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The effect of changing the number of elective hospital admissions on the levels of emergency provision

Sergi Jimenez-Martin, Catia Nicodemo, and Stuart Redding

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Sergi Jimenez-Martin, Universitat Pompeu Fabra, Barcelona GSE and FEDEA

Catia Nicodemo CHSEO, University of Oxford

Stuart Redding CHSEO, University of Oxford

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Abstract

In England as elsewhere, policy makers are trying to reduce the pressure on costs caused by rising hospital admissions by encouraging GPs to refer less patients to hospital specialists. This could have an impact on elective treatment levels, particularly procedures for conditions which are not life-threatening and can be delayed or perhaps withheld entirely. This study attempts to identify the potential consequences on levels of emergency treatment if elective care is managed downwards. Using administrative data from Hospital Episode Statistics (HES) in England we estimate dynamic fixed effects panel data models for emergency admissions at Primary Care Trust and Hospital Trust levels for the years 2004–13, controlling for a group of area-specific characteristics and other secondary care variables. We find that increasing levels of elective care tends to increase the future requirement for emergency treatment. While there is no guarantee that the positive correlation between emergency and elective activity will persist if policy is effective in reducing levels of elective treatment, it does suggest that the cost-saving benefits to the NHS from reducing elective treatment may not be as great in aggregate as anticipated.

Keywords: Health care services, elective and emergency hospital admissions, secondary care, NHS, dynamic panel data

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JEL code: I11, I 18, C30, C33

1 Introduction

Successive Labour Governments funded exceptional growth in UK health spending at an average of 6.4% per annum between 1996/7 and 2009/10 (IFS, 2012), and while growth has stalled in more recent years (IFS 2015), publically funded healthcare spending in England has, overall, been protected from recent austerity measures. However, the NHS is under pressure to improve efficiency and to avoid over-spending, as the National Health Service (NHS) planning document "Everyone Counts: Planning for Patients 2013/14" explains. This efficiency drive could have an impact on treatment levels, particularly elective procedures when patients' conditions are not life-threatening, and operations can be delayed or perhaps withheld entirely if the NHS wishes to redeploy resources to more urgent settings. This study attempts to find a way of identifying the potential consequences on levels of emergency treatment when there are changes to the levels of elective care. A specific policy concern is that if emergency care increases when elective care is reduced, cost-savings achieved by the NHS might not be as significant as the recent efficiency-pursuing policies intend.

In the decade to 2011/12 hospital admissions in England increased by 35.4% (HSCIC, 2012). This high growth was seen in both emergency and elective care, with 1.3m (34.6%) extra emergency admissions and 2.6m (35.7%) extra elective admissions[1]. Several explanations have been proposed for the growth in hospital admissions. They include an increase in illness and frailty linked to the aging population (Blatchford & Capewell, 1997; Gillam, 2010, Poteliakhoff & Thompson 2011); increased ability to detect and treat illness (Hobbs, 1995); the effects of incentives in the tariff model of paying hospitals (Farrar et. al., 2009; Information Centre, 2009a); the creation of Independent Sector Treatment Centres (ISTCs) to perform procedures on NHS-funded patients (Naylor & Gregory, 2009); and "targets" to reduce patients' waiting times for both elective and emergency care. The working practices of GPs have changed, notably the new 'out-of-hours' services (Coast et. al., 1995; Kendall, 2009; Silby et. al., 2007; West, 2010), and this may also have contributed to admissions.

The main objective of this paper is to study the relationship between emergency and elective at hospital and local level using a dynamic fixed-effect panel data model. Work studying the interaction between emergency and elective care has been limited but many studies have

[1] http://content.digital.nhs.uk/article/2021/Website-Search?q=title%3a%22Hospital+Episode+Statistics%2c+Admitted+patient+care+-+England%22+or+title%3a%22Hospital+Admitted+Patient+Care+Activity%22&sort=Relevance&size=10&page=2&area=both#top

looked at elective and emergency activity levels separately. The Nuffield Trust has several reports on this topic. Recent work on emergency admissions (Blunt et. al. 2010) shows that the number of emergency admissions has been rising for some time, in part due to a reduction in the clinical threshold before deciding to admit. Smith et. al. (2014) show that elective admissions are also increasing rapidly and that pressure on hospital resources is likely to continue into the next decade unless more efficient and innovative ways of treating patients can be implemented. Freeman et. al. (2016) is one paper that looks jointly at emergency and elective care, considering the impact of scale in both emergency and elective admissions on hospital costs using a large-scale panel dataset from English hospitals. They find that increasing elective admissions leads to higher costs for emergencies, but increasing emergency admissions does not increase costs for elective admissions.

One reason for the lack of literature studying the interaction between aggregate levels of emergency and elective care is that most shocks affecting demand and supply in healthcare are likely to impact on both types of care simultaneously, making it difficult to identify any causal relationship between the two. We attempt to overcome this by estimating dynamic fixed effects panel data models for emergency admissions at PCT (Primary Care Trust) and NHS Hospital Trust level, showing the impact of elective changes on future levels of emergency care.

Using data from Hospital Episode Statistics (HES) and data on factors that have been found to affect the supply and demand for healthcare in other research (including age of the population, disease prevalences, the numbers of GPs and specialists), we create a panel data set for the years 2004-2013 that we use to estimate how changes in elective activity affected levels of emergency treatment. Our empirical strategy is to estimate dynamic fixed effects panel data models for emergency admissions at PCT and Trust level, controlling for a group of area-specific characteristics and other secondary care variables.

We find that reducing elective care can increase the future requirement for emergency treatment. The results show a clear dynamic effect at the Hospital Trust and the PCT level. The coefficient of lagged emergencies is always significant and positive at the one percent level. The (elasticity) coefficient of the lagged elective admissions is always negative. We also find that the levels of elective activity in Independent Sector Treatment Centres (ISTCs) do not appear to significantly affect emergency admissions.

We are studying a timeframe during which resources available for hospitals were growing with the increase in admissions, but increasing workloads of nurses has been found to increase the chance of patient mortality in US hospitals (Needleman et. al. 2011). Evidence from Germany suggests that the increased risk occurs once occupation levels reach a certain threshold, when staff come under greater risk of making mistakes (Kuntz et. al. 2014). In times of greater workload, longer length of stay for patients has been noted (Berry Jakeker & Tucker 2013, Batt & Terwiesch 2012). These issues are likely to become more important in the NHS as pressure on resources grows.

The rest of the paper is structured as follows. Section 2 explains possible ways in which hospitals and patients could behave when there is a supply side shock to elective care and the ways in which this may impact on the markets for emergency care. Section 3 presents information about recent policy changes. Section 4 details the dataset, then section 5 explains the approach used in the econometric analysis. Section 6 provides results. Section 7 discusses the policy implications and concludes.

2 Supply and Demand processes which could affect hospital admissions

This paper looks at the impact of changes in elective activity on emergency admission rates. In this section, we consider the processes that may occur – changes in elective activity could affect i) the demand for emergency care from patients or ii) the supply of emergency care by hospitals, or a combination of both.

There are two opposing ways in which demand for emergency treatment may be affected by a change in elective activity. Firstly, the two types of hospital activity may be substitutes. Not performing an elective procedure may cause the patient's condition to deteriorate to the stage where emergency treatment is required. For example, not performing an elective hip replacement increases the risk of a patient suffering a fall and thus requiring emergency treatment. If the two types of hospital treatment are substitutes, increasing elective provision would mean less emergency treatment is required by patients. Alternatively, emergency and elective activity could be complements. This may be true if elective procedures cause complications for patients that later require further treatment in an emergency setting. It is likely that there are some conditions for which there are elective and emergency procedures that are substitutes and some for which elective and emergency procedures act as complements. Depending on which of these effects dominates, aggregate demand for emergency care could go up or down because of increased elective provision.

Since the incremental introduction of Payment by Results (PbR) in the last decade, NHS hospitals are paid for the activity that they perform rather than receiving lump-sum income on a per-capita basis. Traditional economic theory proposes that the marginal profit will be equalised across both types of care – if not, hospitals could potentially increase their profits by switching from the less lucrative service to the more financially beneficial type of healthcare. Thus, if there are additional hospital resources available, even if superficially described as “elective”, it is likely that the thresholds for both emergency and elective admissions will be relaxed, with some of the additional resources made available for emergency admissions. This would mean that emergency and elective activity levels move in the same direction after a change in resources.

3 Major Policy Changes in the NHS in England

During the time period studied in this paper, there were several Government policies and initiatives that could have changed incentives and behaviour of both patients and hospitals, in the supply and demand of healthcare in the NHS. The most important policies are explained in more detail in this section.

Arguably the most fundamental change was in the way that hospitals were funded, with a move from a block-grant system to one in which a prospective payment tariff (PPT) system is used to pay hospitals at set rates for the procedures and services they provide. This scheme, introduced from 2004, in connection with increased freedom for patients to decide where they were treated (Patient Choice), allowed funds to follow patients and was designed to create competition between hospitals and reward high performers. Private providers were also encouraged to treat NHS patients, providing they do so at the agreed PPT price. This effectively increased competition within the NHS and the capacity available for elective care. See Dixon et. al. (2010) for a thorough explanation of the policy and its consequences.

A policy announced in 2002 gave greater independence to high performing Hospital Trusts with the introduction of “Foundation Trusts”, and the first Trusts were awarded their new status in 2004. Hospital Trusts who met certain standards were allowed more flexibility in their governance structures, were given increased freedom to operate with less supervision from the Department of Health, and also the ability to raise money from non-NHS patients, as they became more accountable to local communities rather than central Government. One significant part of this policy was the opportunity to retain any operating surplus to invest in local projects rather than return to central funds. This may have increased the incentive to be more efficient.

There was also significant emphasis on trying to reduce waiting times in NHS hospitals, with several phases of policy introduced by the Labour Government attempting to impact on emergency, elective and specialist treatment (Harrison and Appleby 2005, 2009). These policies did have some success (Thompson 2015), although providers have more recently struggled to meet the targets.[2] Waiting lists were not consistent across England and so the consequences of these policies are likely to vary for individual PCTs and Hospital Trusts.

ISTCs were originally conceived in the NHS Plan 2000, to help reduce pressure on waiting times in PCTs by establishing contracts and sites with private sector providers to offer additional capacity for elective procedures, paid for by the NHS. The first ISTC opened in 2003 and was followed by 24 other fixed-site centres, plus two additional mobile facilities as “Wave 1” of the ISTC project. There were nine further centres created in “Wave 2”, 2005-6. In this work we consider also the effects of Wave 1 ISTCs. Wave 1 ISTCs performed a discrete role in a specific type of procedures, namely hips, knees, cataract and varicose veins, and these contracts have now finished. A map showing their locations is presented in Appendix 2. Wave 2 had wider scope and was still operational at the end of 2013. There has been great debate about the merits of the scheme, the costs incurred and its achievements. Work by King’s Fund (2009) and Chard et al (2011) cover these issues. Regardless of their other consequences, ISTCs treated patients who would otherwise have joined waiting lists at existing providers, and their introduction can therefore be seen as a positive shock to the supply of elective healthcare.

Most of these policies can be seen as positive supply shocks in elective care, increasing the resources available for, and incentives to, supply more elective care in hospitals. As discussed in section 2, there are reasons to expect that there is likely to be some spillover into the emergency sector, and that hospitals will also provide more emergency care. It is not clear how patient demand will be affected, and therefore whether emergency or elective activity in aggregate move in the same or a different direction is unclear.

4 Data

[2] http://www.bbc.co.uk/news/health-40162249

This paper looks at the impact of changes in elective activity on emergency admission rates. To do this, emergency activity at PCT level is modelled as a function of several demographic and supply side factors, using panel data for the years 2004 to 2013.

The main source of data is Hospital Episode Statistics (HES), which provides information concerning all inpatients and outpatients admitted to NHS hospitals from 1989-90 onwards. It includes those resident outside England and private patients who were treated in NHS hospitals, and care delivered by Treatment Centres (including those in the independent sector). We consider all admissions, including day cases, for patients admitted as emergency or elective. We exclude maternity-related admissions. Each patient record contains detailed information about the treatment, on clinical issues and additional administrative data, plus patient characteristics such as age, location, gender etc. The dependent variables we estimate are emergency admissions per one hundred thousand of population at PCT and Trust level.

Anonymous patient records are extracted by financial year (1 April to 31 March) and aggregated at PCT and Hospital Trust level. The PCTs were characterised by their boundaries as at 2011. From 1st October 2006, 303 PCTs merged into 151 PCTs and then into Clinical Commissioning Groups (CCGs) on 1st April 2013. For the years considered (2004–2013), there were 151 PCTs in England and 230 Hospital Trusts.

Emergency and elective admissions are likely to depend on population morbidity, so it is important to control for prevalence of specific conditions. The Quality and Outcomes Framework (QOF) provides valuable clinical information concerning prevalence for twenty-two specific diseases in 2013, which will influence the demand for hospital admissions. QOF is a system to remunerate general practices for providing good quality care to their patients, and to help fund work to further improve the quality of health care delivered. Prevalence data are used within QOF to calculate points and payments within each of the clinical domain areas, and provides a snapshot of the number of ill patients on the practice register, as a proportion of the total number of patients registered at the practice. The QOF prevalences used in our analysis are the raw prevalence rates for four conditions, which means no account is taken of differences between populations in terms of their age or gender profiles, or other factors that influence the prevalence of health conditions. The specific conditions used are: Stroke and Transient Ischaemic Attack, Chronic Obstructive Pulmonary Disease, Epilepsy and Cancer. The data on prevalence of the clinical conditions is grouped at PCT level. The data cover almost all GP practices in England, and are extracted from disease registers submitted to the national Quality Management and Analysis System (QMAS).

We use ONS mid-year population estimates to calculate PCT populations, and these data are linked to those of individual characteristics – such as the percentage by age (male population over 65; female population over 60) and gender.

We also include measures that characterise the supply of NHS services namely the number of specialists per one thousand population and the number of hospitals at PCT level.

Table 1 provides a summary description of the variables used to study the period 2004–2013. This Table consists of four sections: activity data, demographic data, the prevalence of specific diseases and variables identifying supply. Activity data shows the dependent variable (*emergency activity*) and our main explanatory variables (*elective activity and elective activity in ISTCs*).

Figure 1 shows the trends of emergency and elective admissions, with the trend of admissions at ISTCs also presented. We observe that after 2008 the increase in both emergency and elective admissions was substantial. Emergency and elective admissions were constant in 2004–2008, and 2009–2014, but there was a big leap between 2008 and 2009. Elective admissions in ISTCs increased steadily across years. Emergency and elective admission rates at Trust level per 100,000 population are illustrated in Figure 2. These series increased steadily between 2004–2009 before a brief decrease for two years but began to increase again in 2012 and 2013.

Figure 3 presents the simple correlations of emergency and elective activity rates by year for all years included in this study. These charts, which control for the different sized populations in PCTs, suggest that the two series are positively correlated, and that areas which experienced higher elective admission rates also had higher emergency admission rates. This could be caused by several factors, such as the demographic characteristics of the local population.

5 Empirical strategy

Our empirical strategy is to estimate dynamic fixed effects panel data models for emergency admissions, controlling for a group of area-specific characteristics and other secondary care variables, plus a selection of variables intended to show the influence of ISTCs, at Hospital

Trust level and then PCT level. This will produce reduced form versions of the model of hospital activity because it is not possible to estimate supply and demand separately. Given that, we estimate the following model:

$$E_{ijt} = \beta_1 E_{ijt-1} + \beta_2 EL_{ijt-1} + \beta_3 G(ISTC_{jt}) + \beta_3 X_{jt} + \beta_4 Supp_{jt} + \sigma_j + \mu_t + \varepsilon_{jt} \qquad (1)$$

where E_{it} represents the number (in logs) of emergency admissions in (public) Trust i belonging to PCT_j in each year t. Apart from the dynamic component, the key explanatory variables that capture elective admissions are the number (in logs) of elective admissions in (public) Trust i and a function, G(.) of the number elective admissions to ISTCs in PCT_j in year t. X_{jt} is a vector of socio-economic characteristics that are time-varying at the PCT_j level in time t, including the local population percentages of genders, ages and diseases. To avoid the possibility of the endogenous recording of conditions following hospital admission, we use prevalence data for the year prior to that of the year of study for hospital admissions. β is a vector of the slope effects of these variables. $Supp_{jt}$ is a matrix of variables that characterise supply-side aspects of healthcare. We include the per capita number of specialists as well as the per capita number of hospitals (see the descriptive statistics section for further details). Finally, we control for time with year effects (μ_t), PCT with fixed effects (σ_j) and ε_{jt} is a random error term which is assumed to be normally distributed with a variance that is allowed to vary across trusts.

In order to specify the G function we consider two specification options: i) $EListc_{jt}$ which represents the log number of elective admissions at ISTCs for patients from PCT_j in time t; and ii) a dummy variable ELD_{jt}, which equals 1 if PCT j had any patients treated by an ISTC in year t, and 0 if the PCT had no patients treated in an ISTC that year. In addition to this, we allow for structural changes after the introduction of an ISTC in a given PCT by interacting the (log) lagged emergencies, E_{ijt-1}, and the (log) lagged elective admissions, EL_{ijt-1}, at the trust with the ELD_j dummy.

To account for the possibility that behaviour of trusts at the PCT level are not (fully) independent we also analyse the model aggregating data at the PCT level. Thus, we alternatively consider the following model:

$$E_{jt} = \beta_1 E_{jt-1} + \beta_2 EL_{jt-1} + \beta_3 G(ISTC_{jt}) + \beta_3 X_{jt} + \beta_4 Supp_{jt} + \sigma_j + \mu_t + \varepsilon_{jt} \qquad (2)$$

Given the dynamic nature of the model and the possibility that *EL* is predetermined, we estimate the model using the Arellano and Bond (AB, 1991) first differences GMM-IV estimator. As has been shown by Jimenez-Martin and Labeaga (2016), the AB method is consistent even in presence of selection due to sample selection, attrition or merger processes. In our model all lags dated *t-2* and backwards are potential instruments for the predetermined variables. The rest of the variables are considered strictly exogenous and are introduced in the regressions as standard IV instruments. We report two-stage robust standard errors throughout.

6 Results

6.1 Results using Trust level data

Table 2 presents results for the estimated specifications of equation (1) using data at Trust level. The first three columns present results in which the effect of ISTCs is proxied with a dummy variable (*ELD*), while the other columns present results using the per capita number of elective interventions (*EListc*). Columns (1) and (4) present the basic specification with socio-economic and supply side controls, while columns (2) and (3) (and 5 and 6) add interactions of the basic variables at the Trust level (lagged emergencies and elective admissions) with the *ELD* dummy. The only difference between columns (2) and (3) lies in the set of instruments for interactions: they are not instrumented in column (2), while they are instrumented by means of GMM instruments in (3). All specifications pass the standard dynamic panel specification test (the Hansen–Sargan test of validity of instruments and the second order serial correlation test of Arellano and Bond (1991)) at the 5 per cent confidence level.

The results regarding the lagged variables at Trust level are very clear and stable across specifications, implying a clear dynamic effect. The coefficient of lagged emergencies is estimated between 0.47 and 0.58 and it is always significant at the one percent level. Alternatively, the (elasticity) coefficient of the lagged elective admissions is always found to be negative, between -0.17 and -0.26, but is only significant at the 10 percent level. These values suggest that a hundred elective admissions in the previous year can be expected to reduce emergencies by between 17 and 26.

In order to check possible complementarity between emergency and hospital admissions we estimate a similar model with the current level of elective admissions as the dependent variable instead of the current level of emergency admissions. We find that the only significant driver is the lagged (log) number of elective admission at the Trust level (with a coefficient always between 0.6 and 0.7). In particular the lagged number of emergencies is never found significant (neither alone or interacted with the *ELD* dummy). Thus, we do not find strong evidence of complementarities.[3]

In general we do not find important (significant) direct effects of the variables related to ISTC elective admissions (the *ELD* dummy has the correct sign and significant at the 10 percent only once and the *EListc* variable is not significant). However, we find interesting effects of their interaction with the Trust level variables, although they are only significant in the specification in which they are not instrumented. In this specification the estimated effects are found to partially (in the case of emergencies) or fully (in the case of elective care) balance the effects found in the specifications without interactions. That is, the interaction with the lagged emergencies is negative, partially compensating the dynamic coefficients, and the interaction with lagged electives is positive, practically compensating the dynamic component.

As regards the demographics, in general we find non-significant effects in all the specifications. Finally, the coefficients of the supply factors are found to have the expected signs. In particular, the hospital per capita variable is found significant in the non-instrumented interaction specifications (columns (2) and (5)).

6.2 Results using PCT level data

In this section we evaluate the model at the PCT level. The results obtained regarding the key coefficients of the model at this level of aggregation will allow us to assess whether decisions are taken at the trust (hospital) or the PCT level.

Table 3 shows the results for the estimated specifications of equation (2) using data aggregated at the PCT level. As in Table 2, the first three columns present results in which the effect of independent elective centres is proxied with a dummy (*ELD*) while the rest present results using the per capita number of elective interventions (*EListc*). Columns (1) and (4) present the basic specification with socio-economic and supply side controls, while columns (2) and (3) (and 5 and 6) add interactions of the basic variables at the trust level (lagged emergencies and elective admissions) with the *ELD* dummy. As in the previous case,

[3] Results from these experiments are not reported but are available upon request.

all the specifications (with the exception of column 5) pass the standard dynamic panel specification test at the 5 per cent confidence level.

Aggregating the Trust variables at the PCT level has strong implications in the results of the model. In the autoregressive part of the model we find that only elective admissions are significant at the five per cent level and have the expected sign. The implied elasticity is between -13 percent and -36 percent. This means that a hundred additional elective admissions in the previous year reduce emergencies by between 13 and 36. The coefficient of the lagged emergencies is not significant. However, a pseudo Wall test cannot reject that the coefficients of elective admission and lagged emergencies are equal to those estimated at the Trust level. This may imply that the relevant decision level is the Trust.

As regards the variables related to ISTC elective admissions, both of them show the correct (expected sign), but in neither case are they significant. The same happens with the interaction terms, which are not found to be significant in any specification.

As in the previous specifications, the demographics coefficients are always non-significant. Finally, the supply factors are found to have the expected signs. As in the previous case the hospital per capita variable is the stronger factor, but is never found to be significant at the five per cent level.

7 Discussion and Conclusions

There is significant pressure on the NHS in England to control expenditure at a time when the public purse is being restricted. This is likely to impact on all aspects of healthcare, but particularly those elective treatments which are for conditions that are not life-threatening and can be delayed or withheld entirely if resources are severely limited. We find, using a panel data model for emergency admissions at PCT and Trust level, that there appears to be a negative correlation between elective activity within hospitals and future emergency activity – i.e. reducing elective activity will likely lead to patients requiring emergency treatment in the future. This presents a problem for policy makers, as it means cost-saving measures that target elective hospital care are unlikely to reap the benefits in aggregate that they had hoped for. It becomes increasingly important for practitioners and policy makers to be as efficient as possible, making sure that where possible patients are treated in primary care settings and focusing specialist referrals on to patients who stand to gain the most to limit the number who require emergency care.

There are other factors to consider. Firstly, this result comes from studying a timeframe that mostly saw large increases in elective and emergency activity, and also funding. Work stemming from that of Evans (1999) has suggested that health care tends to experience a large amount of supply induced demand, where the demand for treatment tends to fill the available capacity. Given the situation recently experienced with large increases in supply, it does not necessarily follow that in times where capacity is restrained, such as those we are currently experiencing, that emergency demand will go up in response to less available elective provision.

A second issue is that we only consider aggregate emergency and elective treatment. A more disaggregated study may be able to identify conditions for which reducing elective care will not create a problem for emergency departments.

Even without further work, the results presented here suggest that this is a complex problem and that reducing elective care is likely to have unanticipated consequences for other areas of the NHS that could require costly solutions.

Table 1: Descriptive Statistics at Trust level

Variable	**Mean**	**Std. Dev.**
Elective admissions per 100k pop at Trust level	9465.72	10213.55
Emergency admissions per 100k pop at Trust level	7175.06	7968.25
Elective ISTC admissions per 100k pop at Trust level	417.94	1161.55
Population at PCT level	423746.60	242254.80
Male population >65 (%) at PCT	5.47	2.96
Female population >60 (%) at PCT	9.31	5.08
Female population (%) at PCT	40.78	20.05
Stroke per 1,000 population at PCT	1587.98	3836.10
Pulmonary Obstruction per 1,000 population at PCT	1600.45	3721.28
Epilepsy per 1,000 population at PCT	570.89	1330.77
Cancer per 1,000 population at PCT	1895.45	4703.05
Specialists per 1,000 population at PCT	1.05	0.87
Average Hospitals per 1,000 population at PCT	0.01	0.01
Total Obs.	2254	

Figure 1: Emergency and Elective Admissions, 2004–2013

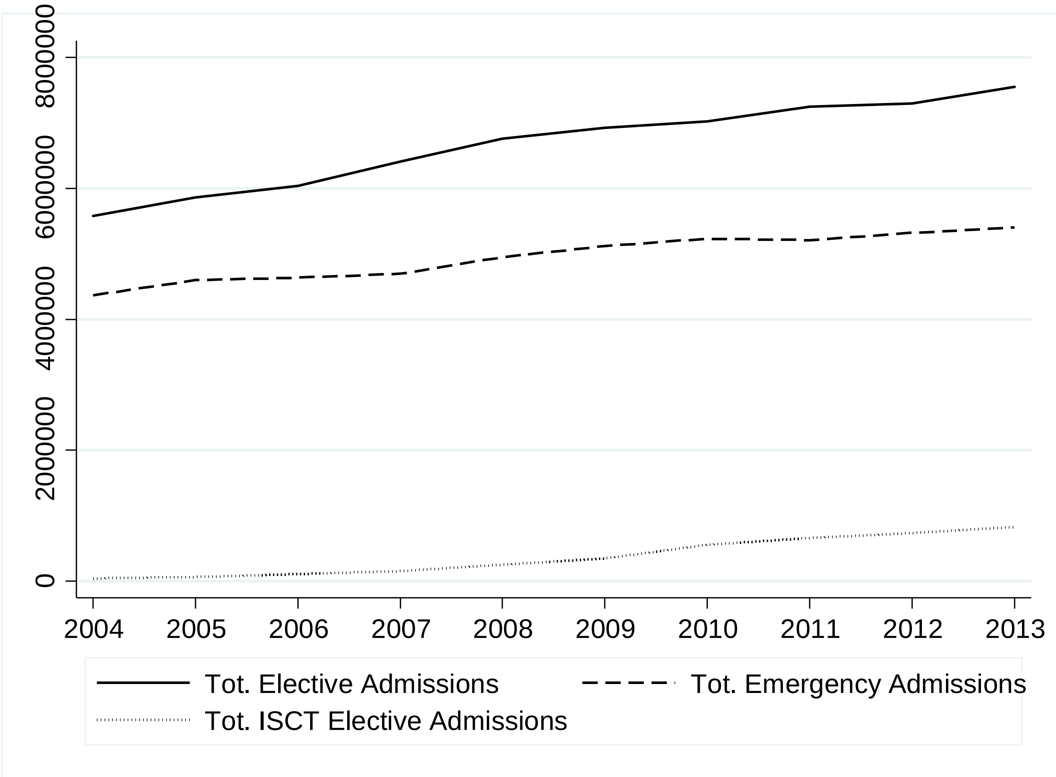

Figure 2: Emergency and Elective Admissions at Trust level per 100k population, 2004–2013

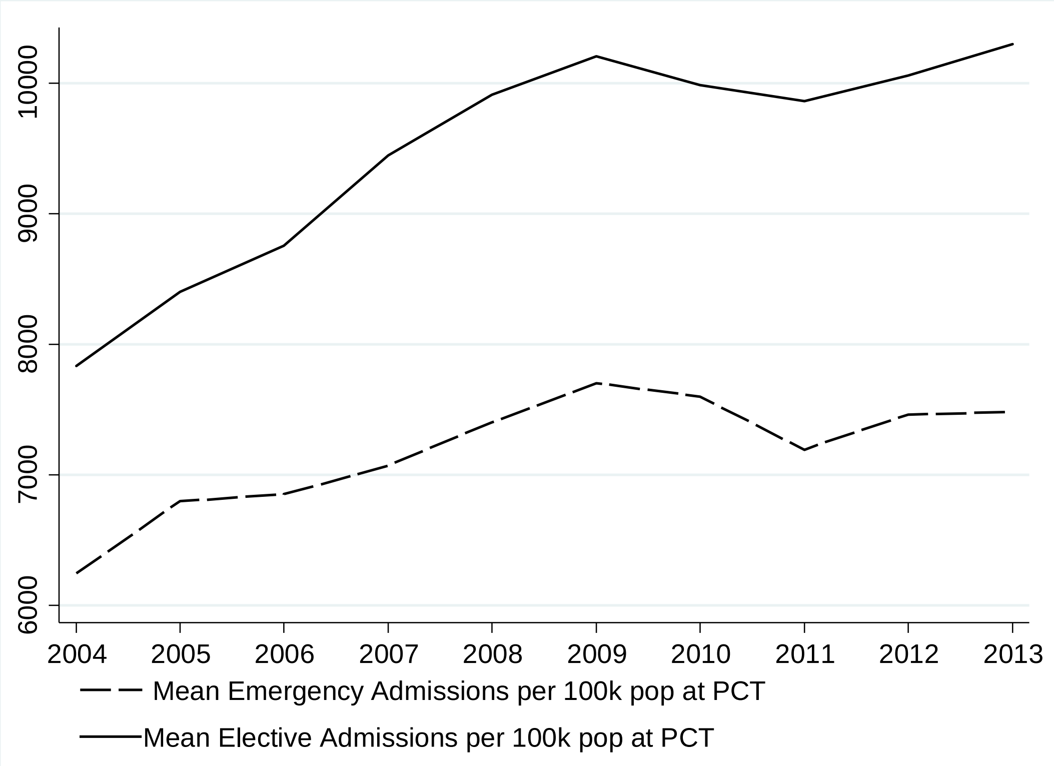

Figure 3: Correlation Plot of Emergency and Elective Activity by Year

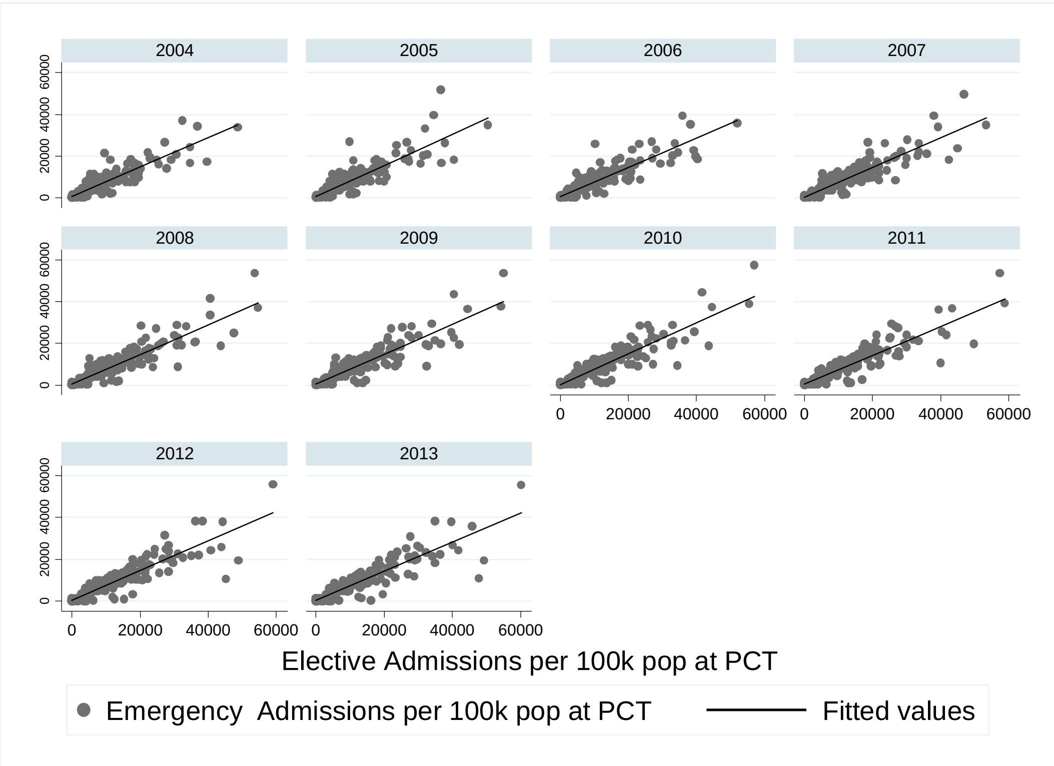

Table 2: Log emergencies Trust Level specifications (239 trusts). Arellano-Bond estimator. 2004–2013.

	(1)	(2)	(3)	(4)	(5)	(6)
E_{ijt-1}	0.47085***	0.58214***	0.49662***	0.47007***	0.57145***	0.49580***
	(3.16435)	(3.05729)	(3.10856)	(3.16468)	(3.19410)	(3.11003)
EL_{ijt-1}	-0.16964	-0.23003*	-0.25578**	-0.16753	-0.25769*	-0.25427**
	(1.60632)	(1.71542)	(2.50508)	(1.58748)	(1.92728)	(2.49233)
E_{ij-1}*ELD		-0.2800***	-0.10237		-0.26096***	-0.10225
		(-2.63293)	(-1.42220)		(-2.78942)	(-1.42249)
EL_{ijt-1}*ELD		0.22093**	0.10023		0.22837***	0.10030
		(2.46205)	(1.42233)		(2.68860)	(1.42297)
ELD	0.01675	-0.12637*	0.01292			
	(1.22272)	(-1.72244)	(1.04153)			
$EListc_{it}$				0.00302	-0.00508	0.00222
				(1.12508)	(-1.24896)	(0.92502)
Stroke per 1k pop at PCT	0.00014	0.01527	-0.00579	0.00052	-0.00377	-0.00532
	(0.00669)	(0.44874)	(-0.24464)	(0.02404)	(-0.12936)	(-0.22553)
Pulm Obs per 1k pop at PCT	-0.00779	-0.00598	-0.00179	-0.00762	-0.00210	-0.00175
	(-0.57497)	(-0.27117)	(-0.12891)	(-0.56863)	(-0.11979)	(-0.12679)
Epilepsy per 1k pop at PCT	-0.00175	-0.01187	-0.00151	-0.00101	-0.00207	-0.00131
	(-0.02834)	(-0.10557)	(-0.02175)	(-0.01613)	(-0.02085)	(-0.01882)
Cancer per 1k pop at PCT	0.00216	-0.01602	0.00112	0.00160	-0.00391	0.00075
	(0.21090)	(-1.13316)	(0.11686)	(0.15585)	(-0.37857)	(0.07849)
% Fem pop>60	-0.01700	0.00833	-0.03100	-0.01753	-0.02452	-0.03167
	(-0.23963)	(0.09411)	(-0.44313)	(-0.24722)	(-0.32594)	(-0.45207)
% Fem pop	-0.00706	-0.00414	-0.00627	-0.00706	-0.00502	-0.00630
	(-1.10890)	(-0.63694)	(-1.00905)	(-1.10957)	(-0.79975)	(-1.01329)
%Male pop >60	0.01640	-0.01018	0.02278	0.01662	0.01485	0.02316
	(0.35314)	(-0.17628)	(0.50144)	(0.35783)	(0.30446)	(0.50878)
Aver. Specialists per 1k pop	0.03103	0.08108	0.02922	0.03013	0.05680	0.02838
	(1.02875)	(1.59321)	(0.95076)	(1.00324)	(1.45427)	(0.92752)
Aver. Hospital per 1k pop	1.02293	1.43432**	0.93655	0.98568	1.21440**	0.90391
	(1.14588)	(2.16179)	(1.17942)	(1.10729)	(2.02540)	(1.13682)
Observations	1,730	1,730	1,730	1,730	1,730	1,730
Hansen	70.52	58.16	75.26	71.29	60.05	75.34
Hansen_df	50	50	64	50	50	64
Hansen p	0.0295	0.200	0.158	0.0256	0.156	0.157
m1	-2.308	-2.161	-2.273	-2.306	-2.212	-2.272
m2	0.639	-0.385	0.573	0.638	0.395	0.573

Robust z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.10. Time dummies are present in the specification but omitted from the table. GMM Instruments: lags (2,5) of E_{ijt-1} and EL_{ijt-1} in all columns; lags (2,2) of E_{ijt-1}*ELD and EL_{ijt-1}*ELD in columns (2) and (5). In the rest of the cases we use standard IV instruments. All the specifications pass the standard specification test.

Table 3: Log emergencies PCT Level specifications (133 PCT). Arellano-Bond estimator. 2004-2013.

	(1)	(2)	(3)	(4)	(5)	(6)
$\boldsymbol{E_{ijt-1}}$	0.26518	-0.01882	-0.03324	0.25706	0.24870	-0.03813
	(1.58953)	(-0.05571)	(-0.10579)	(1.50513)	(1.37429)	(-0.12164)
$\boldsymbol{EL_{ijt-1}}$	-0.12586**	-0.35985**	-0.21684***	-0.12799**	-0.13724**	-0.22018***
	(-2.41244)	(-2.12944)	(-2.58846)	(-2.42646)	(-2.48915)	(-2.60214)
$\boldsymbol{E_{ij-1}}$***ELD**		0.04226	-0.00992		0.03357	-0.00907
		(0.80046)	(-0.31745)		(0.62726)	(-0.29005)
$\boldsymbol{EL_{ijt-1}}$***ELD**		-0.05569	0.00813		-0.03600	0.00693
		(-0.97923)	(0.25644)		(-0.69379)	(0.21751)
ELD	-0.03547	-0.05122	-0.02246			
	(-1.32002)	(-1.25789)	(-1.34470)			
$\boldsymbol{EListc_{jt}}$				-0.00147	-0.00232	-0.00117
				(-1.07736)	(-1.45225)	(-0.85507)
Stroke per 1k pop at PCT	0.00632	0.00347	0.01048	0.00510	0.00796	0.00994
	(0.24206)	(0.16783)	(0.54968)	(0.19696)	(0.30883)	(0.51297)
Pulm Obs per 1k pop at PCT	-0.01402	-0.00646	-0.01410	-0.01377	-0.01386	-0.01404
	(-1.39885)	(-0.58530)	(-1.45087)	(-1.40388)	(-1.32932)	(-1.44299)
Epilepsy per 1k pop at PCT	0.01362	0.01188	0.00979	0.01511	0.01366	0.01018
	(0.17970)	(0.17061)	(0.14163)	(0.19848)	(0.18915)	(0.14534)
Cancer per 1k pop at PCT	0.00200	-0.00440	-0.00202	0.00226	0.00032	-0.00183
	(0.21494)	(-0.35299)	(0.17529)	(0.24099)	(0.03204)	(0.15808)
% Fem pop>60	-0.01974	0.01008	-0.01251	-0.01731	-0.01112	-0.01063
	(-0.48969)	(0.17533)	(-0.26952)	(-0.42370)	(-0.24768)	(-0.22460)
% Fem pop	-0.00524	-0.00641	-0.00560	-0.00512	-0.00505	-0.00549
	(-1.32783)	(-1.16062)	(-1.13699)	(-1.30488)	(-1.27543)	(-1.11831)
%Male pop >60	0.01990	-0.00252	0.01212	0.01809	0.01327	0.01062
	(0.74000)	(-0.06620)	(0.38671)	(0.66365)	(0.44267)	(0.33128)
Aver. Specialists per 1k pop	0.06007	0.07212	0.06289	0.05965	0.06305	0.06295
	(0.90138)	(1.13870)	(0.98598)	(0.89077)	(0.92949)	(0.97970)
Aver. Hospital per 1k pop	-0.47441*	-0.57817	-0.60285*	-0.44419*	-0.38262	-0.57195*
	(-1.84004)	(-1.44792)	(-1.90025)	(-1.72701)	(-1.48046)	(-1.77635)
Observations	1,019	1,019	1,019	1,019	1,019	1,019
Hansen	57.42	53.55	74.05	56.73	70.13	72.10
Hansen df	50	50	64	50	50	64
Hansen p	0.219	0.340	0.183	0.239	0.0316	0.228
m1	-1.256	-0.0487	-0.000855	-1.224	-1.198	0.00455
m2	-0.331	-1.011	-0.811	-0.267	0.136	-0.777

Robust z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.10. Time dummies are present in the specification but omitted from the table. GMM Instruments: lags (2,5) of E_{ijt-1} and EL_{ijt-1} in all columns; lags (2,2) of E_{ijt-1}*ELD and EL_{ijt-1}*ELD in columns (2) and (5). In the rest of the cases we use standard IV instruments. All the specifications pass the standard specification test.

References

Bloom N, Propper C, Seiler S, Van Reenen J. The impact of competition on management quality: Evidence from public hospitals. Rev Econ Stud 2015;82:457–89. https://doi.org/10.1093/restud/rdu045

Blunt I, Bardsley M, Dixon J. Trends in Emergency Admissions in England 2004–2009: Is Greater Efficiency Breeding Inefficiency? Research and Policy Studies in Health Services Briefing. London: The Nuffield Trust; 2010.

Chard J, Kuczawski M, Black N, van der Meulen J, POiS Audit Steering Committee. Outcomes of elective surgery undertaken in independent sector treatment centres and NHS providers in England: audit of patient outcomes in surgery. BMJ 2011;343:d6404. http://dx.doi.org/10.1136/bmj.d6404

Cooper Z, Gibbons S, Jones S, McGuire A. Does hospital competition save lives? Evidence from the English NHS patient choice reforms. Econ J 2011;121:F228–60. http://dx.doi.org/10.1111j.1468-0297.2011.02449.x

Cooper Z, Gibbons S, Skellern M. Independent Sector Treatment Centres in the English NHS: Effects on Neighbouring NHS Hospitals. London School of Economics Working Paper. London: Department of Social Policy and Centre for Economic Performance; 2015

Cooper ZN, McGuire A, Jones S, Le Grand J. Equity, waiting times, and NHS reforms: retrospective study. BMJ 2009;339:b3264. http://dx.doi.org/10.1136/bmj.b3264

Dixon A, Appleby J, Robertson R, Burge P, Devlin N, Magee N (2010) Patient choice: How patients choose and how providers respond. The King's Fund. https://www.kingsfund.org.uk/sites/files/kf/Patient-choice-final-report-Kings-Fund-Anna_Dixon-Ruth-Robertson-John-Appleby-Peter-Purge-Nancy-Devlin-Helen-Magee-June-2010.pdf Accessed July 2017

Evans RG. Supplier-Induced Demand: Some Empirical Evidence and Implications. In Pearlman H, editor. The Economics of Health and Medical Care. London: Macmillan; 1974. pp. 162–73. https://doi.org/10.1007/978-1-349-63660-0_10

Freeman M, Savva N and Scholtes S. Economies of Scale and Scope in Hospitals: Evidence of Productivity Spillovers Across Hospital Services. Working paper, September 2016. http://michael-freeman.net/research/articles/hospitalscalescope_sep2016.pdf (accessed July 2017)

Gaynor M, Moreno-Serra R, Propper C. Death by market power: reform, competition, and patient outcomes in the National Health Service. Am Econ J 2013;5:134–66. https://doi.org/10.1257/pol.5.4.134

Harrison A, Appleby J. Reducing waiting times for hospital treatment: lessons from the English NHS. J Health Serv Res Policy 2009;14:168–73. http://dx.doi.org/10.1258/jhsrp.2008.008118

Harrison, A. and Appleby, J., 2005. The War on Waiting for Hospital Treatment: What Has Labour Achieved and what Challenges Remain. King's Fund.

http://www.bbc.co.uk/news/health-40162249. Accessed June 2017.

https://www.ifs.org.uk/tools_and_resources/fiscal_facts/public_spending_survey/health_spending (accessed May 2017)

https://www.nuffieldtrust.org.uk/files/2017-01/nhs-social-care-funding-outlook-2021-22-web-final.pdf (accessed May 2017)

Jaeker, J.B. and Tucker, A.L., 2013. An empirical study of the spillover effects of workload on patient length of stay. Harvard Business School.

Jiménez-Martín S. and Labeaga J.M. (2016), "Monte Carlo evidence on the estimation of AR(1) panel data sample selection models", WP FEDEA 2016-01.Kelman S, Friedman JN. Performance improvement and performance dysfunction: an empirical examination of distortionary impacts of the emergency room wait-time target in the English National Health Service. J Public Adm Res Theory 2009;19:917–46. https://doi.org/10.1093/jopart/mun028

National Audit Office. Emergency Admissions to Hospital: Managing the Demand. London: National Audit Office; 2013. URL: www.nao.org.uk/wp-content/uploads/2013/10/10288-001-Emergency-admissions.pdf (accessed September 2015).

Naylor C, Gregory S. Briefing: Independent Sector Treatment Centres. London: The King's Fund; 2009.

Needleman, J., P. Buerhaus, V. Pankratz. 2011. Nurse Staffing and Inpatient Hospital Mortality. N. Engl. J. Med. 364(11) 1037–1045.

NHS England. Everyone Counts: Planning for Patients 2013/14. URL: www.england.nhs.uk/everyonecounts/ (accessed 7 June 2016).

Patterson J. The effects of nurse to patient ratios. Nurs Times 2011;107:22–5.

Poteliakhoff E, Thompson J. Emergency Bed Use: What the Numbers Tell Us. London: The King's Fund; 2011.

Smith P, McKeon A, Blunt I, Edwards N. NHS Hospitals Under Pressure: Trends in Acute Activity up to 2022. London: The Nuffield Trust; 2014.

Stress on the Ward: Evidence of Safety Tipping Points in Hospitals Kuntz L, Mennicken R, and Scholtes S. Management Science 201561:4 , 754-771

Thompson, J., 2015. What's happening to NHS waiting times? The King's Fund. https://www.kingsfund.org.uk/blog/2015/02/whats-happening-nhs-waiting-times Accessed June 2017.

Appendix: Structure of the NHS during study period

At the time this analysis was performed, the main organisations responsible for the commissioning and providing of secondary care in the NHS were Strategic Health Authorities (SHAs), Primary Care Trusts (PCTs) and Hospital Trusts (including Foundation Trusts).

SHAs were in operation between 2002 and 2013, with their main role to implement policies as directed by the Department of Health.

PCTS were the lead administrative organisations in the NHS. They were provided with budgets from the Department of Health to commission hospital services and mental health services, and to fund general practitioners. They were responsible for the vast majority of NHS spending.

Hospital Trusts are the providers of secondary care in the NHS, and are commissioned to do so by PCTs. Traditionally, Hospital Trusts were directly accountable to the NHS, but Hospital Trusts were encouraged to gain Foundation Trust status in a process started by the Health and Social Care (Community Health and Standards) Act 2003. Hospitals who met certain standards were allowed to have more flexibility in their governance structures, were given increased freedom to operate with less supervision from the Department of Health, and also the ability to raise money from non-NHS patients.

The analysis presented in this paper took place before the reforms introduced in the Health and Social Care Act 2012, which came into effect on April 1st 2013. This replaced Primary Care Trusts with Clinical Commissioning Groups, GP-led organisations that commission hospital services in line with their patients' needs.

Appendix: Independent Sector Treatment Centres

A map showing PCTs in which wave 1 ISTCs were located is presented below. With only 25 ISTCs, the vast majority of PCTs did not receive one of these new facilities. However, the ISTCs were spread widely across England, located from Bodmin (Cornwall) and Portsmouth on the south coast to Tyne and Wear in the north. The one closest to central London was Ilford (Essex), but London was well served by existing NHS hospitals.

Figure 5 Map: Location of ISTCs