.0415	(0.162)	-0.0759**	(0.010)	-0.216***	(0.000)	-0.289**	(0.005)
GP practice Opted Out	-0.00134	(0.969)	-0.0571	(0.094)	-0.168*	(0.011)	-0.176	(0.238)
ACS_m	-0.00207***	(0.000)	-0.00200***	(0.000)	-0.00175***	(0.000)	-0.00148***	(0.000)
Earned QOF Points	0.00137***	(0.000)	0.000594	(0.108)	0.00103	(0.054)	-0.00133	(0.232)
Nos patients								
Nos practices								
Nos LSOAs								

t statistics in parentheses, * p <0.05, ** p<0.01, *** p<0.001. Regressions also contained dummies for imputation of PMS status and ACS admission rates