The Impact of Competition on Management Quality: Evidence from Public Hospitals: ONLINE APPENDICES

November 13th 2014

Nicholas Bloom
Stanford University, NBER, Centre for Economic Performance and CEPR
Carol Propper
Imperial College, CMPO University of Bristol and CEPR
Stephan Seiler
Stanford University, Centre for Economic Performance
John Van Reenen
London School of Economics, Centre for Economic Performance, NBER and CEPR

ONLINE APPENDICES (NOT INTENDED FOR PUBLICATION)

APPENDIX A: MANAGEMENT PRACTICE INTERVIEW GUIDE FOR THE HEALTHCARE SECTOR

Any score from 1 to 5 can be given, but the scoring guide and examples are only provided for scores of 1, 3 and 5. Multiple questions are used for each dimension to improve scoring accuracy.

(1) Lay out of patient flow

Tests how well the patient pathway is configured at the infrastructure level and whether staff pro-actively improve their own work-place organization

a) Can you briefly describe the patient journey or flow for a typical episode?
b) How closely located are wards, theatres, diagnostics centres and consumables?
c) Has the patient flow and the layout of the hospital changed in recent years? How frequently do these changes occur and what are they driven by?

	Score 1	Score 3	Score 5
Scoring grid:	Lay out of hospital and organization of workplace is not conducive to patient flow, e.g., ward is on different level from theatre, or consumables are often not available in the right place at the right time	Lay out of hospital has been thought-through and optimized as far as possible; work place organization is not regularly challenged/changed (or vice versa)	Hospital layout has been configured to optimize patient flow; workplace organization is challenged regularly and changed whenever needed

(2) Rationale for introducing standardization/ pathway management

Test the motivation and impetus behind changes to operations and what change story was communicated

a) Can you take me through the rationale for making operational improvements to the management of patient pathway? Can you describe a recent example?
b) What factors led to the adoption of these practices?
c) Who typically drives these changes?

	Score 1	Score 3	Score 5
Scoring grid:	Changes were imposed top down or because other departments were making (similar) changes, rationale was not communicated or understood	Changes were made because of financial pressure and the need to save money or as a (short-term) measure to achieve government targets	Changes were made to improve overall performance, both clinical and financial, with buy-in from all affected staff groups. The changes were communicated in a coherent 'change story'

(3) Continuous improvement

Tests process for and attitudes to continuous improvement and whether things learned are captured/documented

a) How do problems typically get exposed and fixed?
b) Talk me through the process for a recent problem that you faced
c) How do the different staff groups get involved in this process? Can you give examples?

	Score 1	Score 3	Score 5
Scoring grid:	No, process improvements are made when problems occur, or only involve one staff group	Improvements are made irregular meetings involving all staff groups, to improve performance in their area of work (e.g., ward or theatre)	Exposing problems in a structured way is integral to individuals' responsibilities and resolution involves all staff groups, along the entire patient pathway as a part of regular business processes rather than by extraordinary effort/teams

(4) Performance tracking

Tests whether performance is tracked using meaningful metrics and with appropriate regularity

a) What kind of performance indicators would you use for performance tracking?
b) How frequently are these measured? Who gets to see these data?
c) If I were to walk through your hospital wards and theatres, could I tell how you were doing against your performance goals?

	Score 1	Score 3	Score 5
Scoring grid:	Measures tracked do not indicate directly if overall objectives are being met, e.g., only government targets tracked. Tracking is an ad-hoc process (certain processes aren't tracked at all).	Most important performance indicators are tracked formally; tracking is overseen by senior staff.	Performance is continuously tracked and communicated against most critical measures, both formally and informally, to all staff using a range of visual management tools

(5) Performance review

Tests whether performance is reviewed with appropriate frequency and communicated with staff

a) How do you review your KPI's?
b) Tell me about a recent meeting
c) Who is involved in these meetings? Who gets to see the results of this review?
d) What is the follow-up plan?

	Score 1	Score 3	Score 5
Scoring grid:	Performance is reviewed infrequently or in an un-meaningful way e.g. only success or failure is noted	Performance is reviewed periodically with both successes and failures identified. Results are communicated to senior staff. No clear follow up plan is adopted.	Performance is continually reviewed, based on the indicators tracked. All aspects are followed up to ensure continuous improvement. Results are communicated to all staff.

(6) Performance dialogue

Tests the **quality** of review conversations

a) How are these meetings structured?
b) During these meetings do you find that you generally have enough data?
c) What type of feedback occurs in these meetings?

	Score 1	Score 3	Score 5
Scoring grid:	The right information for a constructive discussion is often not present or the quality is too low; conversations focus overly on data that is not meaningful. Clear agenda is not known and purpose is not explicitly. Next steps are not clearly defined	Review conversations are held with the appropriate data present. Objectives of meetings are clear to all participating and a clear agenda is present. Conversations do not, drive to the root causes of the problems, next steps are not well defined	Regular review/performance conversations focus on problem solving and addressing root causes. Purpose, agenda and follow-up steps are clear to all. Meetings are an opportunity for constructive feedback and coaching

(7) Consequence management

Tests whether differing levels of (personal) performance lead to different consequences (good or bad)

a) Let's say you've agreed to a follow up plan at one of your meetings, what would happen if the plan weren't enacted?
b) How long is it between when a problem is identified to when it is solved? Can you give me a recent example?
c) How do you deal with repeated failures in a specific sub-specialty or cost area?

	Score 1	Score 3	Score 5
Scoring grid:	Failure to achieve agreed objectives does not carry any consequences	Failure to achieve agreed results is tolerated for a period before action is taken	A failure to achieve agreed targets drives retraining in identified areas of weakness or moving individuals to where their skills are appropriate

(8) Target balance

Test whether targets cover a sufficiently broad set of metrics

a) What types of targets are set for the hospital? What are the goals for your specialty?
b) Tell me about goals that are not set externally (e.g. by the government, regulators).

	Score 1	Score 3	Score 5
Scoring grid:	Goals focused only on government targets and achieving the budget	Goals are balanced set of targets (including quality, waiting times, operational efficiency, and financial balance). Goals form part of the appraisal for senior staff only or do not extend to all staff groups. Real interdependency is not well understood	Goals are a balanced set of targets covering all four dimensions (see left). Interplay of all four dimensions is understood by senior and junior staff (clinicians as well as nurses and managers)

(9) Target inter-connection

Tests whether targets are tied to hospital/Trust objectives and how well they cascade down the organization

a) What is the motivation behind your goals?
b) How are these goals cascaded down to the different staff groups or to individual staff members?
c) How are your targets linked to hospital performance and its goals?

	Score 1	Score 3	Score 5
Scoring grid:	Goals do not cascade down the organization	Goals do cascade, but only to some staff groups, e.g., nurses only	Goals increase in specificity as they cascade, ultimately defining individual expectations, for all staff groups

(10) Time horizon of targets

Tests whether hospital/Trust has a '3 horizons' approach to planning and targets

a) What kind of time scale are you looking at with your targets?
b) Which goals receive the most emphasis?
c) Are the long term and short term goals set independently?
d) Could you meet all your short-run goals but miss your long-run goals?

	Score 1	Score 3	Score 5
Scoring grid:	Top staff's main focus is on short term targets	There are short and long term goals for all levels of the organization. As they are set independently, they are not necessarily linked to each other	Long term goals are translated into specific short term targets so that short term targets become a 'staircase' to reach long term goals

(11) Target stretch

Tests whether targets are appropriately difficult to achieve

a) How tough are your targets? Do you feel pushed by them?
b) On average, how often would you say that you meet your targets?
c) Do you feel that on targets all specialties, departments or staff groups receive the same degree of difficulty? Do some groups get easy targets?
d) How are the targets set? Who is involved?

	Score 1	Score 3	Score 5
Scoring grid:	Goals are either too easy or impossible to achieve, at least in part because they are set with little clinician involvement, e.g., simply off historical performance	In most areas, senior staff push for aggressive goals based, e.g., on external benchmarks, but with little buy-in from clinical staff. There are a few sacred cows that are not held to the same standard	Goals are genuinely demanding for all parts of the organization and developed in consultation with senior staff, e.g., to adjust external benchmarks appropriately

(12) Clarity and comparability of targets

Tests how easily understandable performance measures are and whether performance is openly communicated

a) If I asked your staff directly about individual targets, what would they tell me?
b) Does anyone complain that the targets are too complex?
c) How do people know about their own performance compared to other people's performance?

	Score 1	Score 3	Score 5
Scoring grid:	Performance measures are complex and not clearly understood, or only relate to government targets. Individual performance is not made public	Performance measures are well defined and communicated; performance is public at all levels but comparisons are discouraged	Performance measures are well defined, strongly communicated and reinforced at all reviews; performance and rankings are made public to induce competition

(13) Managing talent

Tests what emphasis is put on talent management

a) How do senior staff show that attracting and developing talent is a top priority?
b) Do senior managers, clinicians or nurses get any rewards for bringing in and keeping talented people in the hospital?

	Score 1	Score 3	Score 5
Scoring grid:	Senior staff do not communicate that attracting, retaining and developing talent throughout the organization is a top priority	Senior management believe and communicate that having top talent throughout the organization is key to good performance	Senior staff are evaluated and held accountable on the strength of the talent pool they actively build

(14) Rewarding high performers

Tests whether good performance is rewarded proportionately

a) How does your appraisal system work? Tell me about your most recent round.
b) Are there any non-financial or financial (bonuses) rewards for the best performers across all staff groups?
c) How does the bonus system work?
d) How does your reward system compare to that at other comparable hospitals?

	Score 1	Score 3	Score 5
Scoring grid:	People are rewarded equally irrespective of performance level	There is an evaluation system for the awarding of performance related rewards that are non-financial (beyond progression through nursing grades or clinical excellence awards for doctors) at the individual level (but rewards are always or never achieved)	There is an evaluation system for the awarding of performance related rewards, including personal financial rewards

(15) Removing poor performers

Tests whether hospital is able to deal with underperformers

a) If you had a clinician or a nurse who could not do his job, what would you do? Could you give me a recent example?
b) How long would underperformance be tolerated?
c) Do you find staff members who lead a sort of charmed life? Do some individuals always just manage to avoid being fixed/fired?

	Score 1	Score 3	Score 5
Scoring grid:	Poor performers are rarely removed from their positions	Suspected poor performers stay in a position for a few years before action is taken	We move poor performers out of the hospital/department or to less critical roles as soon as a weakness is identified

(16) Promoting high performers

Tests whether promotion is performance based

a) Tell me about your promotion system?
b) What about poor performers? What happens with them? Are there any examples you can think of?
c) How would you identify and develop your star performers?
d) Are better performers likely to promote fasters or are promotions given on the basis of tenure/seniority?

	Score 1	Score 3	Score 5
Scoring grid:	People are promoted primarily on the basis of tenure	People are promoted upon the basis of performance (across more than one dimension, e.g., isn't related only to research or clinical excellence)	We actively identify, develop and promote our top performers

(17) Attracting talent

Tests how strong the employee value proposition is

a) What makes it distinctive to work at your hospital, as opposed to your other similar hospitals?
b) If I were a top nurse or clinician and you wanted to persuade me to work at your hospital, how would you do this?
c) What don't people like about working at your hospital?

	Score 1	Score 3	Score 5
Scoring grid:	Our competitors offer stronger reasons for talented people to join their hospitals	Our value proposition to those joining our department is comparable to those offered by others hospitals	We provide a unique value proposition to encourage talented people join our department above our competitors

(18) Retaining talent

Tests whether hospital/Trust will go out of its way to keep its top talent

a) If you had a top performing manager, nurse or clinician that wanted to leave, what would the hospital do?
b) Could you give me an example of a star performer being persuaded to stay after wanting to leave?
c) Could you give me an example of a star performer who left the hospital without anyone trying to keep them?

	Score 1	Score 3	Score 5
Scoring grid:	We do little to try and keep our top talent	We usually work hard to keep our top talent	We do whatever it takes to retain our top talent across all three staff groups

APPENDIX B: DATA

B.1 Sample

The main sampling frame was all acute public sector hospitals (NHS "trusts") in England.[1] There were 174 such units in 2006, but we dropped hospitals without orthopedics or cardiology departments (e.g. specialist eye hospitals) so this left us with a sample of 164 possible hospital trusts. We obtained 161 usable responses from 100 hospital trusts which represented 61% of the frame. We sought responses from up to four senior employees in each hospital: a manager and a clinician from two service lines (cardiology and orthopedics). The data is evenly split between the specialties (52% cardiology and 48% orthopedics), but that it was harder to obtain interviews with the physicians than managers (80% of the respondents were managers). We interviewed one respondent in 53 hospitals, two respondents in 34 hospitals, three respondents in 12 hospitals and four respondents in one hospital. The correlation of the average management score across responders within the same hospital was high (0.53). We examined evidence for selection bias by estimating probit models of whether a trust responded on the observable characteristics used in our analysis. Table B2 contains the results of this exercise. There is no significant correlation at the 5% level between sample response and any of the performance measures or covariates and only one (from 16) of the indicators are significant at the 10% level. This suggests that there was little systematic response bias. In the regressions all interviews with many unanswered questions (three or more) are excluded as the information obtained is unlikely to be reliable. This excludes 3 interviews out of 164.

B.2 Construction of predicted HHIs

Assigning hospital market competitiveness based on which hospital patients *actually* attended - rather than, for example, their area of residence - can induce a correlation between competitiveness and unobservable determinants of outcomes, because patients' hospital of admission may depend on unobserved determinants of their hospital's quality and their own health status. We therefore follow Kessler and McClellan (2000) and Gowrisankaran and Town (2003) in assigning a level of market competition to a hospital based on predicted patient flows from neighborhoods to hospitals. Hospitals are assigned the predicted level of market competition based on the neighborhoods from which they draw their patients. Our construction of HHIs follows Gaynor et al (forthcoming) and the reader is referred to their Appendix B for more details.

For the predicted flows which underlie these HHIs, we estimate a logit model for patient choice. Having estimated these models, *predicted HHIs* at the hospital level are then computed as functions of the patient level predicted probabilities. First, neighborhood level predicted HHIs are computed as the sum of squared (predicted) shares of patients from the neighborhood attending each hospital and second, the hospital level predicted HHI is calculated as a weighted average across these neighborhood HHIs, where the weights are the predicted proportions of the hospital's patients from each neighborhood. The neighborhood is defined as an MSOA (Middle layer Super Output Area).[2] The details are as follows.

Estimated HHIs

The probability π_{ij} that patient i chooses hospital j is given by:

$$\pi_{ij} = \Pr\left(y_{ij} = 1\right) = \frac{\exp\left(\beta_1 d_{ij}\right)}{\sum_{j=1}^{J_i} \exp\left(\beta_1 d_{ij}\right)}$$

The log-likelihood function is:

$$\log L = \sum_{i=1}^{n} \sum_{j=1}^{J} \log\left(\pi_{ij}\right)$$

The predicted HHI for patient i is the sum of their squared probabilities:

[1] A trust can consist of more than one hospital site (just as a firm can consist of more than one plant). The median number of sites was 2 with a range from 1 to 10.

[2] There are approximately 7,000 MSOAs in England each containing approximately 7,200 people, so they are similar in size if not a little smaller than a US zipcode. MSOAs are constructed to have maximum within MSOA homogeneity of population characteristics.

$$H\hat{H}I_i = \sum_{j=1}^{J} \hat{\pi}_{ij}^2$$

Following Kessler and McClellan (2000) we compute the predicted HHI for hospital j as the weighted average across neighborhood level predicted HHIs where the weights equal the predicted proportions of patients from hospital j that live in neighborhood k.

$$H\hat{H}I_j = \sum_{k=1}^{K} \left(\frac{\hat{n}_{kj}}{\hat{n}_j} \right) H\hat{H}I_k, \qquad H\hat{H}I_k = \sum_{j=1}^{J} \left(\frac{\hat{n}_{jk}}{\hat{n}_k} \right)^2$$

$$\hat{n}_j = \sum_{i=1}^{n} \hat{\pi}_{ij}, \qquad \hat{n}_k = \sum_{i=1}^{n_k} \sum_{j=1}^{J} \hat{\pi}_{ij} = \sum_{i=1}^{n_k} 1 = n_k, \qquad \hat{n}_{kj} = \hat{n}_{jk} = \sum_{i=1}^{n_k} \hat{\pi}_{ij}$$

The predicted HHI for neighborhood k is the sum of the squared shares of patients from neighborhood k who attend each hospital j.[3]

Specification of the utility function

We estimate alternative specific conditional logit models using the following specification of the patient utility function:

$$\begin{aligned} U_{ij} = & \sum_{h=1}^{2} \left\{ \beta_1^h \left(d_{ij} - d_{ij^+}^h \right) \times z_j^h + \beta_2^h \left(d_{ij} - d_{ij^+}^h \right) \times \left(1 - z_j^h \right) \right\} \\ & + \sum_{h=1}^{2} \left\{ \beta_3^h \left(d_{ij} - d_{ij^-}^h \right) \times z_j^h + \beta_4^h \left(d_{ij} - d_{ij^-}^h \right) \times \left(1 - z_j^h \right) \right\} \\ & + \sum_{h=1}^{2} \left\{ \begin{array}{l} \beta_5^h \, female_i \times z_j^h \\ + \beta_6^h \, young_i \times z_j^h + \beta_7^h \, old_i \times z_j^h \\ + \beta_8^h \, lowseverity_i \times z_j^h + \beta_9^h \, highseverity_i \times z_j^h \end{array} \right\} + e_{ij} \end{aligned}$$

where z_j^1 is a binary indicator of whether hospital j is a teaching hospital, z_j^2 is a binary indicator of whether hospital j is a big hospital (defined as being in the top 50% of the distribution of admissions), d_{ij} is the distance from the geographic centre of the neighborhood (the MSOA) for patient i to the geographic centre of the neighborhood (the MSOA) for hospital j, $d_{ij} - d_{ij^+}^h$ is the additional distance from patient i to the alternative under examination j over and above the distance to the nearest alternative j^+ which is a good substitute in terms of hospital characteristic h, $female_i$ indicates gender, $young_i$ and old_i are binary indicators of whether patient i is below 60 years old or above 75 years

[3] The predicted HHI for hospital *j* can be calculated in different ways. Gowrisankaran and Town (2003) compute the predicted HHI for hospital *j* as the weighted average across patient level predicted HHIs where the weights are equal to the predicted probability that they attend hospital *j*, $H\hat{H}I_j = \frac{1}{\hat{n}_j} \sum_{i=1}^{n} \hat{\pi}_{ij} H\hat{H}I_i; \qquad \hat{n}_j = \sum_{i=1}^{n} \hat{\pi}_{ij}$.

When each patient lives in their own neighborhood, our approach will give the same predicted hospital level HHIs as Gowrisankaran and Town (2003). However, the larger the geographic scale of the neighborhoods, the more the HHIs based on this approach will differ from those based on the Gowrisankaran and Town (2003) approach.

old respectively, and $lowseverity_i$ and $highseverity_i$ are binary indicators of whether patient i has one ICD diagnosis or three or more ICD diagnosis respectively. All patient level variables are interacted with the variables z_j^1 and z_j^2.[4]

Following Kessler and McClellan (2000), no individual or hospital level variables are entered as main effects and as Kessler and McClellan (2000) and Gowrisankaran and Town (2003), we explicitly omit hospital level fixed effects to prevent predicted choice being based on unobserved attributes of quality. The error term, e_{ij}, is assumed i.i.d, Type I extreme value and captures the effects of unobservable attributes on patient choice.

The model is estimated for the years 2005/6 and undertaken separately for each of the nine Government Office Regions of England, thus allowing parameter estimates to be region-specific.[5]

The sample of admissions is all elective admissions and we restrict our analysis to those hospitals which have 50 or more elective admissions. Hospitals with fewer admissions are dropped from the sample as are the patients who attend these hospitals.[6]

Travel distance
We restrict the distance travelled to be 100km, subject to ensuring that each patient's choice set includes the hospital actually attended and the first and second nearest hospital with each binary characteristic switched on and off. To see why choice of both the first and second hospital is included, the following alternatives are included in all patients' choice sets, irrespective of distance: the hospital actually chosen, the nearest non-teaching hospital ($z^1 = 0$), the nearest teaching hospital ($z^1 = 1$), the nearest small hospital ($z^2 = 0$) and the nearest big hospital ($z^2 = 1$). If the hospital under examination is, for example, the nearest hospital for which $z^1 = 0$, then the nearest alternative which is a good substitute will actually be the second nearest hospital where $z^1 = 0$ and so the differential distance is negative. To compute the value of this differential distance, we must also ensure that we include the second nearest hospital for which $z^1 = 0$ in patient's choice sets. The same argument can be made when the hospital under examination is the nearest hospital that has each of the other hospital characteristics (i.e. $z^1 = 1$, $z^2 = 0$, $z^2 = 1$). Thus, the following alternatives must also be included in all patients' choice sets, even if they are beyond the cut-off distance: the second nearest non-teaching hospital ($z^1 = 0$), the second nearest teaching hospital ($z^1 = 1$), the second nearest small hospital ($z^2 = 0$), the second nearest big hospital ($z^2 = 1$). Where patients actually travel further than 100km, we extend their choice set to additionally include the actual hospital attended. Each patient will thus always have at least four to nine alternatives within their choice set.

Model fit
The proportion of correct predictions is around 75%. (We weight regressions by the inverse of the number of interviews so that hospitals with multiple responses are weighted less (we also cluster standard errors at the hospital level). The results are robust to a range of model specifications including: (1) whether we allow model parameters to be region-specific; (2)

---

[4] For example, consider the teaching hospital dimension $h = 1$ and suppose that the hospital under examination is a non-teaching hospital $z_j^1 = 0$, then the differential distance $d_{ij} - d_{ij^+}^1$ is the distance to the hospital under examination over and above the distance to the nearest hospital which is also a non-teaching hospital.

[5] To make the model computation more efficient, we collapse patients who are identical in terms of model characteristics (i.e. who live in the same MSOA and go to the same hospital and have the same patient level characteristics) into groups. All patients within the group have the same choice set. Similarly, all patients within the group also have the same distances to each hospital within the choice set as distances are measured from MSOA centroids to hospital locations. Frequency weights are used in the estimation to reflect the number of patients within each group.

[6] It is possible for some alternatives within patients' choice sets to be never chosen. This is likely to happen since hospitals located outside the region under investigation will be included in the choice set of those patients living close to the boundary, even if no patients from the region under investigation go to that hospital. These faraway hospitals should not cause any problems with the statistical identification of the model parameters. This is because, unlike standard alternative-specific conditional logit models, our model does not include any hospital-specific intercepts.

the extent to which we expand patients' choice sets beyond the minimum set of hospitals required to estimate the model; and (3) whether we enter distance variables as linear or non-linear variables. Hospital HHIs based on predicted data are lower in value than HHIs based on actual data. The most important coefficient estimates are for distance, so that if patients were allocated to hospitals solely on a distance basis then hospitals would appear more competitive than they actually are. Actual choice of hospital is therefore based on additional factors that we have excluded from the model, and these additional factors lead hospitals to become less competitive than they would otherwise be given geographical location.

B.3 Results Using HHI as a measure of competition

Table B3 contains the results from using actual or predicted HHIs instead of simply the number of hospitals as a measure of competition. Note that we use the inverse of the HHIs (the "numbers equivalent") so that competition is increasing in the measure. The first four columns have actual HHI and the last four columns have predicted HHIs. Column (1) has OLS results and is analogous to column (1) of Table 4, i.e. only basic controls are included. As with Table 4, the coefficient on competition is positive and significant. We include additional controls in column (2) to show that the relationship is robust. Columns (3) and (4) are the same as columns (1) and (2) except we instrument competition with political marginality. As with Table 4, failure to control for endogeneity biases the estimates of the effects of competition on management towards zero. We repeat these specifications in the last four columns and show a similar pattern of results.

APPENDIX C: OTHER RESULTS

C.1 Effects of Hospital closures on Labour vote Share

Table C1 presents results of the changes in the Labour vote share and the closure of hospitals. Column (1) considers the change in the Labour vote share between 1997 and 2005 (two election years won by Tony Blair). A single hospital closure within a 15km radius leads to Labour losing 0.837 percent of votes. This coefficient suggests that if the entire vote share was lost to the second strongest party, this would narrow the gap between Labour and that party by 1.65%. In column (2) we show that closures in the first election cycle (1997-2001) have a similar effect to closures in the second cycle (2001-2005). Column (3) fosues on the second cycle 2001-2005 and shows that although closure in 2001-2005 have the largest effects of vote shares, voters appear to have long memories as closure in 1997-2001 also have a significant negative effect on outcomes 2001-2005. In column (4) we present a placebo test by looking at the 1997-2001 change in the vote share. Although closures 1997-2001 cause a significant fall in the share of the Labour vote, closures in the future (after the 2001 election) are not significantly associated with 1997-2001 vote share changes. This is reassuring as it suggests we are not picking up some unobservable trends correlated with closures and lost support for Labour.

Overall, these results support the popular view that politicians are harmed by hospital closures.

C.2 Full results with all coefficients and standard errors

To conserve space we did not report the coefficients and standard errors on all variables in the main text. Table C2 presents these for our baseline specifications (Table 4) for OLS in column (1), reduced form in column (2), first stage in column (3) and second stage in column (4). Column (1) is the same as column (4) Table 4, Column (3) is the same as column (5) Table 4 and column (4) is the same as column (6) Table 4.

C.3 Alternative ways of dealing with spatially autocorrelated standard errors

To deal with spatial autocovariance of the standard errors our baseline estimates cluster at the country level (there are 48 counties in England). Table C3 presents an alternative method of using Conley (1999) spatially corrected standard errors within a 45km radius for the buffer. The structure of the Table C3 (and coefficients) are identical to Table 3. The standard errors are smaller using this method, suggesting our clustering is, if anything, too conservative.

C.4 Does political marginality lead to more health resources directed at hospitals in these areas?

A concern for our identification strategy is that hospitals in politically marginal areas may enjoy more health resources through "hidden policies". Although this should not happen because of the transparent national funding formula, we have implemented various tests of this assumption by looking at hospital level spending variables and spending by purchasers of care.

<u>Hospital-level capital expenditures</u>

We examine capital expenditures, as these are plausibly more exogenous than expenditure per patient (which was used as a sensitivity test in the previous draft). The capital related items are:

1) **Capital investments:** this covers expenditure on expensive machinery that will not be purchased on a regular basis and for which purchase often involves the support of the local or regional offices of the Department of Health. We have information on:

   a. Total capital expenditure directly, as well as the number of inpatient cases which used a particularly expensive piece of medical equipment, spanning;
   b. The number CT scans
   c. The number of MRI scans, and
   d. The number of cases which used high tech equipment more broadly defined.

2) **Average age of the buildings** that are part of each hospital. This is a good measure of additional longer-run hospital funding, as underfunded hospitals tend to operate out of older buildings as they do not have sufficient funds to fund capital investments.

In Table C4 we regress these outcomes on our marginality instrument. Across our five measures of capital investment we only find a (weakly) significant effect for building age suggesting that marginal areas tend to have older buildings. That is (if anything) they received *less* capital investment. However, we do not want attach too much weight to one marginally significant coefficient out of a large set of measures. Note that the number of observations varies slightly across columns because some of the metrics are available only for a subset of the hospitals in our sample.

As a further robustness check we also included each of the capital investment measures into our baseline IV regression in order to see if our main effect remains significant. Results from this exercise are reported in Table C5 (the first column replicates the result from our baseline regression). The coefficient on our measure of competition remains very similar when including the additional funding measures, both one at a time (columns (2) to (6)) and simultaneously (column (7)). Taken together these tables provide evidence that capital investment does not seem to respond to political incentives and does therefore not pose a serious threat to our identification strategy.

Funding levels of the purchasers

Our second strategy was to collect financial data at the level of the health authority (HA). HAs were, during our period, the main purchasers of care. They were allocated funds on a formula basis (driven primarily by medical need) by the Department of Health. This was used to provide health care for the population under their jurisdiction (there were 100 HAs for England). Among other things, HAs placed contracts with hospitals to assure the provision of secondary care.

If the government did indeed try to influence hospital funding they would have had to do it through the indirect route of allocating more money to HAs in more marginal areas. Complementary to our hospital-level analysis above we therefore investigate directly whether HA funding allocations are correlated with the political contestability (marginality) of constituencies that lie within the HA.

In Table C6 we regress various measures of levels and changes in HA funding against marginality in 1997. We look at both levels and changes as with formula funding politicians may be more able to bring about changes or allocations to special funds in response to marginality than alter the initial levels set by the formula. Column (1) looks at the total allocations of funds in 1999. We break this into the baseline allocation and the increase relative to previous round of funding in the next two columns. Column (4) examines a special "modernisation fund" allocated to HAs in 1999. This kind of 'once-off' funding is allocated according to less transparent guidelines and might be susceptible to being channeled to particular geographical areas. Column (5) examines another specific fund – the "special allocation" which includes funding for overtime, drug misuse and allocation to specially designated "health action zones" (local areas singled out as in particular health need). Finally, column (6) presents the change in allocations due to formula changes. The formula is decided on by an independent body and changes are made to it to reflect changes in need and changes in cost structures. However, if politicians are able to influence funding they may exert influence by changing the formula in favour of marginal constituencies. We find political marginality is insignificant in all regressions suggesting that allocation of funds to Health Authorities was not heavily influenced by marginality.

As a further check we then included these types of funding in our baseline IV-regression as additional controls in Tables C7. Column (1) replicates our baseline regression for comparison. As for the case of the capital investment data, our main coefficient is unaltered when including the additional controls in all columns. Furthermore, the controls are insignificant whether we include each one individually or all at the same time.

Tables C6 and C7 used the 1999 levels of funding because there were most close in time to the 1997 election. As an alternative we could use funding levels in later periods, closer to when we measure management in 2006. The qualitative pattern of results was virtually identical to those reported in Tables C6 and C7 (results available on request).

C.5 What is Political Marginality correlated with?

Table C8 shows the correlation of marginal constituencies with other demographic features of the area. Each cell in column (1) is from a bivariate regression where the dependent variable is an area characteristic (as noted in each row) and the right hand side variable is the marginality instrument. It is clear from the reported coefficients on marginality that these areas (among other things) are more likely to higher rates of employment (e.g. fewer short and long-term unemployed in rows 4 and 8 and non-workers in row 7) and fewer people with long-term illness (row 3). However, our management regressions control for population density and demographics, so column (2) reports the coefficients on marginality after conditioning on population density, the fraction of households owning a car (which captures both income and the degree of urbanization) and a London dummy, all of which are variables used in our main regressions. Using these controls, none of the observables reported in C8 are significantly correlated with marginality.

C.6 Disaggregating the Management Measure

Table C9 shows the baseline IV specification of the effects of competition on management broken down by the sub-components of the management score (monitoring, targets and incentives). Column (1) repeats the baseline specification of Table 4 column (6). The coefficients are similar across the sub-components although, as discussed in the text, there is a little evidence that the effect of incentives may be stronger than the other questions.

C.7 Alternative definitions of catchment areas and competition

We implemented a more sophisticated measure of competition by weighting each rival hospital proportional to the overlap in catchment areas. At the extremes, a hospital at zero distance gets a weight of 1, a hospital at 30km gets a 0; in between the amount of catchment area overlap (relative to full overlap) gives the associated weight. Similarly, we constructed the marginality measure by computing a weighted average of marginality within all constituencies within a 45km radius.[7] The weight is determined by the weight associated with the closest competitor that is influenced by this constituency, i.e. all constituencies within a 15km radius (or less) receive a weight of 1. Constituencies at 45km distance receive a weight of 0. In between those extremes the weight is assigned based on the overlap in catchment areas with the nearest competitor that is affected by the constituency (i.e. lies within its 15km radius).

The results for varying catchment area radius using the weighting described above are in Table C10. The first stages are in Panel A. Column (1) is our baseline IV with a simple count. The second column uses the overlap-weighting with the same radius (catchment area of 15km, which implies hospitals within 30km as competitors and 45km marginality). The remaining columns widen the catchment area definition. We also look at wider catchment areas due to the fact that the new metric attaches a small weight to hospitals at a 30km distance (relative to our simple count measure). If those hospitals still exercise competitive pressure, a wider radius might be appropriate. The results for these first stages are consistently strong and are not affected very much by the precise choice of the catchment radius.

Similarly, for the second stages in Panel B show that our results are robust to switching from a count measure to a weighted competition measure. Again, the exact choice of radius does not matter greatly. However, we do get somewhat stronger results when using a wider radius of 50km (i.e. a catchment area definition of 25km instead of 15km). Possibly suggesting that the overlap-weighting within 30km weights hospitals around 30km distance down “too much”.

We do see that the magnitude of the coefficient changes quite a bit, but this is natural as the variables have quite different interpretations now. For example, an increase of one unit in our count measure corresponds to an additional hospital anywhere within 30km. Instead, a one unit increase in the weighted measure can be interpreted as adding a competitor at zero distance (or 2 competitors at 15km distance). Hence, the coefficient magnitude for the latter case is larger. If we adjust the coefficient for the difference in the standard deviation of the variables results are very similar. The standard deviation for the various competition measures is reported in the final column.

We also tried using a simple triangular kernel which assigns competitors at 0 distance a weight of 1 and competitors at 30km a weight of 0 and interpolates the weighting linearly in between. Marginality in this case is defined as a weighted average using a triangular kernel over a 45km radius. This turns out to be extremely similar to the overlap-based weighting (results available on request).

C.8 Definitions of Marginality

We split marginals into marginally won and marginally lost constituencies (in 1997). We would expect the marginally lost constituencies to matter less as those would have been further out of reach in a closer election. This is indeed what we find in Panel A of Table C11. This is consistent with the idea that some 1997 marginals might have been out of reach in a tighter election. However, the marginally lost constituencies still have explanatory power, but the effect is weaker than for the

[7] We draw the marginality radius wider relative to the radius we use to define competition because of overlaps in catchment areas and political radius. As noted in Figures 3 and 6, for example with a catchment radius of 15km we get a radius for our competition measure of 30km and a marginality radius of 45km radius. This is our current baseline case.

marginally won constituencies. We further investigate the issue by varying the marginality percentage threshold asymmetrically. Recall that in our baseline we define marginality as a margin between -5 and +5 percentage points. Results are shown in panels B and C of Table C11.

We find that excluding (at least part) of the losing marginal leads to our instrument having a stronger effect on competition. However, a tighter window also restricts the variation in the data used to identify the effect as (by construction) fewer constituencies fall into the more narrow percentage threshold window. The substantially larger standard errors for more narrow windows are a result of this (e.g. the standard errors roughly double when using only winning marginals relative to our baseline case of using both winning and losing marginals within a 5% window). We prefer to use our baseline definition of a symmetric margin because: (1) it seems the most straightforward and transparent way to define our instrument, and (2) Precision is higher for this definition relative to more narrow windows.

C.9 A Placebo Test using Secondary Schools

As another test of our identification strategy we compare the impact of political marginality on secondary (combined middle and high) schools to hospitals. The public schools sector has many institutional features that are similar to hospitals as they are free at the point of use, CEOs (principals) receive more resources depending on the number of students they attract and the funding formula is transparent and (in theory) not open to manipulation depending on political marginality status. Unlike hospitals, however, school closure decisions are the formal responsibility of the Local Education Authority (LEA), which decides primarily on financial grounds given per capita pupil funding. Other things equal, the national government would like better public schools in marginal political districts, so if they were able to exert influence in other ways we should also expect to see better school outcomes in marginal districts. Therefore, by comparing the impact of political marginality on outcomes in schools we can evaluate whether marginality is generating some other positive effect on public services (through political pressure on managers or channeling some other unobserved resource). We find that political marginality does *not* matter for schools on any dimension – numbers, expenditure or pupil outcomes. This suggests that it is the effect of political marginality on market structure that is driving our hospital results, rather than some other channel.

We do not have managerial quality measures in schools but do have school outcome indicators: test scores at the school level both in levels and value added. Pupils in England take nationally set and assessed exams at 5 different ages. A key measure of school performance is the performance of pupils in the exams (known as GCSEs or Key Stage 4) taken at the minimum school leaving age of 16. These are “high stakes” exams, as performance in these exams determines the progression of pupils into the final two years of high school and into university level education, and is used to assess school performance by regulators and parents. Our measures are the proportion of pupils that achieved 5 GCSE results with a high grade (grades A* to C) and school value-added: the improvement between the Key Stage 2 exams (which are taken just before entering secondary school at age 11), and the GCSE exams.[8]

As control variables at the school-level we use the proportion of students eligible for a free-school meal to proxy for the income of the parents (eligibility is determined by parental income). We also control for proportion of male, non-white pupils, pupils with special educational needs (severe and less severe), and school and cohort size. At the level of the local authority we control for the share of pupils in private schools and selective schools, population density and total population. In contrast to patient flows to hospitals, catchment areas for schools are delineated by local authority boundaries. When calculating the number of competing schools and the proportion of marginal constituencies we therefore use the local authority as the geographical catchment area, rather than the fixed radius we use for hospitals.[9]

In Table C12 columns (1) and (2) we see that the number of schools at the local authority level is unaffected by the proportion of marginal constituencies within the LEA. Column (1) only includes controls for the political color of the constituencies, whereas column (2) controls for total school and area characteristics. Marginality is insignificant in both columns. The magnitude of the point estimate of the marginality coefficient is also small. A one standard deviation increase in marginality is associated with 15% of a new school (0.153 = 0.255 *0.599), compared to the significant effect of about 50% of an additional hospital for a similar change in political conditions.

[8] At GCSE/Key Stage 4 students can choose to take additional exams on top of the compulsory ones. Because of this variation in the number of exams taken, we use a capped score that only takes the best 8 exams into account.

[9] The main results do not change when a fixed radius is used. We tried using a catchment area of 15km (i.e. the same we used in the hospital market) and obtained qualitatively similar results. We also tried using a smaller radius than in the case of hospitals as schools have a smaller catchment area and again found similar results.

In the absence of an indirect effect of political marginality on performance via the impact on the number of schools, there could still be a *direct* effect of marginality on school performance. For example, politicians might try to influence school performance by providing more funding or by putting pressure on the school management to improve their performance. Contrary to the entry/exit decision, the incentives to improve performance in schools and hospitals will be very similar in this respect. The impact of political contestability on school performance is therefore likely to carry over to hospitals as well. This arguably provides us with a placebo test of the validity of our IV strategy.

We start by looking at the impact of the proportion of marginal constituencies within the local authority on school funding. In columns (3) and (4) of Table C12 we regress expenditure per pupil on the proportion of Labour marginals. As in the case of hospitals we do not find any effect of marginality on public funding for secondary schools. We then look directly at the impact of the political environment on school performance, using the proportion of pupils with at least 5 GCSE exams with a grade between A* and C as the dependent variable in columns (5) and (6). The coefficient on marginality is negative with basic controls and full sets of controls, but not significantly different from zero. Column (7) includes an additional variable of interest, the number of competing schools in the local area. The coefficient on this competition variable is positive and significant.[10] Columns (8) to (10) of Table 6 use the school's value-added and find similar results: a small and insignificant coefficient of political marginality on school outcomes. To put it another way, for a one standard deviation increase in the fraction of marginal constituencies, value added is predicted to increase by a (statistically insignificant) 0.014 of a standard deviation according to column (9). By comparison, a one standard deviation increase in the fraction of marginal constituencies will lead AMI death rates to fall by a (statistically significant) 0.15 of a standard deviation.

In summary, we have provided evidence that political marginality has no impact on school numbers or school performance, but does raise hospital numbers and improve hospital management and healthcare outcomes. This suggests that political marginality influences hospital outcomes through increasing the number of rival hospitals. Of course, schools and hospitals differ in many ways from one another. However, we think the main ways in which the government could influence the performance of each of these public services through funding or political pressure is quite similar. The placebo test therefore provides some additional evidence for the validity of our IV-strategy.

C10: Sample selection due to hospital closures

Hospital closures (some of which are induced by our instrument) do not only lead to variation in our competition measure but also (by construction) lead to a non-randomly selected sample. This might therefore lead to sample selection issues. We illustrate the likely bias from this sample selection issue by considering the reduced-form relationship between management quality and marginality which underlies our IV-regression. Formally we can think of the relationships driving management quality and closures in the following way:

$$M_j = \delta(MARGINALITY)_j + e_j \qquad \textbf{(Outcome equation)}$$

$$Z_j = \pi(MARGINALITY)_j + u_j \qquad \textbf{(Selection equation)}$$

Where $Z_j = 1$ if the hospital existed in 1997 and is still open in 2005 and $Z_j = 0$ if the hospital existed in 1997 and closed by 2005.

The parameter of interest is δ, the effect of political marginality on management. However due to selection, the marginal effect conditional on survival ($Z_j = 1$) is (ignoring subscripts):

$$\frac{\partial M}{\partial MARGINALITY} = \delta - \pi\rho X$$

where in the standard Heckman selection model, under assumptions of joint-normality of the errors, "X" is a positive term (the inverse Mills ratio), π is the coefficient from the selection equation and will be positive according to our identification

[10] This provides some suggestive evidence that competition may matter for performance in public schools as it does for public hospitals.

strategy (hospitals in marginal areas are less likely to close down), and ρ is the correlation coefficient between the two error terms "e" and "u".

In our context, ρ is likely to be positive. The most prominent factor that would cause such a positive correlation is unobserved hospital quality which has a positive impact on management quality. Furthermore it is quite possible that unobserved quality would also lower the probability of a hospital closure and therefore make the hospital more likely to end up in our 2005 sample. If this is the case our estimate of δ would be biased downwards. The selection the bias would therefore be likely to lead to an underestimation of the true coefficient on marginality.

Note that one thing that would rule out a selection problem is π =0, however this is not logically consistent with our IV-argument as we find that marginality influences the number of competing hospitals by affecting closure probabilities. Secondly, within the specific institutional setup of our study it is actually quite likely that ρ is close or equal to zero. It is of course very hard to argue for no correlation on a very general basis. But if hospital quality has actually rather little impact on closure probabilities this at least rules out a prominent candidate that would cause a correlation between the errors and therefore a bias in our regression. This may seem surprising, but hospital closures in the UK were mainly driven by demographics and rationalization – after the creation of the NHS after World War II the population has slowly moved out from the cities to the suburbs (so there are "too many" city centre hospitals) and the minimum efficiency of scale of hospitals has risen (so there are "too many" small hospitals).

In order to explore whether hospital quality had an impact on closure probabilities we obtained measures of hospital quality for 1997 (we have data on a smaller range of outcomes than for those earlier years) and ran "survival" regressions to see whether any of these performance measures predict closure. Table C13 contains these "selection equations" run as linear probability models. The first column replicates column (4) of Table 3. Columns (3) - (6) show that performance had no significant impact on closure probabilities.

We find that none of the quality measures have any predictive power for closures (length of stay and AMI mortality in 1997). Column (2) shows that larger hospitals and specialist hospitals are less likely to be closed down as well as (of course) hospitals in marginal districts. Given that no observed quality measure predicts closure, this seems to be suggestive that unobserved quality also does not enter the selection equation and selection might not be a major issue here. To do this more rigorously would need an additional variable that entered the selection equation but could be excluded from the second stage regression. It is not obvious what such an instrument would be.

Table B1: Data Sources

Variable	Notes	Source
Mortality within 28 days of emergency admission for AMI (in hospital and out of hospital)	During financial quarter Defined according to NHS mortality rate performance indicators (PIs)	Hospital Episode Statistics (HES) (The NHS Information Centre for health and social care) [a]
Mortality within 30 days of surgery for selected emergency procedures (excludes AMI).	During financial quarter Defined according to NHS mortality rate PIs	Hospital Episode Statistics (HES) (The NHS Information Centre for health and social care).[a]
Waiting list size	At start of quarter (as proxied by end of previous quarter)	Department of Health: Provider based waiting times/list statistics
MRSA (Methicillin-Resistant Staphylococcus Aureus) rates	Recorded 6-month period	Health Protection Agency: Half-yearly reporting results for clostridium difficile infections and MRSA bacteraemia
Operating Margin	Recorded annually	Trust Financial Returns (The NHS Information Centre for health and social care)
Probability of leaving in next 12 months	Respondents are asked to rate chances of leaving on a 1 to 5 scale.	NHS Staff Survey[c] (2006). 128,328 NHS staff responded and results are reported as average of scale by each trust
Healthcare Commission rating[d] (Healthcare Commission, 2006)	All trusts are scored on a scale of 1 to 4 on "resource use" and quality of "care"	Our main indicator averages over the two measures and standardizes.
Local authority all-cause mortality rates	Calendar year; standardized	Office of National Statistics
Casemix of admissions: For the general performance indicators (e.g. management regressions and HCC rating) we use case mix for all admitted patients. For the specific outcomes of AMI and general surgery death rates we use condition-specific casemix.	Proportion of admitted patients in each sex-specific age band. 11 age categories: 0-15, 16-45, 46-50, 51-55, 56-60, 61-65, 66-70, 71-75, 76-80, 81-85, >85 and two genders, so up to 22 controls.	Hospital Episode Statistics (HES) (The NHS Information Centre for health and social care).

Notes: All data is pooled between 2005/06

[a] http://www.performance.doh.gov.uk/nhsperformanceindicators/2002/trdca_t.doc.

[b] http://www.performance.doh.gov.uk/waitingtimes/index.htm

[c] http://www.cqc.org.uk/usingcareservices/healthcare/nhsstaffsurveys.cfm

[d] http://www.cqc.org.uk/_db/_documents/0607_annual_health_check_performance_rating_scoring_rules_200702284632.pdf

Variable	Notes	Source
Total admissions, Admissions for AMI, Admission for Emergency Surgery (excludes AMI)	During financial quarter	Hospital Episode Statistics (HES) (The NHS Information Centre for health and social care)
Area Demographics: Population Density, Age- / Gender Mix in the Population		LA statistics from Office of National Statistics
Number of Sites		Hospital Estates and Facilities Statistics[a] (The NHS Information Centre for health and social care).
Foundation Trust Status		Monitor (Foundation Trust Regulator)[b]
Specialist Hospital	Self-coded from individual hospital web pages (2 in the sample: one specialist cardiology centre and a children hospital)	Self-coded
Building Age	Data is provided at the site level and aggregated up to hospital level using the surface area as weights	Hospital Estates and Facilities Statistics[a] (The NHS Information Centre for health and social care).
Expenditure per patient	Cost divided by the number of total admissions	Cost data from Trusts' Annual Reports and Accounts from Trusts' webpages or Monitor[b] (in the case of Foundation Trusts)
Political Variables: Marginal Constituencies, Labour Vote Share and identity of Winning Party	4 elections from 1992 until 2005	British Election Study
School Variables: Pupil Performance Measures, School Size and Characteristics of the Pupils and School Location		National Pupil Data Base Dataset

[a] http://www.hefs.ic.nhs.uk/ReportFilter.asp

[b] http://www.monitor-nhsft.gov.uk/

Table B2: Tests of Sample Selection for Public Hospitals

Variable	Marginal effect(Standard error)	Observations
Performance Measures		
Mortality rate from emergency AMI after 28 days (quarterly average)	0.129 (0.161)	133
Mortality rate from emergency surgery after 30 days (quarterly average)	0.313 (0.365)	163
Numbers on waiting list	0.025 (0.0454)	163
Infection rate of MRSA per 10,000 bed days (half yearly)	-0.025 (0.041)	163
Operating margin (percent)	0.040 (0.032)	164
Likelihood of leaving in next 12 months (1=very unlikely, 5=very likely)	-0.063 (0.04)	161
Average Health Care Commission rating (1-4 scale)	-0.011 (0.043)	164
Size Variables		
Number of total admissions (per 100,000 population)	0.213 (0.417)	164
Number of emergency AMI admissions (per 100,000 population)	53.896 (70.863)	164
Number of emergency surgery admissions (per 100,000 population)	0.612 (4.739)	164
Number of sites	0.016 (0.196)	164
Covariates		
Foundation Trust (hospitals with greater autonomy)	0.091 (0.082)	164
Building age	-0.013 (0.013)	154
Expenditure per patient (£ 1000)	-0.015 (0.008)*	156
Area mortality (average of local authorities in 30km radius, per 100,000,000 population)	0.275 (0.277)	163

Notes: These are the results from separate probit ML regression of whether a public hospital had any response to the survey on the relevant variable (e.g. AMI mortality rate in the first row). There is a population of 164 potential acute hospitals in England and we had 100 hospitals with at least one respondent. For the first 2 rows we use the same restrictions as in table 2: we use only hospitals with more than 150 yearly cases in the AMI regression and exclude specialist hospitals from the regression in the second row. *** indicates significance at 1% level; ** significance at 5%, * for significance at 10%.

Table B3: OLS/IV-Regressions Using Alternative Measures of Competition

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Method	OLS	OLS	IV	IV	OLS	OLS	IV	IV
Dependent Variable	Manage-ment	Manage-ment	Manage-ment	Manage-ment	Manage-ment	Manage-ment	Manage-ment	Manage-ment
1/(Actual HHI) Inverse Herfindahl-Index (Based on Fixed Radius)	0.157*** (0.055)	0.170** (0.071)	0.586* (0.348)	0.685* (0.374)				
1(Predicted HHI) Inverse Herfindahl-Index (Based on ***Predicted*** Patient Flows)					0.459** (0.159)	0.368* (0.187)	1.934* (0.965)	1.865* (1.015)
F-test of instrument in first stage			7.96	6.72			5.89	8.80
General Controls	No	Yes	No	Yes	No	Yes	Yes	Yes
Observations	161	161	161	161	161	161	161	161

Notes: *** Indicates significance at the 1% level; ** significance at 5%, * significance at 10%. The competition measure in columns (1) through (4) is a "number-equivalent" Herfindahl-Index (the inverse of the normalized between 0 and 1 HHI-index) of competition based on admissions of all hospitals within a 30km radius. In columns (5) through (8) we use a "number-equivalent" Herfindahl-Index of competition based on predicted patient flows. IV-columns use the proportion of Labour marginal as an IV. Predicted patient flows are estimated using a model of hospital choice in a first stage (see text and Appendix B for more discussion). Standard errors are clustered at the county level (there are 42 clusters). All columns include controls for the total population and age profile (9 categories) in the catchment area, whether the hospital was a Foundation Trust, number of total admissions and basic case-mix controls (8 age/gender bins of patient admissions), the tenure of the respondent, whether the respondent was a clinician and interviewer dummies as well as the share of managers with a clinical degree. "General controls" include Labour share of votes, the fraction of households owning a car, the number of political constituencies in the catchment area, a set of dummies for the winning party in the hospital's own constituency, a London dummy, teaching hospital status and a dummy for whether there was joint decision making at the hospital level as well as detailed "case-mix" controls (22 age/gender bins of patient admissions). Labour share of votes is defined as the absolute share obtained by the Governing party in the 1997 UK General Election averaged over all constituencies in the catchment area.

Table C1: Voters punish governing party (Labour) when hospitals close

	(1)	(2)	(3)	(4)
Dependent Variable:	Vote Change 1997-2005	Vote Change 1997-2005	Vote Change 2001-2005	Vote Change 1997-2001
Mean of dependent variable				
# Hospital Closures 1997-2005	-0.837***			
	(0.137)			
# Hospital Closures 2001-2005		-0.928***	-0.792***	-0.136
		(0.259)	(0.212)	(0.175)
# Hospital Closures 1997-2001		-0.791***	-0.503***	-0.288**
		(0.174)	(0.122)	(0.136)
Observations	527	527	527	527

Notes: We use Parliamentary constituencies as the unit of analysis here. The dependent variable is the change in the share of votes for the (ruling) Labour party. The right hand side variable is the number of closures in a 15km radius around the constituency centroid (the baseline catchment area definition we use throughout the paper). OLS regressions with robust standard errors below coefficients (in parentheses).

Appendix Table C2: Full Results for Baseline Regressions

Type of Regression	OLS	Reduced Form	IV, 1st Stage	IV, 2nd Stage
Dependent Variable	Mgmt	Mgmt	# Hospitals	Mgmt
Number of Competing	0.181***			0.366**
Hospitals	(0.049)			(0.168)
Proportion of Marginal		2.644**	7.228***	
Constituencies		(1.013)	(2.115)	
General Controls				
Number of Constituencies	0.077	0.117*	0.178***	0.051
	(0.060)	(0.062)	(0.060)	(0.058)
Winning Party was Labour	0.006	-0.018	0.167	-0.079
	(0.235)	(0.227)	(0.565)	(0.295)
Winning Party was Liberal Democrats	0.012	0.320	1.193***	-0.117
	(0.276)	(0.304)	(0.406)	(0.322)
Labour Share of Votes	0.016	0.009	-0.028	0.019
	(0.013)	(0.014)	(0.030)	(0.013)
Size (Total patient admissions)	0.111	0.129	-0.125	0.175
In 10,000s	(0.090)	(0.106)	(0.194)	(0.107)
Foundation Trust	0.562***	0.576***	-0.138	0.627**
	(0.192)	(0.192)	(0.491)	(0.248)
Proportion of Managers with	0.519	0.479	-0.397	0.624
Clinical Degree	(0.374)	(0.361)	(0.396)	(0.416)
Clinicians and Managers	0.264**	0.266*	0.006	0.264*
take decision jointly	(0.128)	(0.135)	(0.229)	(0.135)
Teaching Hospital	0.228	0.245	0.600	0.026
	(0.358)	(0.345)	(0.384)	(0.340)
London	-0.590	-0.162	3.929**	-1.599
	(0.833)	(0.663)	(1.571)	(1.165)
Interviewer 1	0.371	0.390	0.201	0.316
	(0.516)	(0.488)	(0.348)	(0.526)
Interviewer 2	-0.402	-0.318	0.479	-0.494
	(0.497)	(0.488)	(0.318)	(0.498)
Interviewer 3	0.398	0.494	0.473	0.321
	(0.503)	(0.476)	(0.346)	(0.519)
Interviewee Tenure	-0.056***	-0.056**	0.000	-0.056***
	(0.020)	(0.022)	(0.024)	(0.019)
Interviewee is a Clinician	-0.594***	-0.611***	-0.107	-0.572***
	(0.150)	(0.158)	(0.159)	(0.144)
Area Demographics				
Total Population in 15km Catchment Area	-1.354**	-1.111*	1.487*	-1.655**
(1,000,000s)	(0.604)	(0.596)	(0.761)	(0.762)
8 Age-Gender-Controls (F-stat)	1.90*	2.29**	7.32***	2.47**
Fraction of Households that own a car	-0.009	-0.006	0.040	-0.020
	(0.017)	(0.017)	(0.028)	(0.020)
Case-Mix Controls				
22 Age-/ Gender Controls (F-stat)	3.94***	4.36***	4.54***	4.23***

Notes: *** Significance at the 1% level; ** significance at 5%, * significance at 10%. Competition is measured as the number of hospitals in a 30km radius around the hospital (based on a "catchment area" of 15km for the individual hospital). A political constituency is defined as marginal if Labour won/was lagging behind by less than 5% in the 1997 General Election (proportion of marginal constituencies is based on a 45km radius). Standard errors clustered at county level. Labour share of votes is the absolute share obtained by in the 1997 Election averaged over all constituencies in the catchment area. Observations are weighted by the inverse of the number of interviews within the same hospital.

Appendix Table C3: The Effect of Political Pressure on the Number of Hospitals: Conley (1999) spatially-corrected standard errors

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	All Hospitals In 1997	All Hospitals In 1997	All Hospitals In 1997	All Hospitals In 1997	All Hospitals In 1997	Interviewed Hospitals In 2005
Dependent Variable:	# Hospitals 2005	Change # Hospitals 1997-2005	Change # Hospitals 1997-2005	Closure Dummy	Closure Dummy	# Hospitals 2005
Political Marginality in 1997	4.127***			-0.894***	-1.308***	4.955***
	(1.154)			(0.327)	(0.356)	(1.260)
Change in Marginality 1992 - 1997		4.708***	2.919***			
		(1.738)	(1.040)			
# Hospitals per Capita in 30km radius (in 1997)					0.309***	
					(0.088)	
Teaching Hospital Dummy					-0.083	
					(0.102)	
Specialist Hospital Dummy					-0.344*	
					(0.142)	
Population Controls	Yes	No	Yes (Changes)	No	Yes	Yes
Further Controls (see also Table 4)	No	No	No	No	No	Yes
Observations	212	212	212	212	212	161

Notes: *** Indicates significance at the 1% level; ** significance at 5%, * significance at 10%. The number of hospitals is measured within in a 30km radius around the hospital (based on a "catchment area" of 15km for the individual hospital, see text for more details). A political constituency is defined as marginal if Labour won/was lagging behind by less than 5% in the 1997 General Election (proportion of marginal constituencies is based on a 45km radius). Standard errors are corrected using Conley (1999) spatially correlated standard errors on a 45 km radius. Where indicated controls are included for the total population and age profile (9 categories) in the catchment area as well as a London dummy.

Table C4: Relationship between capital expenditure and marginality at the hospital level

Dependent Variable	(1) **Total Capital Expenditure**	(2) **Number of High Tech proceedures**	(3) **Number of CT Scans**	(4) **Number of MRI Scans**	(5) **Building Age**
Marginality	6,914	-483	5,001	-828	22.64*
	(8,461)	(357)	(7,292)	(3,075)	(13.26)
Obs	132	160	160	160	152

Notes: These are "first stage" regressions equivalent to Table (4), Column (5) Apart from marginality the same control variables are included. Capital investments covers expenditure on expensive machinery. Specifically we have information on total capital expenditure directly as well as the number of inpatient cases which used a particularly expensive piece of medical equipment. On the latter we distinguish the number CT scans; the number of MRI scans, and the number of cases which used high tech equipment more broadly defined. Average age of the buildings is an area-weighted average of each hospital site (if there are multiple).

Table C5: Effect of inclusion of hospital capital controls on baseline IV regression

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable:	**Management**	**Management**	**Management**	**Management**	**Management**	**Management**	**Management**
Number of Competitors	0.366**	0.484*	0.346*	0.341**	0.364**	0.338*	0.308*
	(0.168)	(0.247)	(0.176)	(0.165)	(0.179)	(0.181)	(0.181)
Total Capital Expenditure		0.132					0.258
		(0.166)					(0.184)
Number of High Tech			-2.447				-6.111
Procedures			(3.421)				(3.882)
Number of CT Scans				0.298			0.487
				(0.177)			(0.347)
Number of MRI Scans					0.100		-1.070
					(0.341)		(0.777)
Building Age						0.009	0.020
						(0.010)	(0.012)
Observations	161	132	160	160	160	152	130

Notes: These are specifications equivalent to column (6) in Table (4). The first column replicates exactly column (6) in Table (4). All other columns maintain the same specification but add further control variables (which are all reported in the table). All variables are in units of £10,000.

Table C6: Relationship between funding in 1999 and marginality of health authorities in 1997

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	**Total Allocation**	**Baseline Allocation**	**General Increase**	**Modernisation Fund**	**Special Allocations**	**Formula Changes**
	(line O)	**(line K)**	**(line L2)**	**(line L1)**	**(line N)**	**(Table 5.21)**
Marginality	77,995.049	73,658.377	3,604.582	1,171.045	-438.954	-5,771.359
	(80,222.812)	(74,920.092)	(3,813.475)	(1,337.763)	(490.166)	(3,861.152)
Observations	100	100	100	100	100	100

Notes: The unit of observation for these regressions is a Health Authority. No further control variables are included. The dependent variables are all reported in units of £. Total allocation is the sum of the next four columns. Health authorities were given a baseline allocation, two recurrent increases to this baseline (a general increase and one earmarked for modernization (the 'modernisation fund') and other smaller, non-recurrent special allocations covering inter-alia the provision of out of hours care and drug misuse. The letters in the column headings indicate the relevant line of the Department of Health 1999/2000 health authority revenue allocations spreadsheet. For details of what these cover see *NHS Health Service Circular* 1998/2005 http://webarchive.nationalarchives.gov.uk/+/www.dh.gov.uk/en/Publicationsandstatistics/Lettersandcirculars/Healthservicecirculars/DH_4004177

Table C7: Effect of inclusion of 1999 health authority funding controls on baseline IV regression

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable:	Management	Management	Management	Management	Management	Management	Management	Management
Number of Competitors	0.366**	0.369**	0.369**	0.359**	0.361**	0.367**	0.375**	0.362**
	(0.168)	(0.163)	(0.163)	(0.164)	(0.165)	(0.168)	(0.172)	(0.156)
Total Allocation		-0.010						
		(0.008)						
Baseline Allocation			-0.011					0.001
			(0.009)					(0.029)
General Increase				-0.235				-0.873
				(0.177)				(2.042)
Modernisation Fund					-0.672			1.652
					(0.548)			(6.398)
Special Allocations						-0.918		1.164
						(2.045)		(3.326)
Formula Changes							-0.148	-0.171
							(0.241)	(0.223)
Observations	161	161	161	161	161	161	161	161

Notes: These are specifications equivalent to column (6) in Table (4). The first column replicates exactly column (6) in Table (4). All other columns maintain the same specification but add further control variables for the various allocations to Health authorities from Table C6.. All variables except expenditure per patient are in units of £10,000 .Total allocations is the sum of variables in the next four rows, so is excluded in column (8). Source for Health authority funds are from http://webarchive.nationalarchives.gov.uk/+/www.dh.gov.uk/en/Publicationsandstatistics/Lettersandcirculars/Healthservicecirculars/DH_4004177

Appendix Table C8: Correlations of Marginality with other Area Covariates

Method Dependent Variable	(1) Unconditional	(2) Conditional
1. Number of Households (100,000)	-1.363* (0.758)	n/a
2. Fraction of Retired Population	0.211 (0.571)	-0.690 (0.479)
3. Fraction of Population with Long-term Illness	-1.431*** (0.547)	-0.356 (0.380)
4. Fraction of Unemployed	-0.680*** (0.216)	0.077 (0.096)
5. Fraction that Own a House	5.976*** (1.829)	-0.480 (0.815)
6. Fraction of Higher Social Class (Managerial and Professional)	1.172 (1.194)	-0.174 (0.764)
7. Fraction that do not Work	-0.806*** (0.298)	0.006 (0.181)
8. Fraction Long-term Unemployed	-0.252*** (0.084)	0.002 (0.041)
9. Fraction Students	-0.637 (0.569)	0.269 (0.511)
10. Fraction Without Qualification	-1.446 (1.162)	0.697 (0.858)
11. Fraction Migrants	-0.337 (0.443)	0.247 (0.380)
12. Fraction Working Age Pop.	3.272*** (0.982)	0.243 (0.543)
13. Fraction that Work in Manufacturing	0.407 (0.883)	0.550 (0.744)
14. Fraction Using Public Transport\ to Work	-4.802** (2.088)	-0.486 (0.689)
15. Fraction Single Households	-2.233*** (0.728)	0.046 (0.443)
16. Fraction Lone Parents	-1.319*** (0.413)	-0.073 (0.249)

Notes: *** Indicates significance at the 1% level; ** significance at 5%, * significance at 10%. Each cell reports the coefficient (and standard errors) of a *separate* regression where the dependent variable is the variable named in the first column. The sample is composed of 529 constituencies. Each of the 20 variables is regressed on a dummy variable equal to unity if the constituency is marginal (a political constituency is defined as marginal if Labour won/was lagging behind by less than 5% in the 1997 General Election) and zero otherwise. The regressions in the first column are bivariate correlations of a variety of an area characteristic with this marginality variable. The regressions in column (2) condition on some of the basic controls in the main regression analysis: population density, a London dummy, the fraction of households that own a car.

Table C9: IV estimates of impact of competition on components of the management scores

	(1)	(2)	(3)	(4)
Dependent Variable	All	Monitoring	Targets	Incentives
Competition	0.366**	0.296*	0.246	0.417**
	(0.168)	(0.160)	(0.174)	(0.196)
Observations	161	161	161	161

Notes: Column (1) is the same specification as column (6) of Table 4. The other three columns have the same specification but break down the management score into its three main sub-components. In column (2) the score is averaged over the monitoring and operations questions (questions 1-6 in Appendix A); in column (3) for targets we use questions 8-12 and in column (4) for incentives we use questions 7 and 13-18.

Table C10: Tests of robustness to different catchment areas for hospital markets

Panel A - Different hospital catchment areas using "overlap method" (First Stage)

	(1)	(2)	(3)	(4)	(5)
Dependent Variable	#Hospitals 30km	#Hospitals 30km	#Hospitals 40km	#Hospitals 50km	#Hospitals 60km
Marginality 45km	7.228***				
	(2.115)				
Marginality 45km		2.991***			
(Catchment area: 15km)		(1.058)			
Marginality 60km			3.768***		
(Catchment area: 20km)			(1.198)		
Marginality 75km				5.535***	
(Catchment area: 25km)				(1.339)	
Marginality 90km					7.070***
(Catchment area: 30km)					(1.752)
Observations	161	161	161	161	161

Panel B - Different hospital catchment areas "overlap method" (Second Stage)

	(1)	(2)	(3)	(4)	(5)	S.D.
Dependent variable:	Manage-ment	Manage-ment	Manage-ment	Manage-ment	Manage-ment	Competition measure
# Hospitals within 30km	0.366**					9.831
Radius	(0.168)					
30km radius		0.681*				3.848
(Catchment area: 15km)		(0.402)				
40km radius			0.889*			5.174
(Catchment area: 20km)			(0.453)			
50km radius				0.578**		6.317
(Catchment area: 25km)				(0.268)		
60km radius					0.387**	7.314
(Catchment area: 30km)					(0.187)	
Observations	161	161	161	161	161	

Notes: Regressions in panel A are equivalent specifications to column (5) in Table 4. Regressions in panel B are equivalent specifications to column (6) in Table 4. Across columns different competition measures and marginality instruments are used, but the specifications are otherwise the same. The various rows of each panel represent the first and second stage of the regression using the same "overlap" weighting scheme for constructing the competition measure and instrument described above.

Table C11: Tests of robustness to different measures of political marginality

A. Splitting marginal constituencies into those Labour won and those they lost (in 1997).

	(1)	**(2)**
Dependent variable:	**# Hospitals**	**# Hospitals**
Margin -5% to 5%	7.228***	
(Baseline)	(2.115)	
Margin -5% to 0		4.405**
(Labour just lost)		(2.136)
Margin 0 to 5%		15.921***
(Labour just won)		(4.555)
F-stat	11.68	8.35

B. Excluding (some) marginal constituencies that Labour lost from definition of instrument

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Dependent variable:	**# Hospitals**	**# Hospitals**	**# Hospitals**	**# Hospitals**	**# Hospitals**
Margin -4% to 5%	11.515***				
	(2.528)				
Margin -3% to 5%		12.221***			
		(2.879)			
Margin -2% to 5%			11.662***		
			(3.537)		
Margin -1% to 5%				13.954***	
				(3.611)	
Margin 0 to 5%					16.133***
					(4.538)
F-stat	20.74	18.02	10.87	14.93	12.64

C. Excluding (some) marginal constituencies that Labour won from definition of instrument

Dependent variable:	**# Hospitals**	**# Hospitals**	**# Hospitals**	**# Hospitals**	**# Hospitals**
Margin -5% to 4%	6.017***				
	(1.951)				
Margin -5% to 3%		6.574***			
		(1.903)			
Margin -5% to 2%			7.192***		
			(2.100)		
Margin -5% to 1%				6.667***	
				(2.171)	
Margin -5% to 0					4.646*
					(2.535)
F-stat	9.52	11.94	11.73	9.43	3.36

Notes: These specifications are based around column (5) in Table 4 (column (1) in Panel A reproduces this). Column (2) splits the marginality instrument into Labour wins and Labour losses. Panels B and C use a more narrow window to define marginality for the Labour lost case (Panel B) and the Labour won case (Panel C).

Table C12: A Placebo test - the (absence of an) Effect of Political Marginality on Performance in the Schools Sector

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Number of Schools		Expenditure Per Pupil		Exams results: Proportion With 5 GCSE (A*-C)			Value Added: Key Stage 2 to 4 (improvement between ages 11 and 16)		
Unit of Observation	Local Education Authority (LEA)		School		School			School		
Proportion of Marginal Constituencies	-0.863 (0.922)	-0.599 (0.394)	-0.043 (0.057)	0.032 (0.047)	0.001 (0.017)	-0.011 (0.011)	-0.006 (0.011)	0.529 (0.323)	0.216 (0.260)	0.314 (0.262)
Labour Share of Votes	13.770*** (1.892)	0.617 (0.922)	1.155*** (0.089)	-0.117 (0.153)	-0.251*** (0.021)	-0.026 (0.020)	-0.010 (0.019)	-5.505*** (0.442)	-2.577*** (0.475)	-2.276*** (0.469)
Cohort Size (Unit: 10 pupils)				0.006 (0.006)		-0.009*** (0.001)	-0.008*** (0.001)		-0.142*** (0.021)	-0.133*** (0.021)
School Size (Unit: 100 Pupils)				-0.066*** (0.014)		0.012*** (0.002)	0.013*** (0.002)		0.181*** (0.036)	0.196*** (0.036)
Number of Schools in the LEA							0.007*** (0.001)			0.136*** (0.023)
School-Level Controls	No	No	No	Yes	No	Yes	Yes	No	Yes	Yes
LEA-Level Controls	No	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes
Observations	300	300	2782	2782	2782	2782	2782	2782	2782	2782

Notes: *** Indicates significance at the 1% level; ** significance at 5%, * significance at 10%. A political constituency is defined as marginal if Labour won/was lagging behind by less than 5% in the 1997 General Election (proportion of marginal constituencies is based on all constituencies within in the catchment area, i.e. within the local authority). The Labour share of votes is the absolute share obtained by the Governing party in the 1997 UK General Election averaged over all constituencies in the catchment area. All columns include controls for the Labour share of votes. "School-level controls" include the fraction of pupils with a free school meal, male pupils, non-white pupils, and pupils with special education needs (severe and less severe). "LEA-level controls" include the proportion of pupils in private and selective schools, total population and population density.

Table C13: The influence of performance on the probability of closure

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	**Closure Dummy**	**Closure Dummy**	**Closure Dummy**	**Closure Dummy**	**Closure Dummy**	**Closure Dummy**
Marginality	-0.894**	-0.878**	-0.900**	-0.912**	-0.958**	-0.884**
	(0.359)	(0.367)	(0.412)	(0.361)	(0.406)	(0.365)
Size		-0.036**			-0.037	-0.036**
		(0.015)			(0.031)	(0.016)
Teaching Dummy		-0.048			0.005	-0.053
		(0.138)			(0.167)	(0.146)
Specialist Dummy		-0.454**			-0.798***	-0.465**
		(0.191)			(0.168)	(0.190)
AMI Mortality Rate			-0.006		-0.010	
			(0.009)		(0.009)	
Average Length of Stay				-0.009		0.003
				(0.019)		(0.021)
Observations	212	212	179	211	179	211

Notes: *** Indicates significance at the 1% level; ** significance at 5%, * significance at 10%. Column (1) is the same specification as column (4) of Table 3. Size measured by FCE (Finished Consultant Episodes in 10,000s). Columns (3) and (5) control for the total number of AMI admissions. The number of observations differs slightly as we do not have data on the two performance measures in 1997 for all hospitals in the sample.