Do mergers affect hospital outputs and outcomes? Evidence from the English secondary care sector

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Abstract

There is a substantial amount of literature assessing that hospital mergers will bring improvements in terms of services, performance and quality. We examine whether such improvements hold when we consider different combinations of services and different measures of performance. We examine the impact of mergers on a large set of outputs including inpatient admissions, elective admissions, emergency admissions, outpatients, day cases and various combinations of the above and two different measures of performance. We find some evidence that merging activity positively affects hospital outputs and improves performance. Given that mergers reduce the scope for competition between hospitals the findings suggest that further merger activity may be the appropriate way of dealing with poorly performing hospitals.

Keywords: Hospital mergers, Performance, DID, PSM, Wave analysis, Event study
JEL classification: I11, I13, I18, L32

1. Introduction

Over the past twenty-five years, there have been marked changes in organisational structures and budgetary arrangements in the English National Health Service (NHS) causing, among other things, a widespread merger activity in the hospital sector.

At the beginning of the 90's years, the NHS reform has introduced the idea of competition on the supply-side of the internal healthcare market, to achieve an enhanced quality and choice of services offered and to increase efficiency with which services are delivered. In the regulatory framework endorsed by the Department of Health, a set of guidelines have been introduced. Hospitals freely have chosen how to achieve the main aim. In this context, specialty and services' mergers between hospitals have been a key lever of competition in the healthcare sector. Thus, merger activity has increased in many countries as diverse as the US (Ho and Hamilton, 2000; Town et al., 2006; Radach Spang et al., 2009), Belgium, France, Germany, Ireland, Norway, the Netherlands, Sweden and the UK (Ahgren, 2008; Kjekshus and Hagen, 2007; Kroneman and Siegers, 2004).

In the 2002, a second NHS reform was launched to achieve market benefits that have not been occurred in the 90s' reform, enforcing the idea of efficient use of resources and quality of services provided.

In this context of reforms, we want to investigate whether merging activity has had any significant effect on hospital outputs and outcomes. In particular, we focus our research to understand a) if and how the level of hospital outputs measured by inpatient admissions, elective admissions, emergency admissions, outpatients, day cases and various combinations of the above has improved as a result of hospital merger and b) if and how hospital outcomes measured by a system of hospital performance was enhanced as a result of hospital merger. These questions have obvious policy relevance.

Using data from 2000 to 2008, we investigate how the answers to these questions changed over time, especially after the choice to merge. In particular, we analyse mergers effects on outputs and outcomes by putting in comparison a set of merged Trusts versus non-merged Trusts by using hospital data in England. We investigate on how merged Trusts have been able to reconfigure more significantly their services delivered and have achieved a relative advantage than non-merged Trusts. The industrial economics literature applied to the healthcare market offers several explanations about the driving forces behind merger activity and the impact of mergers on the performance of Trusts. In effect, Trusts may have used mergers as a strategic tool to improve their financial performance through price increases (made possible by increased market power) and/or cost reductions (made possible by either economies of scale and scope, monopsony power or favourable adjustments in the product mix), with important policy implications both in terms of services provided to patients and in terms of an efficient use of available resources.

2. Background

From a theorical point of view, the aim of hospital's mergers has been enhanced efficiency and quality benefits, such as production costs reduction, output's increase, quality improvements and both operating and managerial efficiencies enhancements, reinforcement of financial sustainability, simplification of staff recruitment. Whilst, these benefits were not always achieved. Indeed, for instance, the management savings from NHS mergers have been highly variable and sometimes much lower than expected or they have been more likely to injury finances of trusts than improve them (Fulop et al., 2002; Gaynor et al., 2012), furthermore the process of staff recruitment or retainment has not been made easier after merging process (Fulop et al., 2002).

Thus, a wide empirical literature has investigated on possible consequences of hospital mergers activity in terms of economic and non-economic benefits. Some authors have attributed reconfigurations (either mergers or acquisitions) as possible devices to change the mix of services offered (Krishnan et al., 2004), or as tools to gain efficiency (Dranove, 1998; Preyra and Pink, 2006; Kjekshus and Hagen, 2007; Radach Spang et al., 2009). Other researchers have highlighted the impact of mergers on prices (Radach Spang et al., 2009) or how the type of merging hospital have affected costs (Schmitt, 2017).[1] However, ambiguous results have been gathered about merger process' effects on social welfare (Town et al., 2006) or quality of the services provided (Ho and Hamilton, 2000; Propper et al., 2004), although Bloom et al. (2015) suggest that higher management quality and improvement of performance have derived from higher competition results. Recent studies have also shown that the effect of merger between private hospitals can often produce little benefits, in terms of patient welfare (Gaynor et al., 2012). Additionally, several evidences have highlighted how the impact of competition in markets with fixed prices has led to improvements in hospital performance (Gaynor, 2004 and 2006) or on hospital quality and efficiency (Propper, 2008 and 2012; Bloom et al., 2015).

3. Data

3.1 Data Sources

Our data is longitudinal, available annually for a period of 9 years from 2000 to 2008. It contains information on all acute, specialist and teaching hospitals in England with a unique identifier for each hospital. Our unique dataset combines information from several data sources: administrative data providing information on performance, as well as hospital characteristics, extracted and/or derived from the Hospital Episode Statistics (HES); the Hospital Activity Statistics (HAS); the NHS Foundation Trust Directory; the Medical and Dental Workforce Census (Department of Health), and from individual hospitals' websites.

Our data include 1-year pre-treatment policy (year 2000) and 8 years of data post policy. The dataset contains 1,581 observations for: 195 hospitals in year 2000, 186 in year 2001, 175 in 2002, 172 in years 2003, 2004 and 2005, 171 in 2006 and 169 hospitals in years 2007 and 2008. According to Table 1, the number of hospital providers in England has in fact decreased by 13%, from 195 acute and specialist Trusts in 2000 to 169 in 2008.

[Table 1 about here]

1 According to Schmitt (2017), in fact, mergers between independent hospitals have a small and insignificant effects on costs, "while acquisitions by multihospital system can have larger and significant cost reductions".

3.2 Variable Definitions and Measurements

Dependent variables

We consider different hospital outputs measured by several variables to account for various hospital services provided and their possible combinations. In particular, we consider the following hospital activities: number of inpatient spells, number of elective admissions, number of emergency admissions, number of patients attending the first outpatient appointment, number of patients attending first A&E, number of day cases (day hospital or day surgery).[2] We also consider three more dependent variables built on a selection of the above variables: the proportion of elective and emergency admissions, the share of inpatients over outpatients, and the share of day cases over elective admissions. These extra variables will be used to assess if and how hospital mergers alter the combination of services provided. As Trusts differ mostly in the amount of services provided, rather than the decision to provide as service at all, we will focus here on the intensive margin of the degree of providing a service, which we will measure by a log-transformation of the dependent variables.

In order to assess the effect of hospital mergers on outcome, we also consider two different measure of hospital performance, built combining the star rating performance index with either the quality of services index or the use of resources index.[3]

Policy variables

To assess the impact of the reorganizational change due to hospital merger on our output measures, we construct a dummy variable for hospital merger status. Specifically, the variable *merged* equals 1 if the hospital is the result of a merger in a given year, and it is zero otherwise. In addition, we also run specifications in which we use *merged_forward* that is equal to 1 in the year the new merged hospital starts its activity and subsequent years, and zero otherwise.

We also include another policy variable, labelled *ft_forward*, that is equal to 1 in the year the hospital becomes a Foundation Trust and subsequent years, and zero otherwise.[4]

2 We exclude from the analysis both subsequent outpatient attendances and total outpatient attendances, in order to avoid patients' double counting. The same reasoning holds for A&E attendances, thus we exclude subsequent A&E attendances and total A&E attendances as well.

3 The star rating is a composite performance rating that places Trusts into one of four categories of performance: from highest (awarded three stars) to poorest (awarded zero stars). Performance ratings are defined over key government targets such as waiting times and financial management. This system was in place from 2000 to 2004/05 and it was then replaced by the annual health check, a more sophisticated performance rating that places Trusts into one of four categories of performance, from highest (awarded three stars) to poorest (awarded zero stars), based on two aspects: efficient use of hospital resources and quality of the services provided.

4 In 2003 the UK Parliament passed the HSC Act 2003, a bill that allowed some NHS Trusts to acquire a new legal status – Foundation Trust – and become non-profit public benefit corporations in charge of providing goods and services for the purposes of the NHS in England (HSC Act 2003, Part 1, section 1). Several hospitals have thus experienced an organizational change by acquiring this status. FTs have acquired a new set of freedoms in comparison to non-FTs. Specifically, FTs have a higher degree of independence from the Department of Health and more freedom in their corporate governance decisions. For example, more control over appointing and rewarding staff, directors and board members; as well as more control over their long/short term strategies and the way services are managed and operated. More decentralization, managerial and governance flexibility also brings more financial freedoms. In particular, FTs can retain their surpluses, obtain faster access to capital by raising it from both the public and private sectors, invest in the best mix of services for their patients and thus develop business strategies that better coordinate their financial and operating structure with the needs of their local communities. Moreover, these freedoms should also facilitate outsourcing of both medical and non-medical services (e.g., laundry, cleaning, catering, lab analysis, etc.) allowing further increases in efficiency. As a result of all these organizational changes, one can expect that FTs would be encouraged to change their behaviour, and ultimately their performance (HSC Act 2003; Commission for Healthcare Audit and Inspection, 2005). In fact, FT policy advocates tend to argue that the new freedoms of FTs should lead to their better organizational performance, including lower costs and improved efficiency.

Control variables

To account for other variables that may be correlated with our output measures, as well as the key variable of interest (the policy variable), we control for various hospital characteristics.

First, similarly to other healthcare studies, we include inputs of a production function to control for overall hospital capacity (e.g., Wagstaff, 1989; Duggan, 2000; Horwitz and Nichols, 2009). Thus, we consider *total available beds* and *total operating theatres* as measures of capital and the *proportion of medical* and *non-medical staff* as measures of labor.

Second, to account for differences in the complexity of the patients among hospitals, similarly as other studies (e.g., Herr, 2008; Bloom et al., 2015), we include *ALOS* - average length of stay as more severe patients stay in hospital longer. ALOS is often used as a patient complexity measure since it allows capturing the variation of severity not only between, but also within diseases (Wagstaff, 1989). Moreover, we control for *median waiting time* to account for differences in the quality of the service provided and for the *number of tests* dispensed to account for overall hospital use of resources. We also account for differences in the population served by considering the *proportion of patients aged 0-14*, the *proportion of patients aged 60 and over* and the *proportion of female patients*. Since we estimate semi-log specifications, we transform continuous variables into logarithms.

Moreover, we construct an Herfindahl Index (HHI) to capture market competition, using hospital market shares of bed days within a 30 miles radius for each hospital.[5] Given that the HHI already reflects percentages, in our estimations we include HHI in levels rather than the logged values.

Finally, we include a dummy variable *teaching* that is equal to 1 if the Trust is a teaching hospital, and zero otherwise; and a categorial variable *star_2* ranging from 1 (the poorest level of composite performance) to 4 (the highest level of composite performance).

To account for other variables that may be correlated with our outcome performance, as well as the key variable of interest (the policy variable), we control for the following hospital characteristics: whether the Trust is a specialist Trust (*specialist*) and whether it is a teaching Trust (*teaching*). Moreover, we include in the analysis variables *ALOS* and *median waiting time*.

3.3 Aggregate Data Patterns and Descriptive Statistics

Table 2 shows descriptive statistics for our sample overall. Among 1,581 observations in our sample about 2% of hospitals merge in a given year. Activities of hospitals are represented by several measures of efficiency and performance. In particular, hospitals are used to reduce admissions (lessening their high costs) in favour of outpatient activities. On average, outpatient first attendances

5 This is a plain measure of competition defined on the simple number of neighbour competitors and used to control for non-price competition (e.g., quality and/or demand competition), instead of price competition (e.g., technical efficiency). The value within 30 miles was chosen on sensitivity analysis' results.

are quite 10 units greater than inpatients spells. Also, data show that on average, hospitals tend to program admission activity to use more efficiently their resources. Indeed, average number of elective admissions (43368.80) are almost double than emergency admissions (24062.19). These data confirm a decreasing utilization of emergency care in favour of planned care, as also shown by the value of elective-emergency ratio. However, data highlights a higher utilization of emergency care, as shown by A&E first attendance mean (78812.82).

On average, the value of planned care (elective admissions) is double than planned care without overnight remaining is not so high (day cases is only 22918.88).

We analyse dimension of each hospital by considering capital inputs, such as number of beds (on average almost 741) and number of available theatres (on average almost 16) and labour inputs, where the number of non-medical staff is higher than medical staff (non-medical staff is around 89% of total staff while the medical staff is only the 11%).

In order to assess efficiency and quality of the services we consider the median value of waiting time in days (around 50 days) and the ALOS in a hospital (between 5-6 days). ALOS is calculated as the average number of days spent by each inpatient in hospital. This variable is included in the empirical specification to control for the outpatient variation among inpatients not captured by the number of admitted patients. The total number of tests, including CT, MRI, obstetric and non-obstetric ultra-sound tests, radio isotopes and radio-graph tests and fluoroscopy is on average around 179.

Competition between Trusts is measured by the number of bed days within 30 miles (around 48 km) range of each Trust. This is a plain measure of competition defined on the simple number of neighbour competitors and used to control for non-price competition (e.g., quality and/or demand competition), instead of price competition (e.g., technical efficiency).

We consider three groups to control for population's differences: the proportion of young people (about 14%), of elderly population (about 41%) and of females (51% of total population).

Regarding hospital characteristics, 34% of the Trusts in the sample are teaching hospitals while only 11% are specialist hospitals.

We include two types of quality variables to take in account performance. Both are ranking from 1 to 4 and their average score is around 2.9.

[Table 2 about here]

Table 3 and 4 compare the summary statistics between hospitals that went through organizational change in the exact year of merging with those that did not (i.e. for them merged=0 in all years) and hospitals that merged by the end of our sample with those that did not (i.e. for them merged_forward=0 in all years), respectively. The mean differences (last column of Table 3) for average dependent variables suggest that hospitals that merged are more efficient than those that did not. This data pattern supports the expectations of many merging policy advocates, who claimed that mergers were initially created with the intention to have more efficient trusts (e.g., Eaton, 2005).

Moreover, the effect of merger is larger in the planned activities than in unplanned ones. This is consistent with the fact that unplanned admissions include many unexpected treatments, such as emergencies, and if these occur, lifting inefficiency constraints and providing better allocation of resources as a result of hospital re-organization would be much more important than for treatments that can be planned in advance.

However, merged hospitals do not provide significantly larger ratio in any of their combined outcomes, which further raises the question of how merger policy interacted with hospital efficiency in the short term.

Interestingly also, merged hospitals show on average significantly smaller FT status than non-merging hospitals. Though the difference in means is relatively small in terms of magnitudes (0,04 vs. 0,17) – a strong statistical significance could indicate that some hospitals did in fact go through important adjustments in the FT status as a result of merger policy.

Moreover, considering capital and labor inputs, merged hospitals have significant differences in means for all inputs. However, merging process lessen significantly on average the proportion of medical staff in the hospitals. In fact, in line with literature, merged hospitals increase the volume of capital inputs such as number of theatres and beds but sometimes the number of medical staffs can decrease.

Though these correlations in aggregate data are appealing, not significant differences in means for control variables and hospital characteristics, between merged vs. non-merged hospitals, also suggest that hospital heterogeneity (e.g., teaching vs. non-teaching status) and other (observed and unobserved) factors will not play an important role when we consider only the exact year of merging. For this reason, the Table 4 shows differences in means between merged and non-merged hospitals, considering not only the exact year of merging but the whole span from year of merging to the end of our sample.

Thus, in line with the previous results merging process show significant differences in means for all outcome and also, for day case elective ratio. It can suggest that merged hospitals improve their efficiency by planned services and activities in the long-term.

Merged hospitals show on average not significant smaller FT status than non-merging hospitals. The difference in means confirms that FT status will not play a key role in the merging process in the long term.

Unlike previous results, significant differences in means for inputs and control variables rise. Though these correlations in aggregate data are appealing, between merged and non-merged hospitals, also suggest that hospital heterogeneity (e.g., teaching vs. non-teaching status) and other (observed and unobserved) factors will play an important role when it comes to teasing out the impact of organizational change imposed by merger policy. The goal of our empirical analyses described below is to further explore these data patterns.

[Table 3 about here]

[Table 4 about here]

4. Methodology

We use a difference in difference (DID) methodology to test whether there are any differences in the level and in the composition of hospital activity and in the performance of hospital Trusts between merged and non-merged Trusts, whether the merger activity has made any difference at all or whether indeed there are long-standing differences in the level and in the composition of hospital activity and in the performance between these different types of organisations, which have made some of them more likely to merge than others.

We consider nine different measures of hospital activity and two different measures of performance and we compare these measures over time for merged Trusts and non-merged Trusts. We explore the robustness of our results using different combinations of controls and different estimation methods.

One of the main challenges in evaluating whether Trust mergers have any effect on hospital outputs and outcomes is the ability to draw firm conclusions based on comparison between merged and non-merged Trusts, when the decision to merge is voluntary (likely due to poor performance of one of the Trusts involved). Allowing for this potential selection bias is therefore a key component of our research and we describe below our approach to this.

We use the difference in difference matching method (Blundell and Costa Dias, 2002; Wooldridge, 2002) for dealing with selection bias (or self-selection). In particular, we use a matching method as a way to correct the estimation of treatment effects controlling for the existence of confounding factors based on the idea that the bias is reduced when the comparison of outcomes is performed using treated and control Trusts that are as similar as possible (Becker and Ichino, 2002). Under the matching assumption, the only remaining difference between treated and non-treated groups is the treatment. Consequently, if each merged Trust can be matched with a Trust with the same matching variables, but that has not undergone a merger, then the impact of the merger can be isolated (Blundell and Costa Dias, 2002).

We apply a matching based on a function of pre-treatment characteristics. Usually, this is carried out on the conditional probability of a merger given pre-treatment characteristics, i.e. on the propensity score:

$$p(X) = Pr(F = 1|X) = E(F|X) \quad (1)$$

in which *F* is the indicator of exposure to treatment (merger) and *X* is the multidimensional vector of pre-treatment characteristics. The propensity score is therefore a single-index variable summarising pre-treatment characteristics of each Trust in order to make the matching feasible. As a result, if the propensity score *p(X)* is known, the average effect of the treatment on the treated (ATT) can be estimated as follows:

$$ATT = E(Y_1 - Y_0|F = 1) = E\{E(Y_1 - Y_0|F = 1, p(X)\} = \quad (2)$$
$$E\{[E(Y_1|F = 1, p(X)) - E(Y_0|F = 0, p(X))] - [E(Y_0|F = 1, p(X)) - E(Y_0|F = 0, p(X))]\}$$
$$= E\{E(Y_1|F = 1, p(X)) - E(Y_0|F = 0, p(X))\}$$

in which Y_1 and Y_0 are the potential outcomes in the two counterfactual situations of treatment and no treatment and the expression $E\{\cdot\}$ is computed over the distribution of pre-treatment variables X in the treated population, $p(X)|F = 1$. Note that the move to the second line of equation (2) is possible under the condition that only one of Y_1 or Y_0 can be observed for any Trust: it is not possible to observe the same Trust under both treatment and control. By adding and subtracting $E(Y_0|F = 0, p(X))$ in the second line of equation (2), we can decompose the ATT into the average treatment effect (ATE) $E(Y_1|F = 1, p(X)) - E(Y_0|F = 0, p(X))$ and the selection bias $[E(Y_0|F = 1, p(X)) - E(Y_0|F = 0, p(X))]$. Under the assumption of conditional mean independence, $E(Y_0|F = 1, p(X)) = E(Y_0|F = 0, p(X))$ and the selection bias reduces to zero.

Using the propensity score matching model, we match merged Trusts with non-merged Trusts on the basis of observable characteristics. We employ a logit model which models the conditional probability of a merger given the pre-merger characteristics. The model splits the sample into approximately equally spaced intervals of the propensity score and tests within each interval that the average propensity score of treated and control units does not differ. Within each of these intervals the model also tests that the means of each observable characteristic do not differ between treated and control units. This is a necessary condition for the balancing property. The balancing property of the pre-treatment variables is tested to ensure that observations with the same propensity score have the same distribution of observable (and unobservable) characteristics independent of merger. Thus, within each block the propensity score and the characteristics of Trusts do not differ for treated and control units (Becker and Ichino, 2002). We match merged Trusts with non-merged ones on the basis of observable characteristics, other than their level of activity. We employ a logit model for the propensity of a merger to occur, invoking the common support modelling option (Dehejia and Wahba 1999, 2002; Smith and Todd, 2005) which restricts the set of data points over which the test of the balancing property is sought to those belonging to the intersection of the supports of the propensity score of treated and controls. Imposing the common support condition in the estimation of the propensity score may improve the quality of the matching process. Thus, for a given propensity score, mergers are random and merged Trusts and matched non-merged Trusts should on average be observationally identical.

Once outcomes for merged and non-merged Trusts have been matched, we apply a DID matching model (Heckman et al., 1997 and 1998) to eliminate any systematic differences after conditioning on observables. Such differences may arise, for example, because of selection based on unobservable characteristics, or because activity outcomes for merged and non-merged Trusts may be measured in different ways. For example, when data is extracted from different sources, the identification conditions required for matching may be violated. The DID strategy overcomes this problem by allowing for temporally invariant differences in outcomes between merged and non-merged Trusts (Smith and Todd, 2005).

We therefore compare the change in the level of activity for merged Trusts before and after the merger with the change in the level of activity for Trusts in a comparator group that are not undergoing the intervention, over the same period. The DID method enables us to estimate the average effect of a merger on the level of activity of merged Trusts.

4.1 Analysis on hospital activities

We use three types of analysis with fixed effect to identify the average effect of a merger and to explore the robustness of our results: fixed effects, wave analysis and event study.

<u>*Fixed effects*</u>

We investigate on the effect of merger by using the following model:

$$y_{it} = \beta_0 + \beta_{1j}M_{it} + \sum_{k=1}^{13}\beta_{2k}X_{kit} + \sum_{t=1}^{9}\beta_{3t}Z_t + \mu_i + \varepsilon_{it} \qquad (3)$$

where M_{it} is a dummy variable taking values equal 1 if it identifies the exact year of merger (*merged*) or the year when the merger starts and the subsequent years (*merged_forward*). These two policy variables show two merger effects on activities: a *snapshot effect*, when we consider only the year when hospitals merge and a *persistent effect* if we examine the year the new merged hospital starts its activity and subsequent years.

Variable y_{it} is the log of output/outcome for Trust *i* in year t, X_{kit} is the k-th observable time-variant factor (inputs, controls, hospital characteristics) affecting our dependent variables for Trust *i* in year *t*. Z_t represents a year dummies for t=1 (2000), t=2 (2001), and so on, until to t=9 (2008), μ_i represents a hospital fixed effect while the ε_{it} is the error term. Then, β is the estimate of the average effect of organizational change on hospital efficiency.

Wave analysis

As in our database the first merger occurs in year 2001, we create a set of 8 dummy variables for each year during which a merger has occurred. In this specification, variable y_{it} is the log of output/outcome for Trust *i* in year *t* is identified by a set of dummies, M_{itj}:

$$y_{it} = \beta_0 + \sum_{j=1}^{8} \beta_{1j} M_{itj} + \sum_{k=1}^{13} \beta_{2k} X_{kit} + \sum_{t=1}^{9} \beta_{3t} Z_t + \mu_i + \varepsilon_{it} \quad (4)$$

X_{kit}, Z_t, μ_i, ε_{it} and β have the same specification of (3).

Event study

We implement the DID approach comparing hospital activity before and after the merger and between hospitals that merged and those that never merged. We built an aggregate measure (or vector variable) of the outcomes of the merging parties prior to the merger, since there is only one merged after the merger. Thus, we have as a “pseudo-merged” hospitals that allow for consistent comparison of merged hospitals before and after mergers.

Given a possible anticipation effect, we use the event study to examine the variation over time in within hospital outputs for merged hospitals pre and post-policy. We examine hospital activities of the merged hospitals from 2 years prior to the year in which the merger is approved by the regulator to 3 years after. For each output of interest, we use the following specification:

$$y_{it} = \beta_0 + \sum_{j=-2}^{3} \beta_{1j} T_{ij} + \sum_{k=1}^{13} \beta_{3k} X_{kit} + \mu_i + \varepsilon_{it} \quad (5)$$

where T_{ij} is a vector of time effects (dummies) relative to time t = −2 (the baseline), X_{kit} is the k-th observable time-variant factor (inputs, controls, hospital characteristics) affecting our dependent variables for Trust *i* in the year *t*, μ_i represents a hospital fixed effect while the ε_{it} is the error term. Then, β is coefficients of interest.

4.2 Analysis on hospital performance

Hospital outcome is measured by a star system and it represents the hospital performance. We analyse hospital performance rating (from level 1 = low to 4 = high) by applying a fixed effect ordered logit model, considering level 4 as the baseline comparison group. We include hospital characteristics (teaching, specialist and London) and other policy interventions (FT). As a change in the offer of services provided might have an impact on hospital's patient choice and on the quality of the services, our results might be particularly helpful from a policy perspective.

5. Empirical results

Figures 1-9 represent the level of each dependent variable for all trusts before (grey line) and after merger (dark line). Also, we built the possible level of each dependent variable considering the same features after merger (dashed line). The year of merger is different for each variable, depending on trusts analysed.

In general, the number of inpatient spells, elective admissions and emergency admissions increase after trusts' merged (Figures 1, 2, 3), while the proportion of elective-emergency and of inpatient-outpatient ratio are not always increasing (Figures 6 and 7). Even if the A&E first attendances is increasing over time (Figure 5), the inpatient-outpatient ratio decreases after trusts' merged (Figure 9). It can be the results of two combined phenomena: increasing outpatient first attendances' trend (Figure 4) and the more use of ambulatory services as confirmed by the day case's trend (Figure 6).

[Figures 1-9 about here]

5.1. The matched control group

The results for the logit model are shown in Table 5. The sample consisted of 1132 hospitals and the model produced a Pseudo R-squared of 0.085. There were six blocks of Trusts in the final propensity score model, although these were pooled together to produce a control group of 901 observations under common support, compared with 222 in the treatment group with the balancing property satisfied.

Once merged and non-merged hospitals are matched, the unmatched comparison units out of the common support are discarded and are not directly used in estimating the treatment impact (Dehejia and Wahba, 2002). We selected eight variables to produce the highest number of Trusts in the control group under the common support assumption. These include data on hospital characteristics (teaching, performance rating and HHI in 30 miles), some financial and economic features (RCI, surplus and directors' cost), efficiency (ALOS).

The probability of merging in the pre-treatment year is positively associated with the teaching hospital characteristic, with lower number of medical staff and HHI in 30 miles, higher RCI and costs of directors.

[Table 5 about here]

5.2 Fixed effects

Table 6 and 7 shows the regression results for the DID models in which we test the effect of merger policy on several outcome variables. In particular, Table 6 shows the effect of merge process in the exact year when hospitals merge (*merged*). In contrast in the Table 7, we analyse the impact on the same outcomes from the year when hospital merge until to the end of our analysis (*merged_forward*). Results show that merger policy have positive effects on quite all dependent variables, but it is more significant in the subsequent years after its introduction.

Considering only the year when hospitals merge (Table 6), the policy is significant for emergency admission and patient attending first outpatient appointment. In general, merged hospital decrease the volume of unplanned services as shown by the negative effect on ratio of elective – emergency and inpatient-outpatient ratios. Number of beds increase after merging for inpatient, elective and emerging admission as well as for first appointment outpatient services. The negative sign of day case outpatient ratio shows that merger policy increase outpatient services than day cases. The proportion of medical and non-medical staff decrease for all kind of admissions except for first outpatient appointment. In general, the average length of stay and the median waiting in days decreasing in all kind of admissions. Merged hospitals admit fewer young people instead of older ones. Teaching qualification is positively significant only for outpatient services while there is a negative relationship with all emergency services. The quality, measuring in our analysis with the performance rating, is positive and significant for inpatient, emergency admission, for patients attending first appointment outpatient but it is negative for patients attending first appointment A&E.

The effect of merge in the subsequent years (Table 7) is more significant in all types of admission and patients attending first appointment A&E emergency visit. Findings for inputs, controls and hospital characteristics are similar to the results in Table 6, except for the median waiting time that is not significant over time. In general, more important and significant effects of merger policy can be found over time than in the only year when hospital merge.

[Table 6 -7 about here]

5.3 Wave analysis

The wave analysis shows the effect of merge policy in nine different hospital activities. Here, the effect of merger policy is measured by a matrix composed from a set of 8 dummy variables for each year of merger (*merged_y1* to *merged_y8*) or for each year of merger and subsequent years (*merged_forward_y1* to *merged_forward_y8*). The advantage of wave analysis can help us to better understand in which year the merger policy has effect on hospital outputs.

Table 8 shows the effect of *merged_y1* to *merged_y8* on hospital activities. Findings are not so significant, but they become more significant for hospitals who merge in the subsequent years after than the first merged hospitals. These findings can suggest that, considering only the exact year of merger, hospitals that merged some years later than the first ones can have some kind of advantage from the experience of them.

In general, number of beds have positive effects especially for all admission's types and for Patients first attending A&E department while proportion of medical and non-medical staff have a negative and significant effects on outputs. Average length of stay is significant and negative for inpatient and emergency admissions, but the positive sign of elective-emergency ratio shows that emergency admissions decrease more than elective ones, as confirmed by the magnitude of their coefficients (-0.509 vs -0.396). Also, the positive and significant sign of day case-outpatient ratio coefficient (0.117) and the negative and significant sign of inpatient-outpatient ratio shows that merged hospitals decrease more ALOS in admission activities instead of patients attending first outpatient appointment. In line with literature, merge hospitals achieve well level of efficiency reducing ALOS and waiting times in costly activities, such as inpatient, emergency and day-cases admissions. There are not significant effects among population groups on outputs. Teaching hospitals have a negative and significant on emergency admissions (-0.097 significant at 1%) but significant and positive on outpatient activities (0.194 significant at 1%). Higher performance rating is related to positive effect on inpatient and emergency admission, but it has a negative effect on outpatient activities.

In the Table 9 we analyze the effect of each merger year, considering also all period after merging.

Results appear interesting. Indeed, we find significant and positive findings for hospitals who merged in the first year, or better they increase all kind of admissions (planned and unplanned activities) and emergency activities. These results suggest a merger policy can support an increasing of hospital activities. Over time, hospitals who merged in the subsequent years after than the first ones, decrease their activities (negative coefficients' signs but not significant). Also, considering the negative and significant value of merged_forward_y8 we can suppose that mergers are policies that reduce hospitals planned and unplanned activities. In line with literature, our results confirm that only the first merged hospitals take an advantage in terms of efficiency, otherwise they decrease their level of efficiency[6].

5.4 Event Study

Table 10 show the effect of merger on our output of analysis. In this analysis we consider the year of merge, two years of merge as well three years after merging. In general, findings show that hospital activities do not fall post-merger, but the effect of merger policy is significant only for the patients attending first outpatient appointment. This result is in line with the previous findings. Indeed, outpatient activities are more relevant than admissions after merging. Inputs, controls and hospital characteristics effects are in line with results in the previous analyses.

5.5 Performance analysis

In the Table 11 we test effects of merged and merged_forward on two types of performance hospitals: Type-1 if we consider stars system plus services' quality, Type-2 composed by stars system and use of resources. The effect of our merger policies is different in the performance rating Type-1. We have a positive and significant (at 1%) in the exact year hospital merged; while the effect became negative and significant (at 10%) if we consider the year of merger and the subsequent years. This result suggests that the level of this type of performance decreasing over time after merging. Considering the performance rating Type-2, the effect of both policies is significant and positive. A larger effect is by introducing merger policy over time (11.767 vs 0.857). FT status have a negative and significant effect on the performance rating Type-1 while is positive and significant in the Type-2.

In the performance rating Type-1, teaching characteristics is negative and significant in both policies. In general, the sign of ALOS is positive and not significant, while the median waiting time in days decreases in the performance rating Type-1.

In the performance rating Type-2, controls are positive and significant effect by using both merger policies. Only the median waiting time in days decreases in the performance rating Type-2, as well as in the Type-1.

In the table 12 we analyze the effect of merger policy on performance rating by using wave analysis' policy variables. In general, the set of dummy variables that identify the exact year of merger are positive in both type of performance rating, except for the hospitals that merged in the sixth year (in the 2006) where the policy have a positive and significant effect on the performance rating Type-1 and a negative and significant effect on the Type-2. It suggests that mergers do not affect positively the quality of hospital in terms of use of resources. Considering the effect of merger policy over time

[6] These findings can be justified by the merger's high costs, high level of competition, etc.

(merged_forward_y1 to merged_forward_y8) the performance rating fall in each year and over time. In particular, in the first year merger have a negative and significant effect on the performance rating Type-1 but positive and significant in the Type-2. The effect of FT status and controls are similar to the previous analysis (Table 10).

Table 13 show merger's effects by using the BUC estimator on the performance rating Type-1 and Type-2. The performance rating Type-1 falls in the years immediately thereafter merging, while for the performance Type-2 it is positive immediately before the introduction of policy and for the subsequent two years thereafter. Only in the third year after policy introduction the performance Type-2 decrease. The effect of FT status and controls are in line with the previous results.

6. Conclusions

Our preliminary results suggest that hospital mergers may have a positive effect not only in terms of quantity of services provided, but also in terms of different combinations of services provided and in terms of hospital performance.

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Figures

Figure 1. Inpatient admissions. England, 2000-2008

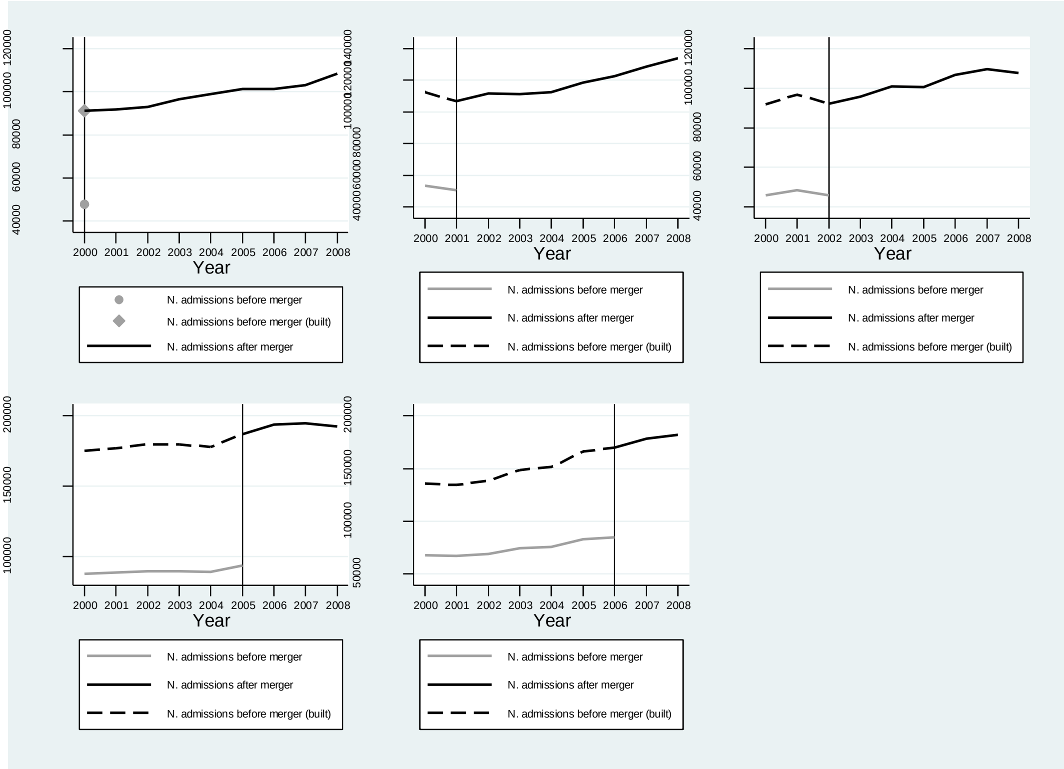

Figure 2. Elective admissions. England, 2000-2008

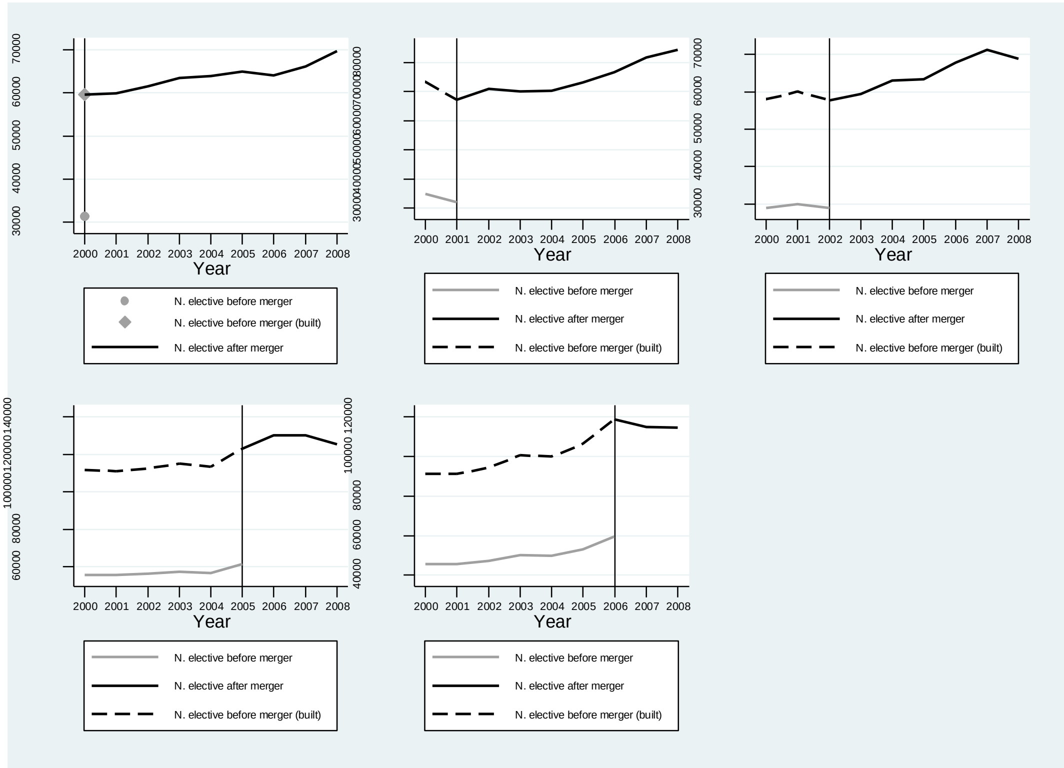

Figure 3. Emergency admissions. England, 2000-2008

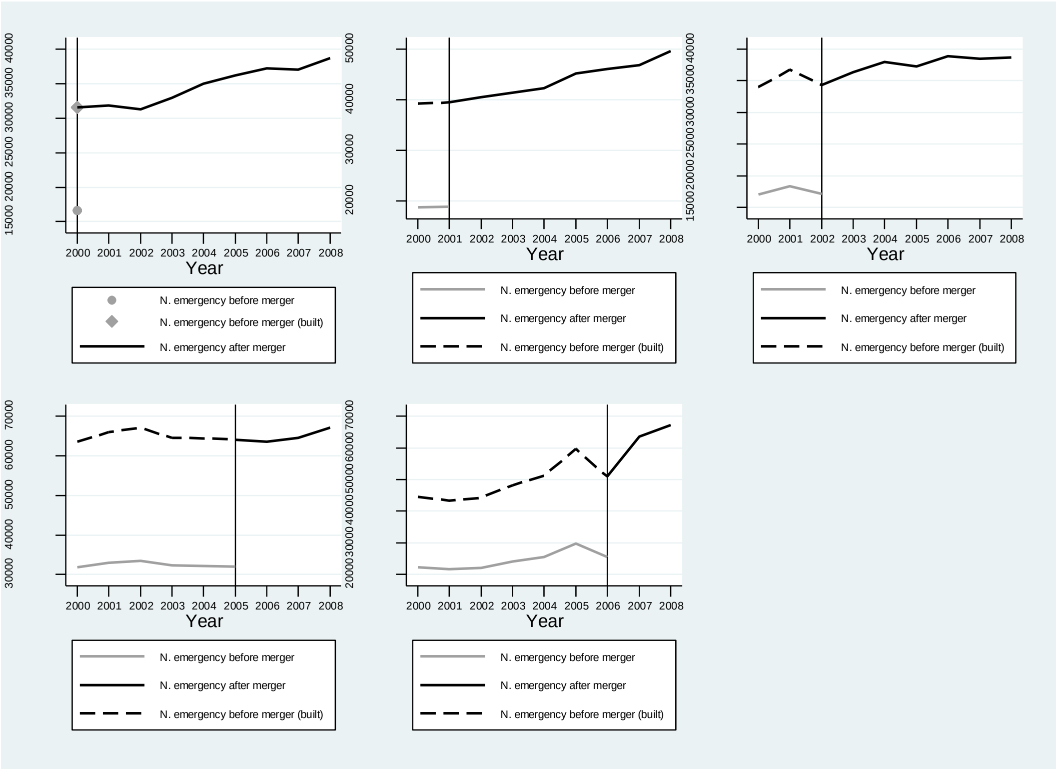

Figure 4. Patients attending first outpatient appointment. England, 2000-2008

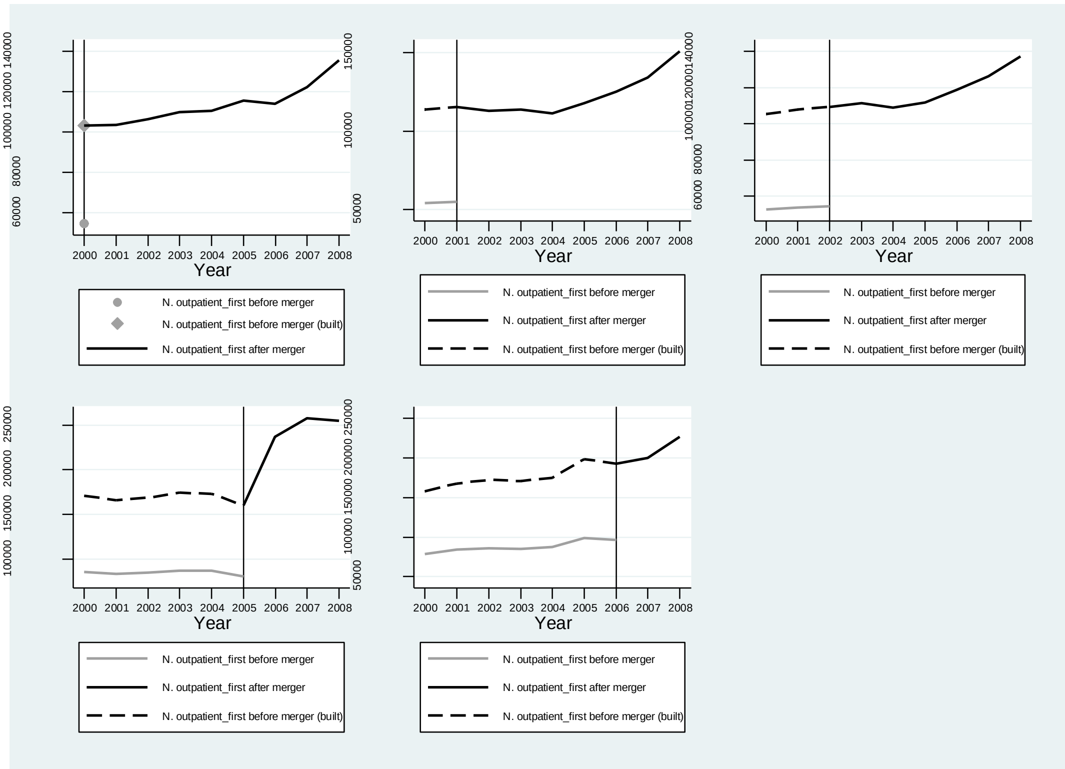

Figure 5. Patients first visiting A&E department. England, 2000-2008

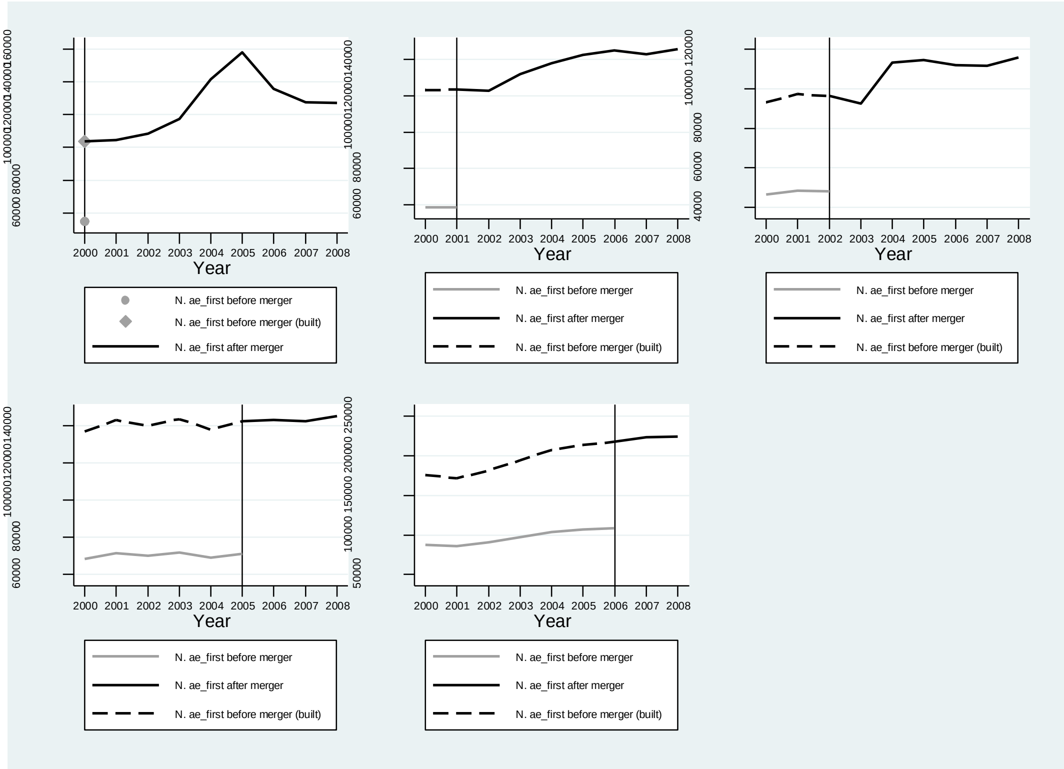

Figure 6. Daycases. England, 2000-2008

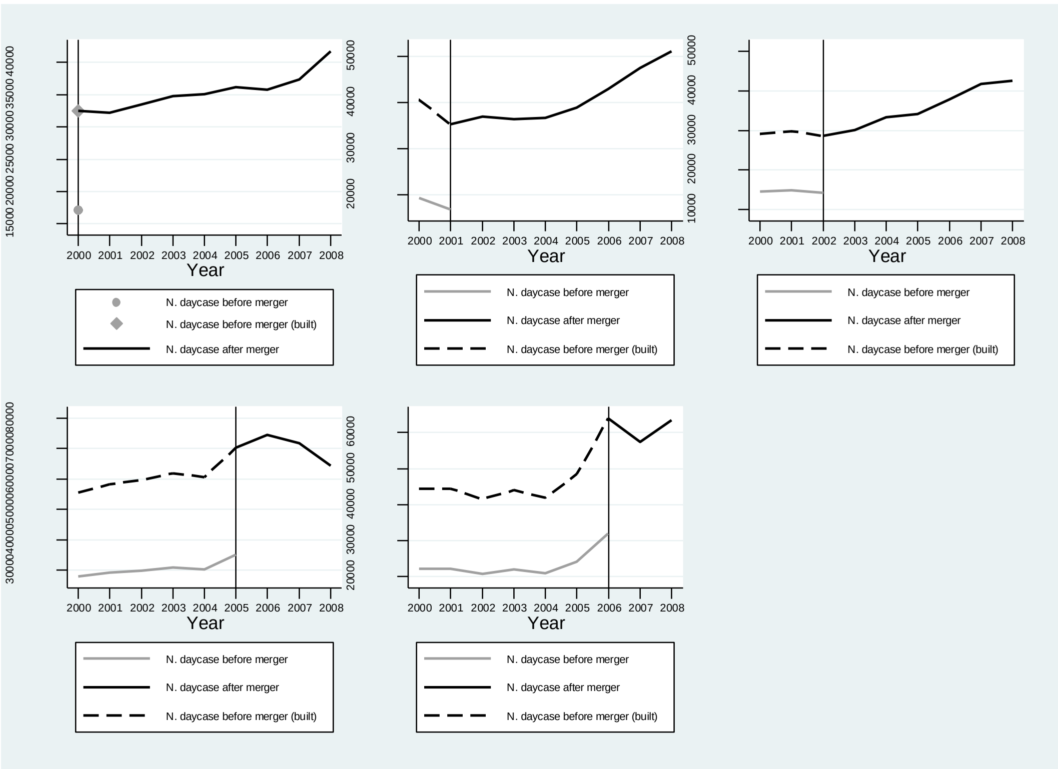

Figure 7. Elective-emergency ratio. England, 2000-2008

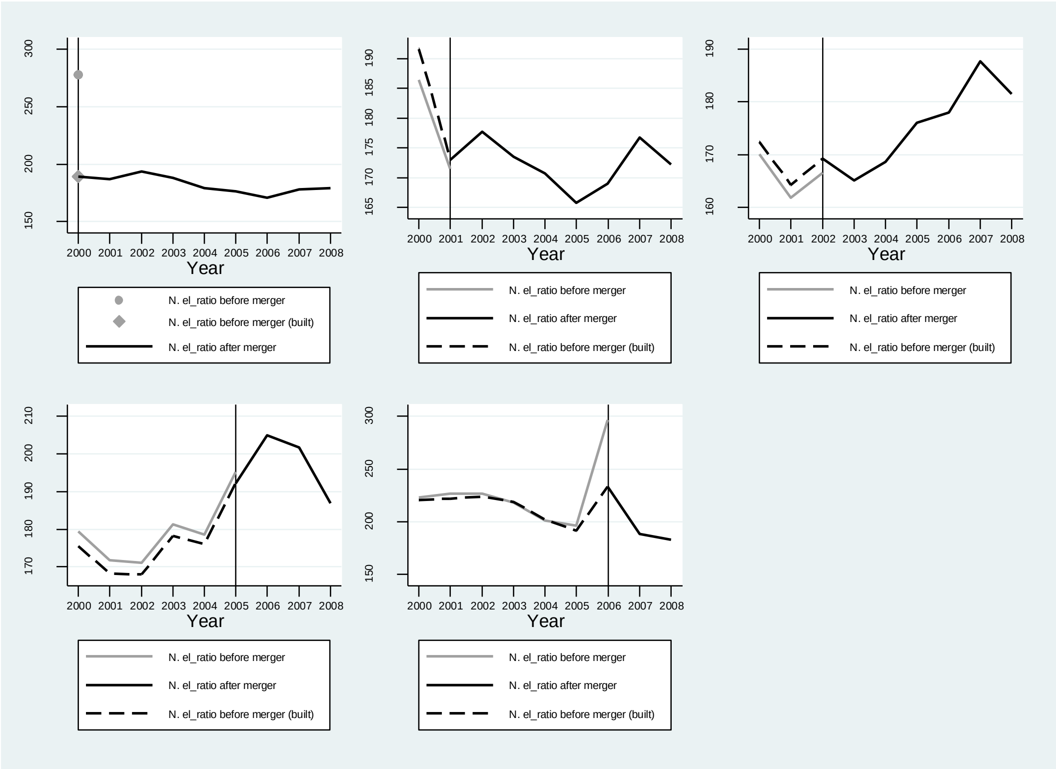

Figure 8. Inpatient-outpatient ratio. England, 2000-2008

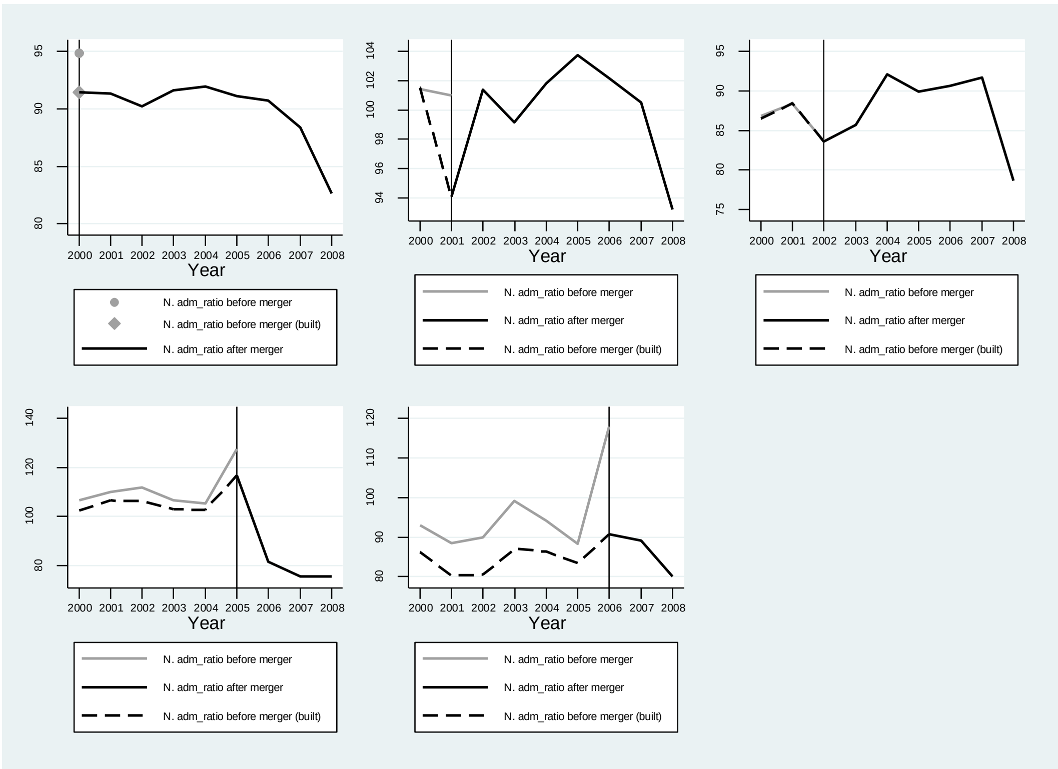

Figure 9. Daycase-elective ratio. England, 2000-2008

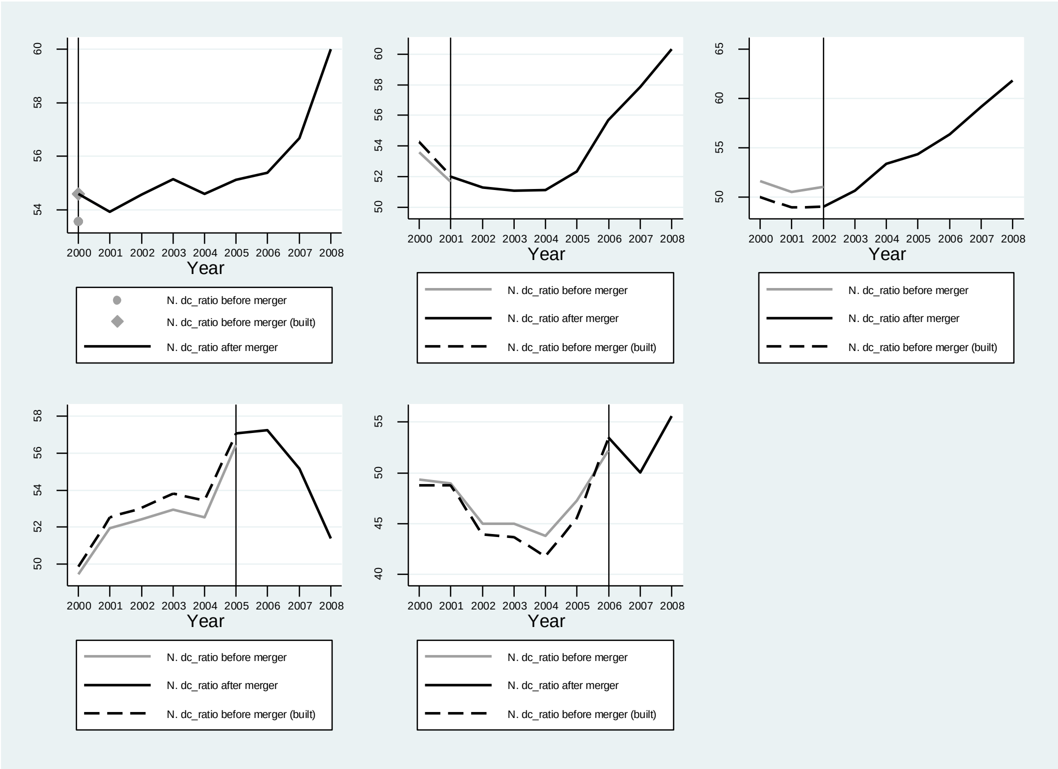

Table 1. Hospitals by their merging status over time. England, years 2000-2008

Year	Total number of Trusts	Number of merged Trusts	Number of merging Trusts	% merged Trusts	% merging Trusts
2000	195	0	19	0%	10%
2001	186	10	21	5%	11%
2002	175	10	6	6%	3%
2003	172	3	0	2%	0%
2004	172	0	0	0%	0%
2005	172	0	2	0%	1%
2006	171	1	3	1%	2%
2007	169	2	0	1%	0%
2008	169	0	0	0%	0%

Table 2. Summary statistics - full dataset

	Obs	Mean	Std. Dev.	Min	Max
Dependent variables					
Number of inpatient spells	1581	67391.940	38177.180	1040	232033
Number of elective admission	1580	43368.800	25205.210	566	154926
Number of emergency admission	1580	24062.190	14093.360	13	85135
Outpatient first attendances	1577	77731.060	44439.860	1006	257783
A&E first attendances	1572	78812.820	46626.310	1	414772
Number of daycase	1577	22918.880	14653.580	1	82856
Elective-emergency ratio (%)	1580	320.659	1251.153	61.908	43969.230
Inpatient-outpatient ratio (%)	1577	93.822	47.793	1.451	818.520
Daycase-elective ratio (%)	1576	51.374	11.222	0.151	96.904
Policy variables					
Merged	1581	0.016	0.127	0	1
Merged_forward	1581	0.111	0.314	0	1
FT	1581	0.166	0.372	0	1
Inputs					
Operating theatres	1568	15.835	9.161	1	57
Total available beds	1581	740.641	412.053	1	2838
Share of medical staff (%)	1560	11.155	2.203	3.970	19.362
Share of non-medical staff (%)	1560	88.845	2.203	80.638	96.030
Controls					
Median waiting time in days	1581	50.385	21.653	1	295
Average length of stay	1581	5.552	1.829	1	23
Patients aged 0-14 (%)	1565	13.972	12.738	1	95
Patients aged 60 and over (%)	1565	40.730	10.033	1	70
Female patients (%)	1580	50.810	6.550	4	88
Total tests	1572	178741.200	98278.550	510	1041579
HHI on bed days - radius 30 miles	1581	2984.791	2866.884	310	10000
RCI (including excess beds)	1386	100.46	10.70	69.09	162.49
Surplus	1298	4661.76	7106.68	-76901	73800
Directors' costs	1282	735.27	265.35	198.00	2088
Hospital characteristics					
Teaching	1581	0.3409	0.4742	0	1
Specialist	1581	0.1139	0.3177	0	1
Performance rating - type 1	1556	2.9274	0.8603	1	4
Performance rating - type 2	1556	2.8670	1.0085	1	4

Table 3. Mean Comparison: Merged vs. Non-Merged (by the end of our sample period; 2000-08)

	Merged (=1 by the year of merging)		**Merged (=0 in all years)**		**Difference**
	Obs	**Mean**	**Obs**	**Mean**	**Merged=1 - Merged=0**
Dependent variables					
Number of inpatient spells	26	110382.90	1555	66673.12	43709.78***
Number of elective admission	26	71047.23	1554	42905.71	28141.52***
Number of emergency admission	26	39335.65	1554	23806.65	15529***
Outpatient first attendances	26	120503.30	1551	77014.05	43489.25***
A&E first attendances	26	120770.30	1546	78107.20	42663.1***
Number of daycase	26	37375.65	1551	22676.53	14699.12***
Elective-emergency ratio (%)	26	181.63	1554	322.99	-141.36
Inpatient-outpatient ratio (%)	26	94.02	1551	93.82	0.20
Daycase-elective ratio (%)	26	52.37	1550	51.36	1.02
Policy variables					
FT	26	0.04	1555	0.17	-0.129*
Inputs					
Operating theatres	26	24.77	1542	15.68	9.084***
Total available beds	26	1288.27	1555	731.48	556.785***
Share of medical staff (%)	26	10.13	1534	11.17	-1.040**
Share of non-medical staff (%)	26	89.87	1534	88.83	1.040**
Controls					
Median waiting time in days	26	51.08	1555	50.37	0.70
Average length of stay	26	5.85	1555	5.55	0.30
Patients aged 0-14 (%)	26	12.92	1539	13.99	-1.07
Patients aged 60 and over (%)	26	40.65	1539	40.73	-0.08
Female patients (%)	26	51.77	1554	50.79	0.98
Total tests	26	278291.30	1546	177067.00	101224.3***
HHI on bed days - radius 30 miles	26	3234.64	1555	2980.61	254.03
RCI (including excess beds)	26	3234.64	1555	2980.61	2.571
Surplus	26	102.99	1360	100.42	4910.090***
Directors' costs	26	9473.50	1272	4563.41	22.569
Hospital characteristics					
Teaching	26	0.50	1555	0.34	0.16
Specialist	26	0.00	1555	0.12	-0.12
Performance rating - type 1	26	3.04	1530	2.93	0.11
Performance rating - type 2	26	3.00	1530	2.86	0.14

Table 4. Mean Comparison: Merged_forward vs. Non-Merged_forward (by the end of our sample period; 2000-08)

	Merged (=1 by the year of merging)		**Merged (=0 in all years)**		**Difference**
	Obs	**Mean**	**Obs**	**Mean**	**Merged=1 - Merged=0**
Dependent variables					
Number of inpatient spells	175	111409.90	1406.00	61913.17	49496.73***
Number of elective admission	175	71063.97	1405.00	39919.22	31144.75***
Number of emergency admission	175	40345.97	1405.00	22033.96	18312.01***
Outpatient first attendances	174	123366.80	1403.00	72071.31	51295.49***
A&E first attendances	175	132494.30	1397.00	72088.23	60406.07***
Number of daycase	175	39328.97	1402.00	20870.54	18458.43***
Elective-emergency ratio (%)	175	177.63	1405	338.475	-160.848
Inpatient-outpatient ratio (%)	174	93.40	1403	93.875	-0.474
Daycase-elective ratio (%)	175	55.05	1401	50.914	4.140***
Policy variables					
FT	175	0.19	1406	0.162	0.032
Inputs					
Operating theatres	175	24.03	1393	14.805	9.229***
Total available beds	175	1184.86	1406	685.350	499.513***
Share of medical staff (%)	175	10.71	1385	11.211	-0.502***
Share of non-medical staff (%)	175	89.29	1385	88.789	0.502***
Controls					
Median waiting time in days	175	48.98	1406	50.560	-1.583
Average length of stay	175	5.28	1406	5.586	-0.306*
Patients aged 0-14 (%)	175	12.37	1390	14.174	-1.808*
Patients aged 60 and over (%)	175	42.49	1390	40.508	1.984**
Female patients (%)	175	50.85	1405	50.806	0.040
Total tests	175	279363.90	1397.00	166136.40	113227.5***
HHI on bed days - radius 30 miles	175	3367.65	1406	2937.137	430.517*
RCI (including excess beds)	175	102.10	1211	100.23	1.876**
Surplus	160	6480.33	1138	4406.08	2074.254***
Directors' costs	155	913.50	1127	710.76	202.735***
Hospital characteristics					
Teaching	175	0.47	1406	0.325	0.144***
Specialist	175	0.00	1406	0.128	-0.128***
Performance rating - type 1	175	2.85	1381	2.938	-0.092
Performance rating - type 2	175	2.74	1381	2.883	-0.146*

Table 5. Logit model for the selection of the appropriate comparator group

Teaching	0.468**
	(0.182)
Share of medical staff (%)	-0.346***
	(0.049)
HHI on bed days - radius 30 miles	-0.059**
	(0.030)
Performance rating – type 1	-0.069
	(0.098)
ALOS	0.029
	(0.071)
RCI	0.030***
	(0.010)
Surplus	0.018*
	(0.011)
Directors cost	1.694***
	(0.316)
Constant	-2.020
	(1.301)
Observations	1,132

Standard errors in parentheses. *Significant at 10%; **significant at 5%; ***significant at 1%.

Table 6. DID empirical results

	Inpatient admissions	**Elective inpatients**	**Emergency admissions**	**Patients attending first outpatient appointment**	**Patients first attending A&E department**	**Inpatient admissions without overnight stay**	**Elective-emergency ratio**	**Inpatient-outpatient rati**	**Daycase-outpatient ratio**
Policy variable									
merged	0.031	0.018	0.046**	0.054***	0.009	0.011	-0.028	-0.022	-0.008
	(0.019)	(0.023)	(0.022)	(0.020)	(0.048)	(0.034)	(0.024)	(0.026)	(0.017)
FT	0.022	0.034	-0.013	0.022	0.035	0.025	0.047	-0	-0.009
	(0.021)	(0.023)	(0.031)	(0.023)	(0.035)	(0.031)	(0.030)	(0.031)	(0.015)
Inputs									
Operating theatres (*in ln*)	0.086	0.088	0.110	0.027	0.026	0.080	-0.022	0.058	-0.014
	(0.058)	(0.062)	(0.070)	(0.043)	(0.059)	(0.061)	(0.053)	(0.070)	(0.030)
Total available beds (in ln)	0.150**	0.138*	0.166**	0.074**	0.017	0.057	-0.029	0.076	-0.082***
	(0.076)	(0.074)	(0.074)	(0.032)	(0.080)	(0.072)	(0.026)	(0.069)	(0.021)
Share of medical staff (% in ln)	-0.406***	-0.382**	-0.780***	0.092	-1.032*	-0.634***	0.397	-0.500*	-0.255*
	(0.123)	(0.160)	(0.242)	(0.304)	(0.544)	(0.236)	(0.292)	(0.297)	(0.138)
Share of non-medical staff (% in ln)	-2.979***	-2.785**	-6.119***	1.228	-8.196	-5.142**	3.334	-4.221*	-2.352*
	(1.075)	(1.396)	(1.916)	(2.596)	(5.339)	(2.088)	(2.351)	(2.512)	(1.232)
Controls									
Average length of stay (in ln)	-0.335**	-0.287*	-0.455***	-0.034	-0.054	-0.071	0.168***	-0.301*	0.220***
	(0.159)	(0.169)	(0.151)	(0.038)	(0.057)	(0.171)	(0.052)	(0.168)	(0.053)
Median waiting time in days (in ln)	-0.040	-0.044	-0.022	-0.021	0.040	-0.075**	-0.021	-0.019	-0.032**
	(0.027)	(0.030)	(0.026)	(0.016)	(0.032)	(0.033)	(0.016)	(0.032)	(0.014)
Patients aged 0-14 (% in ln)	-0.036**	-0.040*	-0.186	-0.070**	-0.027	-0.086**	0.146	0.035	-0.047*
	(0.017)	(0.022)	(0.160)	(0.028)	(0.041)	(0.039)	(0.161)	(0.023)	(0.024)

Patients aged 60 and over (% in ln)	-0.003	-0.003	0.011	0.003	0.047	0.040	-0.014	-0.007	0.042
	(0.016)	(0.019)	(0.021)	(0.020)	(0.038)	(0.064)	(0.020)	(0.022)	(0.056)
Female patients (% in ln)	0.154	0.395	0.012	0.083	0.281	0.686***	0.383	0.071	0.298
	(0.292)	(0.337)	(0.453)	(0.230)	(0.333)	(0.262)	(0.361)	(0.231)	(0.235)
Total tests (in ln)	-0.011	-0.013	-0.007	0.071***	0.003	-0.022	-0.005	-0.082***	-0.008
	(0.014)	(0.015)	(0.025)	(0.021)	(0.029)	(0.020)	(0.027)	(0.025)	(0.012)
hh_bd_30	-0.087	-0.088	-0.087	-0.004	-0.051*	-0.065	-0	-0.083	0.023
	(0.060)	(0.064)	(0.059)	(0.023)	(0.027)	(0.067)	(0.022)	(0.063)	(0.016)
Hospital fixed effects									
teaching	-0.037	0.005	-0.095***	0.170***	-0.049*	-0.018	0.101***	-0.207***	-0.022
	(0.026)	(0.031)	(0.033)	(0.026)	(0.027)	(0.034)	(0.028)	(0.031)	(0.022)
Performance rating (star + use_resources)	0.007*	0.008	0.013*	0.012*	-0.032*	0.010	-0.005	-0.004	0.003
	(0.004)	(0.005)	(0.007)	(0.006)	(0.019)	(0.008)	(0.007)	(0.007)	(0.005)
Year fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	24.646***	22.372***	39.314***	3.752	48.510**	31.965***	-12.337	25.569**	14.167**
	(5.485)	(6.957)	(9.374)	(12.706)	(24.239)	(9.847)	(11.164)	(12.188)	(6.153)
Observations	1,504	1,504	1,504	1,500	1,499	1,500	1,504	1,500	1,500
R-squared	0.316	0.245	0.322	0.555	0.086	0.285	0.142	0.127	0.232
Number of id	201	201	201	201	201	201	201	201	201

Table 7. DID empirical results

	Inpatient admissions	**Elective inpatients**	**Emergency admissions**	**Patients attending first outpatient appointment**	**Patients first attending A&E department**	**Inpatient admissions without overnight stay**	**Elective-emergency ratio**	**Inpatient-outpatient rati**	**Daycase-outpatient ratio**
Policy variable									
Merged_forward	0.353***	0.315***	0.422***	0.002	0.420***	0.436***	-0.107***	0.352***	0.124***
	(0.036)	(0.038)	(0.040)	(0.031)	(0.058)	(0.039)	(0.031)	(0.038)	(0.022)
FT	0.021	0.033	-0.015	0.023	0.033	0.023	0.048	-0.002	-0.010
	(0.021)	(0.023)	(0.031)	(0.023)	(0.035)	(0.031)	(0.030)	(0.031)	(0.015)
Inputs									
Operating theatres (*in ln*)	0.080	0.082	0.104	0.032	0.016	0.070	-0.023	0.048	-0.017
	(0.058)	(0.063)	(0.070)	(0.043)	(0.058)	(0.061)	(0.053)	(0.070)	(0.030)
Total available beds (in ln)	0.143**	0.132*	0.159**	0.075**	0.009	0.049	-0.027	0.069	-0.085***
	(0.072)	(0.071)	(0.070)	(0.033)	(0.075)	(0.068)	(0.026)	(0.066)	(0.022)
Share of medical staff (% in ln)	-0.418***	-0.392**	-0.795***	0.088	-1.044*	-0.647***	0.403	-0.508*	-0.258*
	(0.123)	(0.160)	(0.240)	(0.306)	(0.548)	(0.235)	(0.291)	(0.296)	(0.138)
Share of non-medical staff (% in ln)	-3.157***	-2.935**	-6.342***	1.172	-8.383	-5.337**	3.407	-4.345*	-2.396*
	(1.067)	(1.390)	(1.894)	(2.610)	(5.381)	(2.071)	(2.348)	(2.503)	(1.228)
Controls									
Average length of stay (in ln)	-0.334**	-0.286*	-0.454***	-0.036	-0.052	-0.069	0.169***	-0.298*	0.221***
	(0.159)	(0.169)	(0.151)	(0.038)	(0.057)	(0.171)	(0.052)	(0.168)	(0.053)
Median waiting time in days (in ln)	-0.040	-0.044	-0.023	-0.021	0.039	-0.076**	-0.021	-0.019	-0.032**
	(0.027)	(0.030)	(0.026)	(0.016)	(0.032)	(0.033)	(0.016)	(0.032)	(0.014)
Patients aged 0-14 (% in ln)	-0.036**	-0.040*	-0.187	-0.071**	-0.027	-0.086**	0.147	0.035	-0.046*
	(0.017)	(0.022)	(0.160)	(0.027)	(0.041)	(0.039)	(0.161)	(0.023)	(0.024)
Patients aged 60 and over (% in ln)	-0.004	-0.004	0.009	0.003	0.046	0.040	-0.013	-0.007	0.042

	(0.016)	(0.019)	(0.021)	(0.020)	(0.038)	(0.064)	(0.020)	(0.022)	(0.055)
Female patients (% in ln)	0.161	0.401	0.021	0.085	0.288	0.694***	0.381	0.076	0.300
	(0.294)	(0.340)	(0.455)	(0.230)	(0.335)	(0.262)	(0.361)	(0.231)	(0.234)
Total tests (in ln)	-0.016	-0.017	-0.012	0.072***	-0.003	-0.028	-0.004	-0.087***	-0.010
	(0.013)	(0.015)	(0.024)	(0.021)	(0.028)	(0.019)	(0.027)	(0.024)	(0.012)
hh_bd_30	-0.087	-0.088	-0.088	-0.003	-0.052*	-0.066	-0	-0.084	0.022
	(0.061)	(0.064)	(0.059)	(0.023)	(0.027)	(0.068)	(0.022)	(0.063)	(0.016)
Hospital fixed effects									
teaching	-0.033	0.008	-0.091***	0.171***	-0.045*	-0.015	0.099***	-0.204***	-0.021
	(0.026)	(0.031)	(0.033)	(0.027)	(0.027)	(0.034)	(0.028)	(0.031)	(0.022)
Performance rating (star + use_resources)	0.008*	0.008	0.013*	0.012*	-0.032*	0.011	-0.005	-0.004	0.003
	(0.004)	(0.005)	(0.007)	(0.006)	(0.019)	(0.008)	(0.007)	(0.007)	(0.005)
Year fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	25.521***	23.114***	40.397***	3.976	49.450**	32.943***	-12.677	26.225**	14.399**
	(5.457)	(6.934)	(9.277)	(12.775)	(24.415)	(9.766)	(11.151)	(12.147)	(6.127)
Observations	1,504	1,504	1,504	1,500	1,499	1,500	1,504	1,500	1,500
R-squared	0.320	0.248	0.325	0.554	0.088	0.289	0.142	0.130	0.234
Number of id	201	201	201	201	201	201	201	201	201

Table 8. Wave analysis' empirical results

	Inpatient admissions	**Elective inpatients**	**Emergency admissions**	**Patients attending first outpatient appointment**	**Patients first attending A&E department**	**Inpatient admissions without overnight stay**	**Elective-emergency ratio**	**Inpatient-outpatient rati**	**Daycase-outpatient ratio**
Policy variable									
merged_y1	0.022	0.017	0.028	0.030	-0.010	0.036	-0.011	-0.008	0.014
	(0.029)	(0.036)	(0.039)	(0.025)	(0.087)	(0.051)	(0.042)	(0.032)	(0.028)
merged_y2	0.011	-0.004	0.035	0.049	0.095*	-0.011	-0.038	-0.036	-0.007
	(0.032)	(0.038)	(0.029)	(0.037)	(0.056)	(0.058)	(0.025)	(0.040)	(0.027)
merged_y3	0.024	-0.012	0.090*	0.055*	-0.132	-0.030	-0.103**	-0.032	-0.018
	(0.045)	(0.053)	(0.047)	(0.032)	(0.203)	(0.061)	(0.046)	(0.061)	(0.020)
merged_y6	0.027	0.049**	-0.008	-0.019	-0.017	0.128***	0.057***	0.045*	0.078***
	(0.020)	(0.022)	(0.020)	(0.017)	(0.019)	(0.028)	(0.015)	(0.023)	(0.013)
merged_y7	0.184***	0.176**	0.200***	-0.028	0.202***	0.179**	-0.024	0.211***	0.011
	(0.068)	(0.071)	(0.069)	(0.034)	(0.074)	(0.076)	(0.036)	(0.072)	(0.024)
FT	0.034	0.041	0.019	0.023	0.038	0.041	0.023	0.010	-0
	(0.028)	(0.030)	(0.029)	(0.023)	(0.052)	(0.035)	(0.018)	(0.034)	(0.014)
Inputs									
Operating theatres (*in ln*)	0.075	0.067	0.090	0.041	0.001	0.031	-0.022	0.034	-0.050
	(0.092)	(0.097)	(0.096)	(0.045)	(0.097)	(0.092)	(0.048)	(0.095)	(0.032)
Total available beds (in ln)	0.301**	0.275**	0.345***	0.088	0.222**	0.213	-0.070	0.213*	-0.068*
	(0.126)	(0.130)	(0.124)	(0.054)	(0.107)	(0.132)	(0.045)	(0.126)	(0.038)
Share of medical staff (% in ln)	-0.438**	-0.421*	-0.556***	-0.256	-1.730*	-0.864***	0.134	-0.182	-0.437***
	(0.182)	(0.227)	(0.178)	(0.208)	(0.897)	(0.328)	(0.195)	(0.264)	(0.158)
Share of non-medical staff (% in ln)	-3.261*	-2.929	-4.487**	-2.517	-15.797*	-6.837**	1.558	-0.754	-3.779**
	(1.783)	(2.162)	(1.724)	(2.129)	(8.985)	(2.977)	(1.779)	(2.645)	(1.462)
Controls									
Average length of stay (in ln)	-0.442*	-0.396	-0.509**	-0.023	-0.150	-0.284	0.113*	-0.420*	0.117***
	(0.234)	(0.249)	(0.218)	(0.037)	(0.098)	(0.242)	(0.059)	(0.239)	(0.039)

Median waiting time in days (in ln)	-0.047	-0.049	-0.043	-0.021	0.044	-0.076**	-0.006	-0.025	-0.026**
	(0.034)	(0.038)	(0.031)	(0.015)	(0.036)	(0.038)	(0.014)	(0.039)	(0.011)
Patients aged 0-14 (% in ln)	-0.020	-0.036	-0.003	-0.051	-0.065	-0.046	-0.033	0.030	-0.013
	(0.039)	(0.050)	(0.035)	(0.033)	(0.084)	(0.072)	(0.038)	(0.051)	(0.034)
Patients aged 60 and over (% in ln)	0.466	0.600	0.371	0.412	1.228	1.943***	0.229	0.054	1.293***
	(0.498)	(0.528)	(0.552)	(0.264)	(1.024)	(0.542)	(0.350)	(0.532)	(0.178)
Female patients (% in ln)	0.579	0.897	0.227	0.169	1.287	1.602***	0.669	0.410	0.696***
	(0.539)	(0.575)	(0.678)	(0.325)	(1.135)	(0.607)	(0.493)	(0.542)	(0.195)
Total tests (in ln)	0.013	0.009	0.017	0.079***	0.065*	-0.006	-0.008	-0.065**	-0.013
	(0.025)	(0.027)	(0.026)	(0.021)	(0.037)	(0.032)	(0.016)	(0.030)	(0.015)
hh_bd_30	-0.142	-0.149	-0.135	-0.010	-0.055	-0.142	-0.014	-0.133	0.007
	(0.105)	(0.110)	(0.099)	(0.020)	(0.040)	(0.109)	(0.022)	(0.105)	(0.018)
Hospital fixed effects									
teaching	-0.026	0.024	-0.097***	0.194***	-0.020	0.011	0.122***	-0.220***	-0.011
	(0.032)	(0.036)	(0.037)	(0.035)	(0.056)	(0.041)	(0.027)	(0.038)	(0.018)
Performance rating (star + use_resources)	0.009**	0.008	0.010**	0.003	-0.037**	0.014*	-0.003	0.005	0.007
	(0.004)	(0.005)	(0.005)	(0.006)	(0.019)	(0.009)	(0.006)	(0.008)	(0.005)
Year fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	21.777**	18.265*	27.941***	19.421*	74.757**	29.004**	-5.071	7.002	15.021**
	(9.170)	(10.821)	(8.715)	(10.420)	(35.190)	(14.164)	(7.742)	(12.466)	(6.845)
Observations	1,115	1,115	1,115	1,113	1,115	1,112	1,115	1,113	1,112
R-squared	0.290	0.236	0.351	0.504	0.105	0.304	0.206	0.118	0.324
Number of id	181	181	181	181	181	181	181	181	181

Table 9. Wave analysis' empirical results

	Inpatient admissions	**Elective inpatients**	**Emergency admissions**	**Patients attending first outpatient appointment**	**Patients first attending A&E department**	**Inpatient admissions without overnight stay**	**Elective-emergency ratio**	**Inpatient-outpatient rati**	**Daycase-outpatient ratio**
Policy variable									
merged_forward_y1	0.285***	0.240***	0.360***	-0.008	0.328***	0.320***	-0.119***	0.292***	0.089***
	(0.060)	(0.064)	(0.061)	(0.044)	(0.106)	(0.067)	(0.034)	(0.070)	(0.027)
merged_forward_y2	-0.004	-0.001	-0.012	-0.006	-0.013	-0.006	0.011	0.003	-0.004
	(0.018)	(0.019)	(0.021)	(0.011)	(0.062)	(0.024)	(0.016)	(0.018)	(0.013)
merged_forward_y3	0.003	0.021	-0.025	-0.007	-0.024	0.030	0.047***	0.010	0.009
	(0.016)	(0.018)	(0.018)	(0.013)	(0.032)	(0.022)	(0.014)	(0.020)	(0.011)
merged_forward_y4	-0.014	-0.020	-0.004	-0.006	0.044	-0.027	-0.016	-0.013	-0.007
	(0.024)	(0.028)	(0.024)	(0.015)	(0.032)	(0.035)	(0.020)	(0.028)	(0.011)
merged_forward_y5	-0.001	-0.001	0.001	-0.024	0.009	0.009	-0.002	0.029	0.010
	(0.014)	(0.015)	(0.016)	(0.032)	(0.034)	(0.034)	(0.013)	(0.032)	(0.024)
merged_forward_y6	-0.009	-0.021	0.011	-0.054**	-0.038	-0.035*	-0.032	0.044	-0.014
	(0.014)	(0.014)	(0.022)	(0.025)	(0.037)	(0.021)	(0.022)	(0.028)	(0.012)
merged_forward_y7	-0.011	-0.007	-0.013	-0.009	-0.043	-0.004	0.006	-0.003	0.004
	(0.020)	(0.027)	(0.021)	(0.036)	(0.043)	(0.045)	(0.027)	(0.037)	(0.021)
merged_forward_y8	-0.086***	-0.081***	-0.090***	-0.032	0.028	-0.107**	0.009	-0.053	-0.024
	(0.028)	(0.031)	(0.033)	(0.043)	(0.044)	(0.049)	(0.029)	(0.052)	(0.026)
FT	0.035	0.043	0.020	0.023	0.038	0.043	0.022	0.012	0
	(0.029)	(0.031)	(0.030)	(0.023)	(0.052)	(0.036)	(0.018)	(0.034)	(0.014)
Inputs									
Operating theatres (*in ln*)	0.065	0.059	0.077	0.036	-0.009	0.020	-0.018	0.030	-0.053
	(0.092)	(0.098)	(0.096)	(0.045)	(0.096)	(0.092)	(0.047)	(0.096)	(0.032)
Total available beds (in ln)	0.280**	0.258**	0.319***	0.084	0.202*	0.188	-0.060	0.196	-0.076*
	(0.121)	(0.126)	(0.118)	(0.055)	(0.106)	(0.129)	(0.046)	(0.124)	(0.039)
Share of medical staff (% in ln)	-0.434**	-0.417*	-0.554***	-0.219	-1.743*	-0.866***	0.137	-0.216	-0.445***
	(0.183)	(0.228)	(0.180)	(0.207)	(0.912)	(0.326)	(0.199)	(0.267)	(0.156)

Share of non-medical staff (% in ln)	-3.224*	-2.887	-4.473**	-2.128	-15.954*	-6.876**	1.586	-1.103	-3.864***
	(1.787)	(2.170)	(1.748)	(2.114)	(9.157)	(2.948)	(1.816)	(2.667)	(1.439)
Controls									
Average length of stay (in ln)	-0.443*	-0.398	-0.509**	-0.022	-0.153	-0.286	0.111*	-0.422*	0.118***
	(0.233)	(0.248)	(0.218)	(0.037)	(0.097)	(0.241)	(0.058)	(0.239)	(0.039)
Median waiting time in days (in ln)	-0.047	-0.049	-0.043	-0.021	0.043	-0.076**	-0.006	-0.025	-0.026**
	(0.034)	(0.037)	(0.031)	(0.015)	(0.035)	(0.038)	(0.014)	(0.039)	(0.011)
Patients aged 0-14 (% in ln)	-0.019	-0.034	-0.001	-0.047	-0.064	-0.044	-0.033	0.028	-0.013
	(0.039)	(0.050)	(0.035)	(0.034)	(0.086)	(0.072)	(0.038)	(0.052)	(0.034)
Patients aged 60 and over (% in ln)	0.462	0.600	0.359	0.421	1.222	1.942***	0.241	0.042	1.292***
	(0.500)	(0.530)	(0.554)	(0.266)	(1.020)	(0.544)	(0.349)	(0.535)	(0.178)
Female patients (% in ln)	0.575	0.895	0.223	0.133	1.279	1.601***	0.672	0.442	0.698***
	(0.537)	(0.572)	(0.679)	(0.331)	(1.143)	(0.606)	(0.495)	(0.543)	(0.195)
Total tests (in ln)	0.006	0.004	0.008	0.078***	0.055*	-0.013	-0.005	-0.071***	-0.015
	(0.022)	(0.025)	(0.020)	(0.020)	(0.032)	(0.029)	(0.016)	(0.027)	(0.015)
hh_bd_30	-0.144	-0.151	-0.137	-0.011	-0.055	-0.145	-0.014	-0.133	0.007
	(0.106)	(0.111)	(0.100)	(0.020)	(0.041)	(0.110)	(0.022)	(0.106)	(0.018)
Hospital fixed effects									
teaching	-0.033	0.017	-0.103***	0.183***	-0.020	0.001	0.120***	-0.216***	-0.013
	(0.032)	(0.036)	(0.037)	(0.037)	(0.059)	(0.042)	(0.029)	(0.040)	(0.019)
Performance rating (star + use_resources)	0.008**	0.008	0.011**	0.003	-0.038**	0.014*	-0.003	0.006	0.007
	(0.004)	(0.005)	(0.005)	(0.006)	(0.019)	(0.009)	(0.006)	(0.008)	(0.005)
Year fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	21.843**	18.246*	28.214***	17.750*	75.783**	29.435**	-5.363	8.724	15.498**
	(9.260)	(10.922)	(8.839)	(10.317)	(35.997)	(14.061)	(7.865)	(12.674)	(6.730)
Observations	1,115	1,115	1,115	1,113	1,115	1,112	1,115	1,113	1,112
R-squared	0.294	0.239	0.356	0.510	0.105	0.308	0.209	0.122	0.325
Number of id	181	181	181	181	181	181	181	181	181

Table 10. Event study's empirical results

	Inpatient admissions	**Elective inpatients**	**Emergency admissions**	**Patients attending first outpatient appointment**	**Patients first attending A&E department**	**Inpatient admissions without overnight stay**	**Elective-emergency ratio**	**Inpatient-outpatient rati**	**Daycase-outpatient ratio**
Policy variable									
merged_lag2	0.010	-0.009	0.040	0.113***	0.097	-0.029	-0.050	-0.104	-0.027
	(0.076)	(0.085)	(0.068)	(0.041)	(0.115)	(0.098)	(0.049)	(0.071)	(0.026)
merged_lag1	-0.064	-0.083	-0.032	0.092*	0.027	-0.074	-0.051	-0.156*	0.005
	(0.069)	(0.075)	(0.071)	(0.052)	(0.059)	(0.081)	(0.045)	(0.083)	(0.026)
merged	0.029	0.020	0.045*	0.079**	-0.004	0.029	-0.025	-0.050	0.007
	(0.024)	(0.030)	(0.027)	(0.032)	(0.049)	(0.051)	(0.032)	(0.035)	(0.027)
merged_lead1	0.027	0.021	0.033	0.079**	-0.021	0.017	-0.012	-0.052	-0.004
	(0.025)	(0.031)	(0.028)	(0.032)	(0.050)	(0.048)	(0.030)	(0.039)	(0.025)
merged_lead2	0.029	0.041	0.009	0.064**	-0.042	0.047	0.032	-0.035	0.006
	(0.029)	(0.033)	(0.031)	(0.027)	(0.034)	(0.051)	(0.029)	(0.038)	(0.027)
merged_lead3	0.013	0.018	0.004	0.061**	0.001	0.016	0.014	-0.054*	-0.002
	(0.016)	(0.020)	(0.019)	(0.028)	(0.041)	(0.039)	(0.022)	(0.031)	(0.024)
FT	0.029	0.036	0.014	0.024	0.040	0.031	0.022	0.005	-0.004
	(0.029)	(0.031)	(0.029)	(0.023)	(0.052)	(0.036)	(0.017)	(0.034)	(0.014)
Inputs									
Operating theatres (*in ln*)	0.068	0.064	0.072	0.036	-0.033	0.014	-0.008	0.033	-0.064*
	(0.089)	(0.094)	(0.093)	(0.043)	(0.107)	(0.087)	(0.047)	(0.094)	(0.035)
Total available beds (in ln)	0.294**	0.276**	0.325***	0.083	0.205*	0.212	-0.049	0.212	-0.071*
	(0.127)	(0.134)	(0.121)	(0.053)	(0.109)	(0.138)	(0.046)	(0.129)	(0.038)
Share of medical staff (% in ln)	-0.469***	-0.474**	-0.545***	-0.264	-1.822*	-0.949***	0.071	-0.205	-0.471***
	(0.175)	(0.219)	(0.167)	(0.205)	(0.929)	(0.316)	(0.187)	(0.262)	(0.151)
Share of non-medical staff (% in ln)	-3.513**	-3.430	-4.255**	-2.561	-16.717*	-7.660***	0.825	-0.957	-4.102***
	(1.756)	(2.140)	(1.636)	(2.095)	(9.238)	(2.900)	(1.704)	(2.650)	(1.381)
Controls									

Average length of stay (in ln)	-0.461*	-0.434	-0.492**	-0.011	-0.187	-0.356	0.057	-0.450*	0.085**
	(0.249)	(0.265)	(0.232)	(0.036)	(0.119)	(0.258)	(0.055)	(0.253)	(0.035)
Median waiting time in days (in ln)	-0.044	-0.044	-0.045	-0.024*	0.047	-0.067*	0.001	-0.020	-0.023**
	(0.035)	(0.038)	(0.032)	(0.015)	(0.037)	(0.039)	(0.013)	(0.040)	(0.011)
Patients aged 0-14 (% in ln)	-0.028	-0.053	0.009	-0.038	-0.086	-0.079	-0.062	0.010	-0.028
	(0.038)	(0.052)	(0.029)	(0.033)	(0.101)	(0.079)	(0.041)	(0.052)	(0.036)
Patients aged 60 and over (% in ln)	0.526	0.797	0.167	0.258	1.360	2.310***	0.630***	0.268	1.457***
	(0.514)	(0.547)	(0.494)	(0.192)	(1.146)	(0.567)	(0.203)	(0.551)	(0.176)
Female patients (% in ln)	0.424	0.747**	-0.009	-0.076	0.978	1.381***	0.755***	0.498	0.622***
	(0.309)	(0.332)	(0.301)	(0.101)	(0.866)	(0.386)	(0.147)	(0.322)	(0.136)
Total tests (in ln)	0.010	0.009	0.010	0.076***	0.056*	-0.006	-0.002	-0.065**	-0.013
	(0.018)	(0.021)	(0.017)	(0.020)	(0.032)	(0.027)	(0.016)	(0.025)	(0.015)
hh_bd_30	-0.063	-0.059	-0.070	0.002	-0.037	-0.048	0.011	-0.066	0.011
	(0.046)	(0.048)	(0.044)	(0.013)	(0.025)	(0.048)	(0.013)	(0.048)	(0.009)
Hospital fixed effects									
teaching	-0.061	-0.054	-0.062	-0.019	-0.024	-0.038	0.008	-0.040	0.017
	(0.057)	(0.071)	(0.052)	(0.076)	(0.058)	(0.076)	(0.060)	(0.074)	(0.025)
Performance rating (star + use_resources)	0.010**	0.010*	0.011**	0.002	-0.035*	0.018**	-0.001	0.008	0.009*
	(0.004)	(0.005)	(0.005)	(0.006)	(0.019)	(0.008)	(0.006)	(0.008)	(0.005)
Year fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	23.336**	20.438*	28.563***	21.262**	80.357**	32.534**	-3.520	6.700	16.423**
	(9.032)	(10.757)	(8.345)	(10.018)	(37.041)	(14.032)	(8.014)	(13.006)	(6.404)
Observations	1,074	1,074	1,074	1,072	1,074	1,071	1,074	1,072	1,071
R-squared	0.275	0.227	0.344	0.522	0.105	0.316	0.277	0.121	0.357
Number of id	149	149	149	149	149	149	149	149	149

Table 11. Performance analysis – DID estimation

	Performance rating Type-1 (star + quality of the services)		**Performance rating Type-2 (star + use of resources)**	
Policy variable				
merged	0.554*		0.857*	
	(0.322)		(0.455)	
merged_forward		-1.373***		11.767***
		(0.105)		(1.026)
FT	-1.128***	-1.116***	1.681***	1.663***
	(0.225)	(0.225)	(0.291)	(0.293)
Controls				
teaching	-13.689***	-13.696***	12.164***	12.069***
	(1.027)	(1.027)	(1.041)	(1.041)
Average length of stay (in ln)	0.066	0.075	0.632***	0.647***
	(0.091)	(0.090)	(0.103)	(0.102)
Median waiting time in days (in ln)	-0.002	-0.002	-0.011*	-0.011*
	(0.006)	(0.006)	(0.006)	(0.006)
Observations	1,846	1,846	2,045	2,045

Table12. Performance analysis – Wave analysis estimation

	Performance rating Type-1 (star + quality of the services)		**Performance rating Type-2 (star + use of resources)**	
Policy variable				
merged_y1	0.110		0.465	
	(0.537)		(0.485)	
merged_y2	0.703		1.379*	
	(0.519)		(0.796)	
merged_y3	1.023		1.532	
	(0.769)		(1.811)	
merged_y6	12.811***		-14.608***	
	(1.003)		(1.003)	
merged_y7	0.113		13.804***	
	(0.121)		(1.024)	
merged_forward_y1		-1.109***		13.114***
		(0.241)		(1.048)
merged_forward_y2		-0.559		-0.186
		(0.476)		(0.526)
merged_forward_y3		-0.089		-0.469
		(0.438)		(0.482)
merged_forward_y4		-0.221		-0.674
		(0.499)		(0.576)
merged_forward_y5		-0.175		-0.399
		(0.547)		(0.670)
merged_forward_y6		0.635		0.965
		(0.601)		(0.590)
merged_forward_y7		0.429		-0.505
		(0.672)		(0.731)
merged_forward_y8		-0.711		0.565
		(0.971)		(1.331)
FT	-1.128***	-1.123***	1.683***	1.699***
	(0.225)	(0.230)	(0.291)	(0.290)
Controls				
teaching	-12.437***	-13.682***	13.938***	12.674***
	(1.027)	(1.030)	(1.041)	(1.042)
Average length of stay (in ln)	0.065	0.064	0.632***	0.610***
	(0.092)	(0.091)	(0.103)	(0.103)
Median waiting time in days (in ln)	-0.002	-0.002	-0.011*	-0.011*
	(0.006)	(0.006)	(0.006)	(0.006)
Observations	1,846	1,846	2,045	2,045

Table 13. Performance analysis – Event study estimation

	Performance rating Type-1 (star + quality of the services)	**Performance rating Type-2 (star + use of resources)**
Policy variable		
merged_lag2	1.148	0.630
	(1.027)	(0.961)
merged_lag1	-0.068	0.222
	(0.707)	(0.718)
merged	0.212	0.567
	(0.487)	(0.568)
merged_lead1	-0.135	0.559
	(0.614)	(0.500)
merged_lead2	-0.081	0.304
	(0.555)	(0.568)
merged_lead3	-0.405	-0.319
	(0.502)	(0.626)
FT	-1.103***	1.686***
	(0.225)	(0.294)
Controls		
teaching	-1.271	-0.230
	(0.814)	(0.965)
Average length of stay (in ln)	0.079	0.588***
	(0.092)	(0.111)
Median waiting time in days (in ln)	-0.001	-0.009
	(0.006)	(0.006)
Observations	3,423	3,488

Dipartimento di Studi Giuridici
Filosofici ed Economici

Sapienza
Università di Roma

Roma, 19 Maggio 2019

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Io sottoscritta Marini Giorgia Marini dichiaro che la studentessa Cirulli Vanessa è regolarmente iscritta al terzo anno del Dottorato di Ricerca in ECONOMIA E FINANZA (XXXII ciclo) presso la Sapienza Università di Roma.

Si allega copia in carta semplice del certificato di carriera.

In fede,

Giorgia Marini

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