Did increased competition undermine socio-economic equity in hospital care in the English National Health Service from 2003 to 2008? Panel analysis of small area administrative data

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ABSTRACT

Background There is evidence that competition can improve the quality and efficiency of hospital care. Concerns remain, however, that competition may undermine socio-economic equity in hospital care. We examine this issue in the context of the pro-competition reforms of the universal and comprehensive English National Health Service from 2003 to 2008.
Objective Our objective is to identify effects of competition on small area socio-economic inequalities in hospital utilisation by exploiting year-by-year changes in local hospital market dispersion as the pro-competition reforms were phased in.
Data We use administrative data on hospital utilisation, deprivation, population size, age-sex structure and disease prevalence for 32,482 English small areas from 2003 to 2008. Annual indices of market dispersion are constructed by computing hospital level indices based on patient flows and attributing them to small areas using distance-weighted averages.
Methods Panel data models of small area utilisation with fixed effects are estimated and equity effects of competition identified using three way interactions between deprivation, market dispersion and year, allowing for time varying need and independent sector supply variables.
Results We find a negative association between market dispersion and elective admissions in deprived areas. Pro-competition reform reduced this negative association slightly.
Conclusion Increased competition in the NHS between 2003 and 2008 did not undermine socio-economic equity in hospital care and if anything may have very slightly increased utilisation of elective inpatient care in deprived communities.

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1. Introduction

There is a substantial body of economic theory and evidence about the effects of competition on the cost and quality of hospital care (Gaynor 2006). It is known, for instance, that competition can improve quality (Kessler & McClellan, 2000) though not if buyers have poor information about quality (Propper, Burgess, & Gossage, 2008). Less is known, however, about the effects of competition on socio-economic inequality in hospital care (Cookson, Dusheiko, Hardman, & Martin, 2010). We aim to provide some evidence in the context of important pro-competition reforms of the universal and comprehensive English National Health Service (NHS) between 2003 and 2008.

The reforms were introduced by a Labour administration led by Prime Minister Tony Blair and his Chancellor Gordon Brown, who subsequently became Prime Minister from 2007-10. These "Blair/Brown" reforms fostered competition in two main ways. First, on the supply side, independent sector (IS) hospitals were encouraged gradually to enter the market for NHS funded patients: we estimate that IS activity made up 0.02% of NHS non-emergency inpatient activity in 2003/4 rising to 2.2% by 2008/9. Second, on the demand side, patients were offered a choice of hospital from December 2005 and case based hospital payment was phased in from 2003/4 to 2005/6 so that money would follow the patient's choice (Department of Health 2003). Prime Minister Blair predicted his reforms would enhance equity for poorer patients, by increasing hospital capacity and patient choice (Blair 2003, Department of Health 2003). By contrast, critics predicted that choice and independent sector provision would undermine socio-economic equity (Appleby, Harrison, & Devlin, 2003; Barr, Fenton, & Blane, 2008; Oliver & Evans, 2005; Tudor-Hart, 2006). Evidence on the equity effects of competition is timely, as the English NHS is about to embark upon an even more ambitious programme of pro-competition reform under the coalition administration of Conservative Prime Minister David Cameron and Liberal Democrat Deputy Prime Minister Nick Clegg (Department of Health 2010).

In providing evidence of this kind, one key challenge lies in disentangling the effects of hospital competition on socio-economic equity from the effects of other contemporaneous changes in the health system and the wider social and economic environment. For example, the rapid growth in NHS spending and capacity during the 2000s may have tended to improve socio-economic equity in hospital care, if activity was able to grow faster in deprived areas with greater unmet need. Changes in the wider socio-economic environment may also have played a role, for example improved access to web-based information and the ageing of the consumerist "baby boomer" generation. Our research design aims to disentangle the specific effects of competition from these broader influences on socio-economic equity in hospital care.

We identify competition effects by exploiting both change in local hospital market dispersion and change in policy regime over time. Annual indices of local market dispersion are constructed by computing hospital level indices based on patient flows and attributing them to small areas using distance-weighted averages. As one would expect, the pro-competition Blair/Brown reforms were accompanied by a general increase in hospital market dispersion during the period. However, local market dispersion varies by different amounts at different times in different parts of the country. Towards the beginning of the reform period, variation in local market dispersion is unlikely to reflect change in competitive pressure and will instead reflect change in other local demand and supply factors. As the pro-competition reforms are gradually phased in, however, increases in local market dispersion gradually become more likely to reflect increases in competitive pressure. We can therefore identify the effect of competition

as a change over time in the effect of market dispersion before and during the introduction of pro-competition reforms.

The second key challenge lies in measuring change in socio-economic equity in hospital care, and doing so in a way that can be linked to change in local hospital market dispersion. Conventional individual level survey data approaches are unable to include adequately large samples of individuals using hospital care each year in all local hospital markets in England. We therefore use administrative data on all individuals who used hospital care in the English NHS from 2003 to 2008, comprising a total of 37.7 million elective inpatient hospital admissions. It is not possible in England to link this data to individual level data on socio-economic status. We therefore aggregate to the level of 32,482 English small areas with average population of 1,500.

The concept of equity we examine is small area socio-economic equality in health care for equal need. We estimate fixed effect linear panel data models of small area hospital utilisation as a function of population need, deprivation and market dispersion. We then identify equity effects of competition by examining how interactions between market dispersion and deprivation change over time. Variations in equity over time can be more robustly identified than levels of equity at a point in time. Levels of equity are hard to quantify in cross sectional analysis because one has to assume that observed utilisation inequalities relative to need are not biased by unobserved differences in population need. By contrast, our identification of equity effects rests on the more reasonable assumption that relative differences in unobserved population need between more and less deprived areas remain stable from one year to the next. We assume throughout that there was pre-existing inequity in hospital utilisation favouring socio-economically advantaged individuals and areas prior to the reform period, an assumption shared by both critics and proponents of pro-competition reform and supported by cross sectional evidence from a range of survey and administrative studies (Dixon, Le Grand, Henderson, Murray, & Poteliakhoff, 2007). We therefore interpret a relative increase in hospital utilisation in deprived areas as a beneficial improvement in socio-economic equity, and a relative decrease as a harmful deterioration in socio-economic equity.

2. Background

2.1 Pro-competition reform of universal and comprehensive health systems

Pro-competition reform is a perennial policy prescription in debates about how to improve health care efficiency (Le Grand and Bartlett 1993, Cutler 2002; Federal Trade Commission and Department of Justice 2004; Cookson and Dawson 2006). A number of high income countries have experimented with pro-competition reform designed to improve efficiency in the context of "equity-oriented" health systems designed to ensure that all citizens have access to a comprehensive package of health care (Cutler 2002). Two distinct types of reform have emerged. First, "quasi market" reforms introduced in the context of single payer "Beveridge" style health systems like the English NHS (Le Grand 1999). Other countries that experimented with "quasi market" reforms in the 1990s include Italy (France and Taroni 2005), Sweden (Harrison and Calltorp 2000) and New Zealand (Ashton, Mays and Devlin 2005). Second, "managed competition" reforms introduced in the context of "Bismark" style health systems funded by multiple social insurance plans (sometimes known as "sickness funds"). Countries that have experimented with "managed competition" reform in the 1990s and 2000s include Germany (Brown and Amelung 1999), the Netherlands (van den Ven and Schut 2008, 2009) and Switzerland (Reinhardt 2004).

The fundamental difference is that "managed competition" involves competition between third party payers for enrolless as well as competition between hospitals for patients (Enthoven 1978, 1985, 1988, 1993). In theory, "managed competition" gives payers an incentive to contract selectively and aggressively with hospitals to lower prices and raise quality. The "management" of competition has various elements, including:

- Government provision of comparative information on health plan quality, to ensure that enrolees are well informed consumers and not duped by misleading advertising
- Regulation of revenues, via a cross subsidisation formula that compensates plans that enrol relatively elderly and unhealthy individuals likely to cost more, to ensure that plans do not compete by "cream-skimming" young and healthy enrolees who cost less
- Regulation of the minimum benefit package, to ensure all citizens have access to a fairly comprehensive package of care and are protected from catastrophic financial risk of having to pay out of pocket for uncovered services
- Regulation of health plan premiums for the minimum benefit package, via "community rating" as a fixed percentage of income with means-tested subsidies.

By contrast, "quasi markets" operate within a "single payer" system with a single comprehensive benefit package for all citizens funded via a single taxation and/or a social insurance system. Competition between third party payers for enrollees is prohibited. Instead, competition between hospitals for patients is introduced by one or both of the following two demand side reforms. First, "payer-driven competition" involving selective contracting with hospitals by geographically defined third party payers. Second, "patient-driven competition" involving patient choice of hospital with money following the patient in the form of a fixed price hospital payment. There is an obvous tension between "patient-driven" and "payer-driven" competition, since the ability of a payer to switch activity from one hospital to another is diluted if patients can choose either hospital. "Quasi market" reforms also often include supply side reforms designed to encourage hospitals to behave in a competitive manner – for example, deregulation of publicly owned hospitals (e.g. relaxing central controls over recruitment, disposal of assets and retention of surplus) and/or facilitated entry of independent sector hospitals (both for-profit and not-for-profit) into the quasi market for publicly funded patients.

Both types of pro-competition reform are heavily constrained by rules designed to ensure equity in the delivery and financing of health care, and by political barriers to exit – politicians always face strong opposition from local constituents when public hospitals are threatened with closure (J Le Grand, 2002). Nevertheless, there is robust evidence from studies of "quasi market" reforms of the English NHS in the 1990s that pro-competition reform can introduce some limited forms of competitive pressure and that this competitive pressure can have some limited effects on efficiency and quality (Propper, et al., 2008; Propper & Soderlund, 1998). Unfortunately, pro-competition reforms in other countries have not yet been subject to rigorous evaluation and so evidence on their effects is limited.

2.2 The Blair/Brown pro-competition reforms of the English NHS

The Blair/Brown reforms involved both supply side and demand side mechanisms for introducing hospital competition. On the supply side, independent sector (IS) providers were encouraged to enter the market for publicly funded NHS patients, initially through the "Independent Sector Treatment Centre" programme of nationally agreed contracts with generous

terms (Mason, Street and Verzulli 2010). This reform was introduced in 2003/4, but IS providers only started to provide more than 1% of NHS activity from 2006/7 - we estimate that IS activity made up 0.03% of NHS non-emergency inpatient activity in 2003/4, rising to 0.08% in 2004/5, 0.31% in 2005/6, 1.12% in 2006/7, 1.42% in 2007/8 and 2.17% in 2008/9. Prior to this reform, IS provision of NHS funded services was mostly sub-contracted on an *ad hoc* basis by publicly funded NHS hospitals at times of capacity shortage, for example to perform "waiting list initiatives" to clear patient backlogs, rather than routinely offered on a competitive basis.

On the demand side, patient choice of hospital at the point of GP referral was phased in nationally from December 2005. The policy was that from December 2005 all patients should be offered a choice of four or five hospitals including one independent sector provider, leading up to "free choice" of any public or independent hospital in the NHS national directory from April 2008 (Dixon et al. 2010). This was coupled with a national system of fixed price case based hospital payment based on a local variant of DRGs ("Healthcare Resource Groups"), which was gradually phased in nationally from 2003/4 for a basket of elective inpatient services and subsequently expanded to include all elective services in 2005/6. The policy was that by 2007/8 this system would fund 90% of all hospital care, including outpatient visits and accident and emergency (Street and Maynard 2007). Prior to these reforms, NHS patients largely had to accept whatever referral their GP made for them and hospitals were largely paid on the basis of block contracts negotiated with local public agencies ("Primary Care Trusts") responsible for purchasing health care on behalf of the local population.

All of these reforms were introduced alongside substantial growth in NHS expenditure. From 1999 to 2010, real annual NHS spending growth averaged 6.56% compared with 3.48% from 1950/01 to 1999 (Appleby, Crawford and Emmerson 2009). Between 2003 and 2008, real net expenditure on the NHS in England grew by 30.1% from 72.7 to 92.5 billion in GBP sterling at 2008 prices, with real annual spending growth of 9.4% in 2003, 4.7% in 2004, 7.8% in 2005, 3.2% in 2006, 7.8% in 2007 and 3.6% in 2008 (Health Select Committee 2010). The reforms were also introduced alongside a strong target-based performance management regime for hospitals involving publication of data on performance against target and associated rewards and sanctions for hospital managers. In particular, hospital managers were strongly incentivised to meet an aggressive sequence of maximum waiting time targets for elective inpatient treatment: 18 months from outpatient consultation to inpatient treatment by March 2001, falling by three months a year to 12 months by March 2003, 9 months by March 2004, then 6 months by December 2005 and ultimately to 18 weeks from GP referral to inpatient treatment by December 2008 (Department of Health 2000, 2004). There is evidence that these reforms increased hospital competition and that this competition improved hospital quality (Gaynor, Moreno-Serra and Propper 2010, Cooper et al. 2010). However, there is no evidence about the effects of hospital competition during the Blair/Brown reform period on socio-economic equity.

2.3 A theoretical story about why the Blair/Brown reforms might undermine socio-economic equity in hospital care

Unfortunately, economic theory offers no theoretical predictions about the effects of competition on socio-economic inequality in hospital care. We therefore focus attention in this section on the empirical hypothesis commonly raised by critics of hospital competition: that competition will undermine socio-economic equity in hospital care. Critics rarely spell out the causal mechanisms through which competition might be expected to influence socio-economic inequality in hospital care (Dixon & Le Grand, 2006). However, we attempt to spell out one

possible causal mechanism below, based on the idea that competition may reduce the "pro-social motivation" of NHS managers and clinicians of NHS managers and clinicians to treat patients on the basis of clinical need, regardless of financial and non-financial incentives to do otherwise.

In economics, the term "pro-social motivation" refers to the general idea that an individual may be motivated by concerns for the welfare of other people in society (Benabu and Tirole 2006). Pro-social motivation may involve a mixture of (i) "extrinsic" motivations such as direct financial or non-financial rewards, (ii) "intrinsic" motivations such as ethical beliefs about duty or the "warm glow" of satisfaction from helping others, and (iii) "reputational" motivations such as concern for future employment and promotion prospects. Evidence to support the claim that "pro-social motivation" can influence the behaviour of public sector workers, compared with private sector workers, includes large-scale US and UK survey findings that public sector workers are more likely than private sector workers to do voluntary work (Houston 2006) and unpaid overtime (Gregg et al. 2008).

In the case of health care, professional medical associations clearly have an important influence on the pro-social motivation of medical practitioners, through their involvement in medical training, accreditation and regulation and in setting general professional norms of medical ethics. However, individual hospitals may also be able to influence pro-social motivation by setting their "mission" or "ethos" and tailoring recruitment, remuneration and promotion practices accordingly. A hospital's ability to influence "intrinsic" motivation may be partly a selection effect, in attracting certain types of people to work in the hospital, and partly an effect of organisational ethos in helping to re-shape employee preferences. Through these mechanisms, NHS hospital managers and clinicians may be powerfully motivated to provide high quality care to all patients on the basis of clinical need, irrespective of personal incentives such as pay and working conditions and corporate incentives such as financial and waiting time targets.

According to the behavioural economic theory of "motivational crowding out" (Frey & Oberholzer-Gee, 1997), the introduction of incentive mechanisms with "extrinsic" rewards and punishments – such as competition – may cause pro-social motivations to be reduced or "crowded out" by self-interested motivations. To put it in Le Grand's colourful terminology, competition may encourage health professionals to behave more like self-interested "knaves" than pro-social "knights" (J. Le Grand, 2003). Faced with competitive incentives, hospital decision makers may focus on self-interested goals such as maintaining financial stability and meeting waiting time targets, rather than pro-social goals such as providing high quality care to all patients on the basis of clinical need.

The waiting time targets and case based hospital payment mechanisms introduced into the English NHS in the 2000s may have given hospital managers and clinicians an incentive to alter specialist referral and admission thresholds in order to select against patients who cost more to treat and stay longer in hospital thus making it harder to clear patient backlogs. There is a standard body of economic theory about hospital incentives to focus on treating fit, low cost, short staying patients ("creaming") and to avoid treating unfit, high cost, long staying patients ("dumping") (Ellis, 1998). There is also some evidence that socio-economically disadvantaged patients tend to suffer from greater co-morbidity and to consume more hospital resources including more complications and longer lengths of stay (Epstein, Stern, & Weissman, 1990). The NHS environment in the 2000s may therefore have given hospitals an incentive to under-admit disadvantaged patients and over-admit advantaged patients. Prior to the introduction of

competition, these incentives may be held in check by pro-social motivation among staff. However, if competition leads to a reduction in pro-social motivation, hospital decision makers may start to respond to these pre-existing incentives to "cream" advantaged patients and "dump" disadvantaged patients – thus increasing socio-economic inequality in the use of hospital care.

Different theoretical stories could be constructed about why competition might lead to socio-economic inequality in the quality of hospital care used – for instance, the idea that advantaged individuals tend to be more active and better informed consumers in a competitive marketplace, and therefore better able to avoid low quality hospitals. However, our focus in this paper is on socio-economic inequality in the volume of hospital care used.

3. Data

Table 1 presents global descriptive statistics for the main small area level variables, pooled from 2003 to 2008, and table 2 presents year-by-year means. The unit of analysis is the Lower Super Output Area (LSOA). There are 32,482 LSOAs in England with a mean population of about 1,500 individuals and a minimum of 1,000.

Table 1 about here

Table 2 about here

3.1 Hospital utilisation

Our hospital utilisation variable is based on data from the national Hospital Episode Statistics (HES) inpatient database, which covers all hospital patients admitted to hospital in the English NHS. All elective (non-emergency) inpatient admissions were extracted for individuals aged 18 and over in financial years 2001/2 through 2008/9. We focus on acute hospital elective admissions by excluding admissions to Primary Care Trusts (PCTs) and mental health care trusts. Anonymous records were extracted by financial year and summed to the patient's small area of residence. Observations were excluded if there were missing data fields for small area or age, which occurred in a very small proportion of cases (fewer than 0.1%), or if there were duplicate records or other forms of multiple counting of episodes for the same admission. Records were extracted in the form of Continuous Inpatient Spells that include transfers between consultant and hospital within same admission spell (Castelli et al. 2008). We included all relevant providers of NHS hospital care, including Independent Sector Treatment Centres (ISTCs) under national contracts and Independent Sector providers under local contracts. As discussed later, ISTC activity reporting is incomplete, especially from 2003/4 to 2006/7.

Year by year utilisation rates per 100,000 population for each of these hospital utilisation indicators are reported in Table 2, based on mid-year population estimates from the Office for National Statistics (ONS).

3.2 Indices of hospital market structure

We measure market structure using a Herfindahl-Hirschman Index (HHI) of hospital market concentration. The index is defined as the sum of the squared market shares of all hospitals in the market, and normally ranges from 0 to 1. To facilitate interpretation of our regression results in terms of increasing market dispersion, we rescale the index from -100 (i.e. a monopoly market) to 0 (i.e. a market with an infinite number of hospitals each controlling an infinitesimally small

share of the market). An increase in this index (moving us closer to zero) thus represents an increase in market dispersion.

In our analysis, a "hospital" is defined as either an NHS Trust (a group of local public hospital sites funded and managed under the same organisational umbrella) or an independent sector provider site. Our data on market shares include patient flows to both NHS Trusts and IS sites; though in sensitivity analysis we also construct indices based on NHS Trusts only.

We construct our LSOA level HHI index of market structure using a three step procedure:

1. We first calculate HHI indices at GP practice level, based on shares of patients referred by the GP practice to neighbouring hospitals. This index measures the degree of concentration of GP practice referrals for elective admissions for each GP practice in England.

2. We then calculate HHI indices at hospital level as a weighted average of the HHI scores of all GP practices referring patients to that hospital. The weights are calculated using the number of hospital admissions coming from each GP practice.
3. Finally, we attribute the hospital level HHI indices to each LSOA as weighted average of the hospital level HHI of the closet five hospitals within a 60 km fixed radius distance from the LSOA demographic centroid. This is because, from December 2005, GPs had to offer patients a choice of least 4 or 5 hospitals. The weights are inversely proportional to the hospital distance to reflect patient willingness to travel: hospitals closer to the LSOA population are given greater weight. However, all hospitals within a 5 km fixed radius distance are given the same weight, since LSOA residents do not all live in the population centroid but are dispersed within this area. Propper et al. (2007) find that 90% of patients for elective admissions travel no further than 60km. Almost all LSOAs in England have at least one hospital within 60 km. The few (about 30) LSOAs with no hospitals within 60 km are on the border with Scotland, and most probably seek care in Scottish hospitals, so we exclude them from our study.

The GP practice is an appropriate starting point for defining hospital market shares in the institutional setting of the English NHS, since patients can only access elective hospital care through GP referrals. The patient's GP practice is likely to play an influential role in patient choice of hospital, and people typically live close to their GP practice to minimize travel costs. In sensitivity analysis we also calculate an alternative index using the LSOA as the initial market unit in the first step of calculation of our index, instead of patient GP practices. We find a 90% correlation between these two versions of our LSOA level concentration index.

Our index measures actual market concentration based on actual patient flows, rather than predicted market concentration based on exogenous patient characteristics. More computationally intensive indices based on predicted market concentration are sometimes used in studies of effects of competition on quality, due to concerns about endogeneity of market concentration with respect to hospital quality (Kessler and McClellan 2000). Market concentration is likely to be endogenous with respect to hospital quality, because increased hospital quality is likely to attract an increased market share thus increasing market concentration. However our interest centres on socio-economic equity, rather than hospital quality, and our dependent variable is small area utilisation. It is not obvious why a change in small area utilisation would cause hospital market concentration to change, and so concerns

about endogeneity are less well founded. Nevertheless, we conduct a sensitivity analysis using a time invariant index of hospital market dispersion fixed at 2003 in order to address possible concerns about endogeneity of change in market dispersion with respect to change in utilisation.

We also compute a time varying index of independent sector penetration, in order to test the hypothesis that apparent effects of competition are an artefact of increases in local hospital capacity rather than a real increase in competition. This index simply counts the number of independent sector providers within a 60km fixed radius distance from the LSOA demographic centroid. We also conduct sensitivity analysis using a 30km radius.

3.4 Area deprivation

Small area socio-economic status is measured using the income deprivation domain of the English Indices of Deprivation 2007 (Department of Communities and Local Government 2008). This index indicates the proportion of individuals resident in the LSOA in the year 2004 who were living in low income households. Low income households are defined as those either receiving means-tested low income out-of-work benefits (including income support, income-based job seeker's allowance, pension credit guarantee, and subsistence or accommodation support from the national asylum support service) or receiving means-tested low income in-work benefits (including working families tax credit and child tax credit) and whose equivalised income is below 60% of the median before housing costs. The index was produced by the Social Disadvantage Research Centre at the University of Oxford for the Department of Communities and Local Government.

We use this index because it is easy to interpret on a cardinal scale suitable for regression analysis and does not include any health related variables that might introduce circularity into the modelling. For most of the analysis, we treat this index as a cardinal variable. This allows us to take account of the full socio-economic distribution and avoids the potential selection biases associated with focusing on ratios or gaps between arbitrarily defined extreme groups. In one illustrative graph, however, we use this index to categorise small areas as "deprived" or "non-deprived" in terms of the absolute proportion of individuals living in low income households: (1) 0-20% ("low deprivation") and (2) 20% or more ("high deprivation"). This generates two unequally sized groups comprising 72.2% and 27.8% of small areas respectively. We also conduct sensitivity analysis using the Economic Deprivation Index (Department of Communities and Local Government 2009). This index measures income deprivation among individuals aged under 60 and is time-varying for the first three years of our period from 2003 to 2005 but frozen thereafter for the next three years.

3.5 Need variables

We control for a range of time varying small area need variables including population size, age-sex structure, and disease prevalence. We use ONS mid-year population estimates in 5 year age-sex bands (from 15-19 to 85 plus). Estimates of disease prevalence at GP practice level are obtained from Quality and Outcomes Framework disease registers submitted to the national Quality Management and Analysis System (QMAS), which covers nearly all GP practices in England (8,294 GP practices in 2007/8). These data show the proportion of individuals registered to the GP practice who are recorded as having the disease in question. We attribute this to small area level using the Attribution Dataset of patient registration addresses within GP practices. The attribution process assumes that prevalence for a particular small area is a weighted sum of the prevalence in each GP practice serving that small area, with weights

proportional to the number of small area residents registered with each GP practice. Both the QOF data and practice to small area attribution data were obtained from the NHS Information Centre. Most of the data starts from 2003/4 onwards and refers to all age populations, though with some exceptions. All of the disease prevalence variables use all age practice list size as the population denominator. However, diabetes prevalence is based on patients aged 17 and over; epilepsy and chronic kidney disease is based on patients aged 18 and over; and obesity prevalence is based on patients aged 16 and over.

4. Methods

We model small area utilisation as a function of local market structure, time policy trend and population demographic and need variables. We use small area level fixed effects to allow for unobserved heterogeneity between small areas in local supply and demand factors that did not change between 2003 and 2008. The effect of each explanatory variable is therefore identified using within-area variation over time rather than between-area variation in global mean levels of the variables across all periods. We use a fixed effects specification as opposed to a random effects specification in order to control for unobserved heterogeneity between small areas in time invariant characteristics likely to be correlated with local market structure, such as historical supply and demand factors that generate between-area variations in global mean utilisation, market structure and need.

Our small area level regression equation can be written:

$$y_{it} = a_i + b_1 hhi_{it} + b_2 imd_i * hhi_{it} + b_3 hhi_{it} * year(2004) + ... + b_7 hhi_{it} * year(2008) +$$
$$+ b_8 hhi_{it} * imd_i * year(2004) + ... + b_{12} hhi_{it} * imd_i * year(2008) + b_{13} year(2004) + ... + b_{17} year(2008) +$$
$$+ b_{18} x + b_{19} z + \varepsilon_{it}$$

where

y_{it} is the utilization count in small area *i* in year *t* (2003-2008)

hhi_{it} is the index of local market dispersion (the negative of the HHI index of concentration)

d_i is the time invariant index of income deprivation

x_{it} are controls for need, including population size, age-sex structure and disease prevalence

y_{it} are controls for supply, including the number of independent sector hospitals within 60km and whole time equivalent GP numbers.

We use linear models since inpatient admissions are approximately normally distributed at small area level. To identify equity effects of competition, we use interaction terms between market dispersion, deprivation and year. We treat income deprivation as a continuous variable on a scale of 0 to 100, and market dispersion as a continuous variable on a scale from -100 (monopoly) to 0 (fully dispersed). Our market dispersion variable is based on market shares of all publicly funded NHS activity, including activity by both public and independent sector hospitals. In our main analysis we use a time variant index of market dispersion, to fully exploit the power of our panel dataset. In sensitivity analysis we also use a time invariant index of market dispersion fixed at its 2003 value, in order to address possible concerns about endogeneity of change in market dispersion with respect to change in utilisation. In this sensitivity analysis, the effect of competition is identified by within area change in utilisation alone. The sensitivity analysis is unable to identify the baseline effect of local market dispersion in 2003 since this is washed out in the fixed effects. However, it is able to identify change over

time in the effect of local market dispersion in 2003 on utilisation patterns by level of deprivation, as competition is introduced.

The effect of competition on socio-economic equity is identified using a three-way interaction term between the degree of local market dispersion, the degree of small area deprivation, and a year dummy variable capturing the gradual introduction of competition over time. The estimated coefficient on this three-way interaction term can be interpreted as the year by year change, as competition is introduced, in the effect of local market dispersion on utilisation by increasing levels of deprivation. (Or, equivalently, the year by year change in the effect of deprivation on utilisation by increasing levels of local market dispersion). The identification of this coefficient is achieved by including all main terms composing this three-way interaction and all the two-way interactions between them.

A baseline deprivation term is not included because deprivation is not time varying and so the baseline cross sectional relationship between deprivation and utilisation is washed out in the small area fixed effects. We cannot therefore identify the baseline effect of deprivation on utilisation using our fixed effects model, or draw any conclusions about the baseline level of socio-economic inequity in 2003.

We can however identify change over time in the effect of deprivation on utilisation, based on within-area change over time in utilisation. The coefficients on the deprivation*year terms can be interpreted as indicating overall national trends in socio-economic equity since 2003 for small areas with highly dispersed markets (a modified HHI score of zero). A pattern of increasingly negative coefficients (i.e. increasing in absolute value) would indicate a relative decrease in utilisation among deprived areas since 2003 – which can be interpreted as a harmful decline in socio-economic equity – and *vice versa.*

The effect of local market dispersion on socio-economic equity in 2003 (i.e. the baseline year) is indicated by the coefficient on the dispersion*deprivation term. This coefficient shows how dispersion modifies the effect of deprivation in 2003. A negative coefficient would indicate a negative modification effect, suggesting that increased dispersion reduces utilisation in deprived areas in 2003. Any such effect at baseline cannot be attributed to competition, however, since in 2003 there is little or no competition. Instead, it can be attributed to changes in other local supply and demand factors that influence the degree of market dispersion in 2003 – such as hospital re-configurations and changes in GP referral patterns for reasons unconnected with competition, such as waiting time targets.

Over time, however, change in dispersion starts to be more closely related to competitive pressure, as competition is introduced and starts to influence local market dispersion. The effects of competition on socio-economic equity can therefore be identified by the coefficients on the dispersion*deprivation*year terms. These coefficients show change over time in how dispersion modifies the effect of deprivation on utilisation. A gradual pattern of change in these coefficients can be interpreted as an effect of gradually increasing competition. A pattern of increasingly negative coefficients would indicate that the modification effect of dispersion becomes increasingly negative (or decreasingly positive) over time, as competition is introduced. This could be interpreted as a harmful effect of competition on socio-economic equity – and *vice versa.*

Other coefficients of interest include the baseline dispersion coefficient, which indicates the marginal effect of market dispersion on utilisation in 2003 for small areas with zero deprivation, and the dispersion-year coefficients which indicate the change in this marginal effect over time.

Our fixed effects identification strategy requires the absence of any time variant policy confounders correlated with time variation in local market structure. One potential such confounder could be independent sector penetration, which might potentially influence the relationship between deprivation and utilisation independently of competition. We therefore use two model specifications, with and without a control for time-varying independent sector penetration in the form of the number of Independent Sector providers within a 60 minute drive.

All models used cluster robust standard errors to allow for clustering within small area over time, and all regression modelling was done using Stata 11.

4. Results

4.1 Change in hospital market structure between 2003 and 2008

Figure 1 presents kernel density plots of the distribution of the HHI index of hospital market concentration across small areas of England, comparing 2003 with 2008. The index is scaled from 0 to 1, where 1 represents a fully concentrated market (i.e. monopoly). There is a clear leftward shift between 2003 and 2008, showing that market concentration fell as the pro-competition reforms were introduced. Figure 2 presents the geographical distribution of the HHI index on a "heat map" of England, again comparing 2003 with 2008. These maps also show a pattern of reduced market concentration between 2003 and 2008. These figures confirm the pattern in table 2, which shows the mean dispersion index rising from -59.0 in 2003 to -54.9 in 2008.

Figure 1 about here (kernel density plots of HHI index)

Figure 2 about here (heat maps of HHI index)

4.2 Equity effects on all elective inpatient hospital utilisation

Figure 3 shows crude annual utilisation trends in all elective inpatient admissions broken down by two dispersion groups ("low dispersion" and "high dispersion") and two deprivation groups ("low deprivation" and "high deprivation").

Figure 3 about here (utilisation by dispersion and deprivation)

In 2003, "low dispersion" areas have substantially higher hospital utilisation than "high dispersion" areas. Furthermore, within both dispersion groups, "high deprivation" areas have higher utilisation than "low deprivation" areas in 2003. Utilisation then grows over time in all four groups, though more rapidly in "high dispersion" than "low dispersion" areas. Within the "low dispersion" group, utilisation grows faster in the "low deprivation" areas. By contrast, within the "high dispersion" group, utilisation grows slightly faster in the "high deprivation" areas. Growth of utilisation in deprived areas was thus faster within the "high dispersion" group of areas than the "low dispersion" group. By 2008, the "dispersed, deprived" group had caught up with the "non-dispersed, deprived group", whereas the "dispersed, non-deprived" group still lagged behind the "non-dispersed, non-deprived" group. Insofar as the "high dispersion" group

is likely to face a larger increase in competitive pressure during the period, this is suggestive evidence that competition may have helped to facilitate growth in elective hospital admissions in deprived areas and thus to improve socio-economic equity.

We now turn to the regression results, to examine competition effects on equity using statistical methods that are more powerful than these graphical methods and less sensitive to selection bias due to arbitrary definition of dispersion groups and deprivation groups.

Figure 4 about here (effect of dispersion on elective inpatient hospital admission)

Our regression results are perhaps easiest to understand in graphical form, since the interaction terms can be hard to interpret. Figure 4 shows how the marginal effect of local market dispersion on utilisation varies by deprivation and over time. In each year, the marginal effect of dispersion is negative. This negative effect is modified by deprivation to become even more negative in more deprived areas. Over time, however, this negative modification effect of deprivation is gradually attenuated, as shown by the upward slope of the marginal effect contour on the year axis from 2003 to 2008. The effect of dispersion on utilisation in deprived areas is still negative in 2008 – but less so than in 2003. So competition has slightly attenuated this effect and thus slightly increased utilisation in deprived areas. Since we assume there was pre-existing socio-economic inequity favouring advantaged areas in 2003, we can interpret this result as showing that competition slightly improved socio-economic equity. We now turn to the full results, for completeness.

Table 3 about here (regression results for inpatient utilisation)

Table 3 shows the results of our linear fixed effect model of all elective inpatient admissions. We find that the incorporation of IS penetration in model 2 generally reduces the effect of market dispersion on utilisation as expected, but does not affect the key coefficient on the three way interaction terms between market dispersion*deprivation*time.

The deprivation*year interactions show a pattern of significant and increasingly positive coefficients, rising to 1.339 by 2008 in model 2. This suggests that, in reference category areas with high market dispersion (a modified HHI score of zero), the effect on admissions of a one percentage point increase in the proportion of individuals living in households on low income benefits was 1.339 higher in 2008 than 2003. This is a relatively small effect in the context of a global mean small area admission count of 193. However, it does suggest that admissions grew slightly faster in more deprived areas and hence that overall socio-economic equity slightly improved over time.

The dispersion*deprivation coefficient of -0.0656 in model 2 is also significant though small. There are two logically equivalent ways of interpreting this coefficient. First, in terms of the effect of deprivation on utilisation, and how this is modified by dispersion. Second, in terms of the effect of dispersion on utilisation, and how this is modified by deprivation. In the former interpretation, this coefficient suggests that in 2003 a one percentage point increase in local hospital market dispersion modified the effect of deprivation on utilisation by -0.0656 of one admission. Equivalently, in the latter interpretation, this coefficient suggests that a one percentage point increase in deprivation modified the effect of local hospital dispersion by -0.0656 of one admission.

The dispersion*deprivation*year terms show a pattern of significant and increasingly positive coefficients. This again can be interpreted in two different though logically equivalent ways. First, it suggests that competition slightly attenuated the negative modification effect of dispersion on the effect of deprivation on utilisation. Second, it suggests that competition slightly attenuated the negative modification effect of deprivation on the effect of dispersion on utilisation. Either way, the coefficient suggests that competition slightly increased utilisation in deprived areas and therefore slightly improved socio-economic equity. These coefficients are very small, however: by 2008, the modification effect is attenuated by only 0.0155 of one admission.

Our sensitivity analysis using a time invariant index of market dispersion fixed at 2003 yields precisely the same pattern of results.

5. Discussion

5.1 Main findings

We find no evidence that increased competition in the English NHS from 2003 to 2008 had any harmful effect on socio-economic equity in hospital care. If anything, we find that competition may have very slightly improved socio-economic equity, by helping to facilitate the slightly more rapid growth of elective inpatient admissions over time in deprived areas. Our findings do not support the hypothesis that competition undermines socio-economic equity in health care, or the theoretical story that competition reduces the pro-social motivation of hospitals to treat deprived patients.

However, the increase in competition between 2003 and 2008 was not large. One indication of this is that hospital market dispersion rose by just under five percentage points between 2003 and 2008, from -59 to -54.9 on our modified HHI scale. So it remains possible that larger doses of competition could have important effects on socio-economic equity.

It is not clear why competition very slightly increased elective inpatient admissions in deprived areas. One possible speculation is that patient choice was particularly beneficial to deprived patients living in "high choice" areas with dispersed hospital markets, in helping them choose hospitals with lower waiting times. In turn, this may have increased utilisation in those deprived areas by reducing local waiting list backlogs and allowed local clinicians to lower referral and treatment thresholds. Another possible speculation is that competitive pressure may have generated market incentives for hospitals to seek out profitable new business among patients with previously unmet needs, who may disproportionately reside in deprived areas. However, we have no data to support either speculation, and in any case the effect is so small as to be negligible from a national policy perspective.

Figure 2 illustrates the importance of using a fixed effect specification. Elective inpatient admission rates in 2003 are substantially higher in areas with more concentrated hospital markets. Since competition was only gradually introduced after 2003, this between-area association cannot be attributed to competition in 2003 but must instead be the result of unobserved historical factors. One possible speculation is that the association may be due to population growth in some metropolitan areas during the 1980s and 1990s outstripping growth in hospital capacity in those areas. Those areas may therefore tend to have both low utilisation

rates per head of population and relatively dispersed hospital markets compared with rural areas with low population density and few local hospitals. Our fixed effect specification purges the effect of this historical between-area association from our estimates.

The estimated effect of market dispersion on utilisation remains negative, however, even in our fixed effects model. One possible explanation for this is a continuation of historical trends discussed above – i.e. growth in demand for hospital services in metropolitan areas with growing market dispersion continuing to outstrip the increase in supply. Another possible speculation is that it might be a side-effect of strong centralised performance management of hospital waiting time targets. Hospitals struggling to meet waiting time targets may seek to reduce their waiting list backlogs not only by increasing activity but also by reducing the inflow of new patients onto their waiting list by (1) encouraging patients to seek treatment in other hospitals with shorter waiting times and (2) tightening referral and treatment thresholds. The effect of (1) is to increase local market dispersion and the effect of (2) is to reduce local utilisation. Again, however, we have no data to support either of these speculations.

5.2 Methodological strengths and limitations

One strength of our study is the use of panel data methods to identify effects of competition. We exploit both change in local market dispersion within small areas and change in policy regime to identify effects of competition. This is more powerful than relying on cross sectional variation in market dispersion between small areas, which may be correlated with unobservable historical and geographical determinants of hospital utilisation that have nothing to do with competition.

A second strength is that our study covers all patients in the English NHS. This is an important advantage of administrative data over survey data for our purposes, two reasons. First, our study is representative of all sections of the community including the most socio-economically deprived individuals who are sometimes hard to include in sample surveys. Second, our study includes millions of admissions (7,371,928 in 2008) and this thus sufficiently well powered to statistically significant equity trends.

This study has several limitations. First, we only observe socio-economic status at the level of small areas – with mean population 1,500 – and not at the level of individuals. This means that strictly speaking we can only draw conclusions about people living in low income areas, since not all individuals living in low income areas have low socio-economic status. Nevertheless, living in a low income area is a reasonable proxy for low socio-economic status, since housing in England is highly segregated by socio-economic status and LSOA boundaries were designed by ONS to delineate relatively homogenous small areas in terms of socio-economic status and other social factors. Second, we focus on hospital care and do not specifically examine equity in primary care. However, all of our hospital utilisation indicators potentially capture inequities arising at the primary care stage in the patient pathway. Finally, like all administrative datasets, HES contains coding and measurement errors. General measurement error will not bias our estimates of change in equity, and it seems unlikely that coding of patients residing in deprived small areas systematically improved (or deteriorated) more rapidly than coding of patients in less deprived small areas. One possible source of bias is missing data for Independent Sector (IS) providers. If IS patients are less likely to be drawn from deprived communities, the missing data could in theory obscure disproportionate rises in IS activity in affluent areas. However, mean area deprivation is not much lower among IS patients than among patients treated by NHS Trusts: only 1.56 percentage points lower in a recent study of 2007/8 data covering 78% of

procedures coded in IS activity (Mason et al. 2010). Furthermore, IS activity makes up a relatively small proportion of NHS activity in the early years of the ISTC programme when coding was particularly poor – less than 1% until 2006/7 – and activity coding has improved since then (NHS Information Centre 2009). Missing data on IS activity is thus unlikely to be sufficiently large proportion of total activity to bias our results. A final limitation is that we only examine inequality in the volume of hospital care, as opposed to the quality and outcomes of hospital care. We therefore cannot test hypotheses about effects of competition on quality of care or theoretical stories about deprived patients being less able than affluent patients to avoid low quality hospitals due to poor information and reluctance to travel long distances.

5.3 Comparison with other studies

Our main finding that hospital competition had no substantial effect on socio-economic equity during the Blair/Brown reforms is consistent with previous findings about the effects of hospital competition during the Thatcher/Major "internal market" reforms of the NHS in the 1990s. A small area study of NHS hospital episode statistics from 1991 to 2001 found that the NHS "internal market" reforms had no impact on socio-economic inequalities in hip replacement and revascularisation (Cookson et al. 2010). Like the Blair/Brown reforms, however, the "internal market" reforms of the 1990s involved a relatively small dose of hospital competition.

Our findings are also consistent with studies of overall trends in small area socio-economic equity during the 2000s, which have generally shown no change during the period – including small area socio-economic equity in waiting times for hip replacement, knee replacement and cataract surgery from 1999 to 2007 (Cooper et al. 2009), rates of preferred surgery for colorectal, breast and lung cancer between 1999 and 2006 (Raine et al. 2010) and rates of all elective inpatient admissions, all outpatient visits, hip replacement, cataract surgery, gastroscopy and coronary revascularisation (Cookson et al. 2010).

Taken together with the results of other studies, our results suggest that socio-economic patterns of health care utilisation are deeply ingrained, and that small doses of "quasi market" competition have little or no effect on socio-economic equity in health care in the context of universal and comprehensive health systems.

Table 1: Descriptive statistics for key small area variables, pooled from 2003 to 2008

Variable	N	Mean	Std. Dev.	Min	Max
Outcome variable					
All elective inpatient admissions	194,700	193.581	86.52316	1	1225
Other variables of interest					
Market dispersion (-HHI)	194,700	-57.4663	11.49276	-90.9541	-31.8357
Market dispersion (-HHI), public hospitals only	194,700	-58.408	11.84603	-91.0268	-31.8654
Independent sector hospitals within 60km	194,700	3.923184	4.97048	0	29
Independent sector hospitals within 30km	194,700	1.289291	1.855103	0	16
Public hospitals within 60km	194,700	21.97356	15.33405	1	51
Public hospitals within 30km	194,700	9.313955	10.21175	0	35
Deprivation (IMD 2007 income domain)	194,700	15.6263	12.1815	0.130407	83.01696
GPs per 1,000 population	194,688	5.153165	2.180921	0.003992	22.81976
Need variables (LSOA mean values)					
Atrial fibrillation	194,688	1.313074	0.432189	0.002453	3.861849
Cancer	194,688	0.836734	0.376254	0.000296	3.157688
Chronic kidney disease	194,688	2.632431	1.224484	0.003937	11.7216
Chronic obstructive pulmonary disease	194,688	1.428914	0.581021	0.000425	4.719756
Coronary heart disease	194,688	3.558598	1.031392	0.0019	11.371
Diabetes	194,688	3.618464	0.764299	0.001644	9.961481
Epilepsy	194,688	0.59908	0.139823	0.000202	2.302933
Heart failure	194,688	0.774387	0.258887	0.001458	3.971765
Hypertension	194,688	12.18198	2.51097	0.006251	26.77129
Hypothyroidism	194,688	2.484119	0.707834	0.000688	6.426805
Obesity	194,688	7.562583	1.96462	0.010666	22.32652
Stroke and transient ischaemic attack	194,688	1.57993	0.501761	0.000662	10.10573
Total population aged 20 or over	194,700	1177.945	210.2728	307	7849

Note to Table 1:

1. Observations on the 32,480 Lower Layer Super Output Areas (LSOAs) in England are pooled across all seven years from 2003 to 2008.
2. Population size variables by 5 year age-sex bands not reported for reasons of space.

Table 2: Descriptive statistics by year (small area mean values)

	2003	2004	2005	2006	2007	2008
Total population aged 20 or over	1,154.6	1,161.4	1,173.3	1,182.8	1,192.6	1,203.1
All elective inpatient admissions per 100,000	15,129.5	15,137.0	16,055.0	16,851.2	16,959.8	19,039.0
Market dispersion (-HHI)	-59.0	-58.9	-58.1	-57.2	-56.8	-54.9
Market dispersion (-HHI), public hospitals only	-59.1	-59.0	-58.5	-58.4	-58.3	-57.2
Independent sector hospitals within 60km	0.1	0.3	3.1	3.2	5.9	11.0
Public hospitals within 30km	9.4	9.4	9.4	9.3	9.1	9.1
Public hospitals within 60km	22.2	22.2	22.2	21.9	21.7	21.7

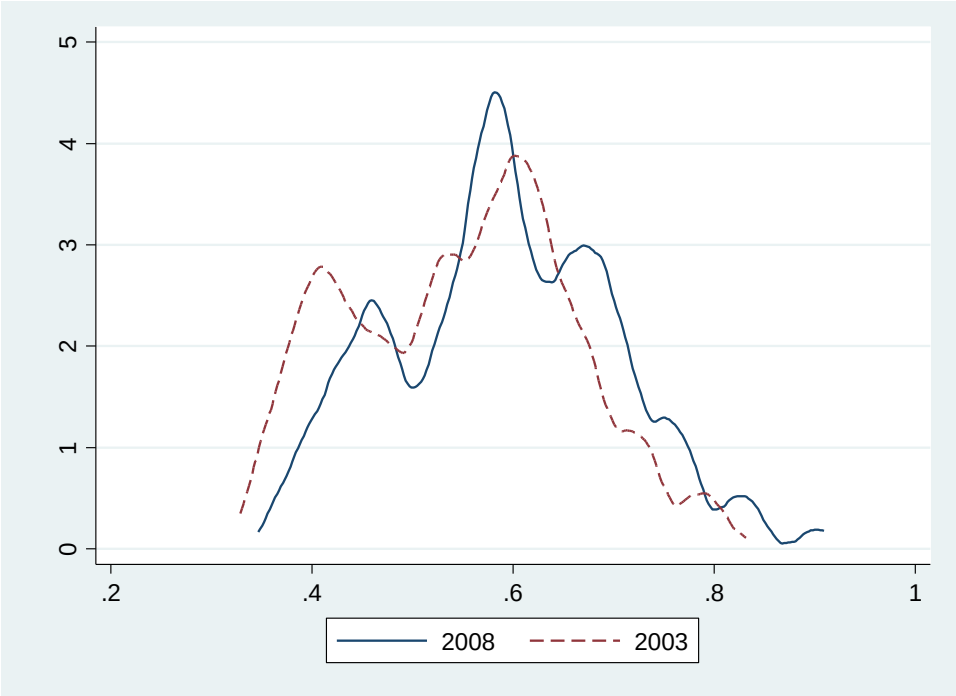
Table 3: Regression results for all elective inpatient hospital utilisation (linear fixed effect models)

Variables	Model 1		Model 2	
	all elective	se	all elective	se
Dispersion * Deprivation * 2004	0.00211	(0.00183)	0.00229	(0.00183)
Dispersion * Deprivation * 2005	0.00950**	(0.00247)	0.00956**	(0.00247)
Dispersion * Deprivation * 2006	0.0133**	(0.00299)	0.0135**	(0.00299)
Dispersion * Deprivation * 2007	0.0113**	(0.00319)	0.0116**	(0.00319)
Dispersion * Deprivation * 2008	0.0158**	(0.00362)	0.0155**	(0.00362)
Dispersion * 2004	-0.00182	(0.0377)	-0.00485	(0.0377)
Dispersion * 2005	-0.000614	(0.0492)	-0.0661	(0.0503)
Dispersion * 2006	0.250**	(0.0592)	0.202**	(0.0594)
Dispersion * 2007	0.232**	(0.0620)	0.149*	(0.0630)
Dispersion * 2008	0.296**	(0.0696)	0.144*	(0.0733)
Deprivation * 2004	0.214	(0.110)	0.225*	(0.110)
Deprivation * 2005	0.718**	(0.151)	0.722**	(0.151)
Deprivation * 2006	0.960**	(0.183)	0.980**	(0.183)
Deprivation * 2007	1.007**	(0.193)	1.019**	(0.193)
Deprivation * 2008	1.372**	(0.216)	1.339**	(0.216)
Dispersion * Deprivation	-0.0648**	(0.00843)	-0.0656**	(0.00842)
Dispersion	-0.525**	(0.136)	-0.461**	(0.135)
Independent sector hospitals within 60km	-	-	0.466**	(0.0792)
GPs per 1,000 population	0.899**	(0.231)	0.926**	(0.231)
year2004	-1.544	(2.272)	-1.867	(2.272)
year2005	4.029	(3.000)	-1.300	(3.129)
year2006	23.74**	(3.671)	19.09**	(3.727)
year2007	17.14**	(3.855)	9.380*	(4.035)
year2008	41.06**	(4.291)	27.25**	(4.818)

Notes to Table 3:

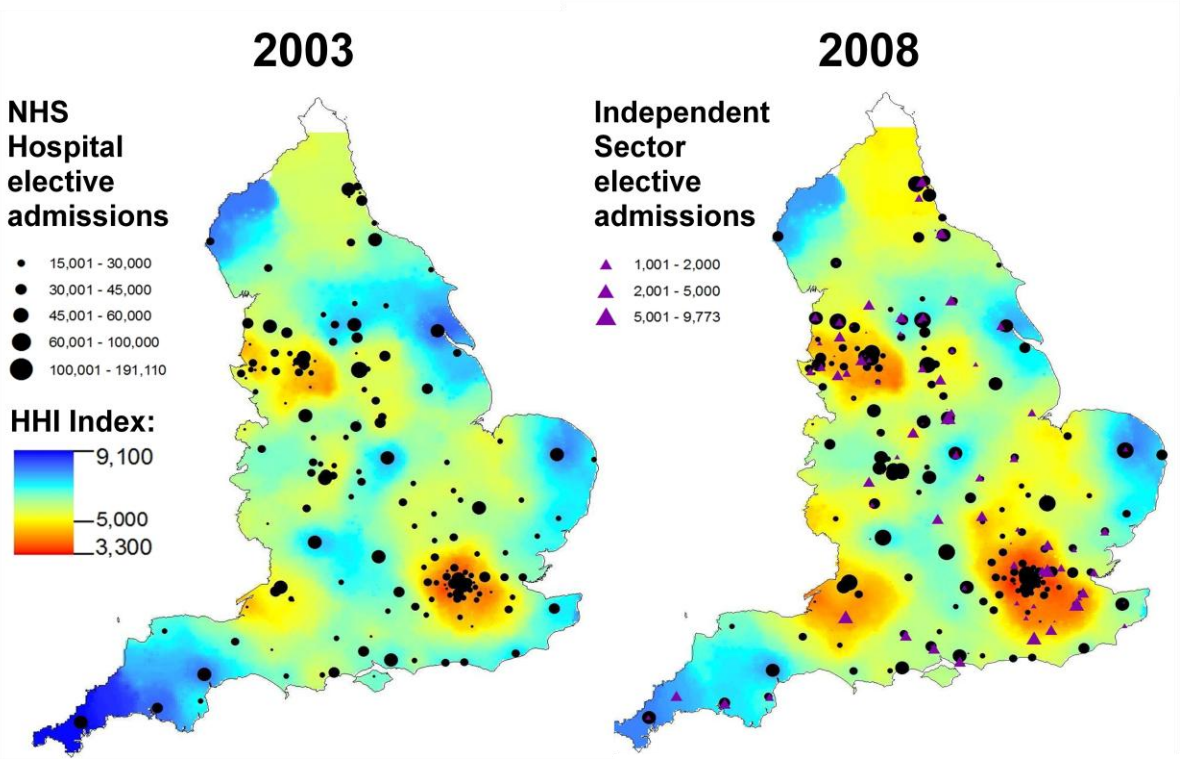
1. Robust standard errors in parentheses.
2. ** $p<0.01$, * $p<0.05$
3. Both models include population size, age-sex fractions and need variables as controls (coefficients not shown), and model 2 adds the number of IS providers within 60 minutes as a control for time varying IS supply factors.
4. There is no baseline deprivation coefficient, because the baseline cross sectional relationship is washed out in the small area fixed effects.
5. Dispersion is scaled from -100 to 0, with -100 representing a fully concentrated market and 0 a fully dispersed market. Deprivation is scaled from 0 to 100, with 100 representing 100% of individuals from households on low income benefits.

Figure 1: HHI index of hospital market concentration for among English small areas, comparing 2003 and 2008 (kernel density plot)



Note to Figure 1: This HHI Index is scaled from 0 (fully dispersed) to 1 (monopoly).

Figure 2: Hospital market concentration in the English NHS, comparing 2003 and 2008



Note to Figure 2: This HHI Index is scaled from 0 (fully dispersed) to 10,000 (monopoly).

Figure 3: Elective inpatient hospital utilisation by deprivation and dispersion (observed rates per 100,000 population)

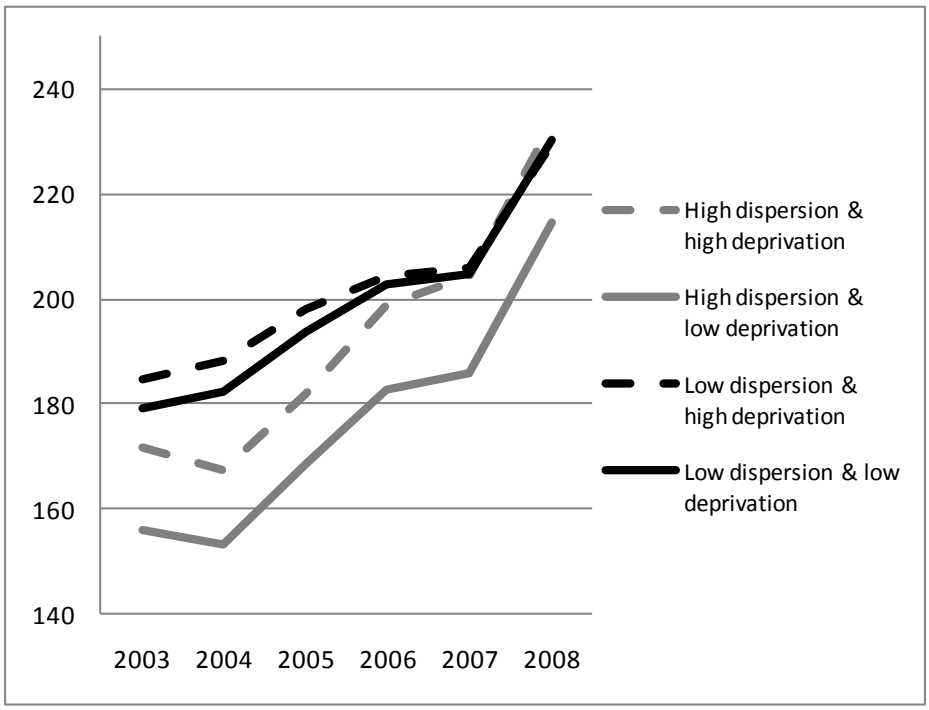
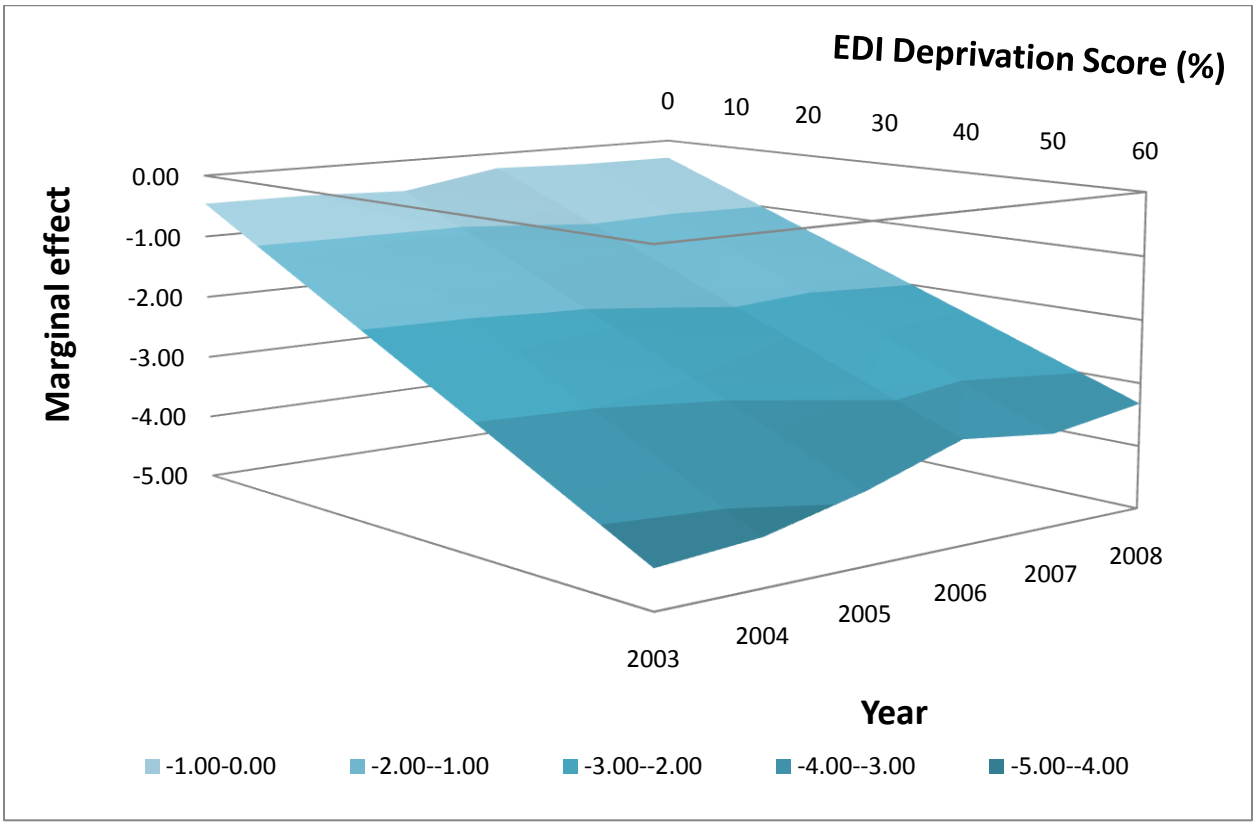


Figure 4: Marginal effect of hospital market dispersion on all elective inpatient admissions



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