HAVE MERGERS AFFECTED HOSPITAL ACTIVITY IN THE ENGLISH HOSPITAL SECTOR?[1]

(PRELIMINARY VERSION – PLEASE DO NOT QUOTE W/O AUTHOR'S PERMISSION)

Giorgia Marini

Centre for Economic and International Studies
University of Rome Tor Vergata

November, 2009

SUMMARY

Over the past fifteen years, there has been a distinct change in the NHS "market" in England with widespread merger activity taking place – in 1994 there were around 262 Trusts, reducing to 169 by 2008. The industrial economics literature applied to the healthcare market, offers a number of 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 in terms of the quality of the service provided to the patients and the efficient use of available resources.

Keywords: Trust mergers, ownership, Foundation Trusts, scale and scope economies
JEL Classification: I11, O33

---

[1] A previous version of this paper was presented at the 14th Italian Conference on Health Economics (October 2009).

INTRODUCTION

Since the 1990s, merger activity between hospitals 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).
As a consequence, a wide literature on hospital mergers has emerged to identify which hospital's characteristics are taken into account when choosing a merging partner (Harrison, 2006), to study hospital 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), to impact prices and hospital costs (Radach Spang et al., 2009), to affect social welfare (Town et al., 2006) and quality of the services provided (Ho and Hamilton, 2000; Propper et al., 2004).[2]
Knowing that hospitals exhibiting economies of scale are more likely to merge (Sinay, 1998) and that English Trusts, regardless of the ownership status, exhibit economies of scale (Marini and Miraldo, 2009), the main purpose of this paper is to investigate whether English Trusts that have merged are able to reconfigure their product mix offer more significantly than non-merged Trusts and achieve a relative advantage.
Hospital mix offer is measured through the total number of admitted patients, the total number of outpatient attendances (including first and subsequent attendances) and the total number of A&E attendances (including first and subsequent attendances). In effect, according to figures in Table 1, hospital activity in England has increased between 2000/01 and 2007/08 by around 121,000 new treated patients. There has been not only a change in the level of activity but also a change in the composition of mix offer. In fact, the shares of admitted patients and outpatient attendances have decreased between 2000/01 and 2007/08 (from 17.3 to 16.2 the former, from 69.1 to 64.4 the latter), while the share of A&E attendances has increased over the same period of time (from 13.5 to 19.4).

[Table 1 about here]

In order to answer the question whether the level and composition of mix offer has changed due to hospital mergers, we use a DID model in which we check whether being a merged Trust has a significant impact not only on the level but also on the composition of hospitals' activity.
As a change in the offer of services provided might have an impact on the quality of the services, our results might be particularly helpful from a policy perspective.

METHODOLOGY

We use a difference in difference (DID) methodology to test whether there are any differences in the level of activity between merged Trusts and non-merged Trusts, whether the merger has made any difference at all or whether indeed there are long-standing differences in the level of activity between these different types of organisations, which have made some of them more likely to merge than others. We track three measures of activity over time for merged Trusts before they actually merged and investigate how they compare with non-merged Trusts over time. We explore the robustness of our results using three dependent variables, two different control groups and three estimation methods.
One of the main challenges in evaluating whether Trust mergers have any effect on the level and composition of activity 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

[2] I only focus on the last 10 years of literature.

potential selection bias is therefore a key component of our research and we describe below our approach to this.
We use two methods that have been proposed for dealing with selection bias (or self-selection) in treatment effect models: the DID method and the difference in difference matching method (Blundell and Costa Dias, 2002; Wooldridge, 2002).
We 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. To identify the average effect of a merger, we estimate the following model:

$$y_{it} = \beta_0 + \sum_{j=1}^{8} \beta_{1j} M_{ij} + \sum_{t=2}^{8} \beta_{2t} D_t + \sum_{k=1}^{5} \beta_{3k} X_{kit} + \sum_{j=1}^{8}\sum_{t=2}^{8} \delta_{jt} M_{ij} D_t + \varepsilon_{it} \qquad (3)$$

in which y_{it} is the level of activity (either total number of admitted patients or total number of outpatient attendances or the total number of A&E attendances) for Trust i in year t where t covers 8 years from 2000/01 to 2007/08. M_{ij} is the dummy variable associated with the jth wave of Trust mergers. So, M_{i1} takes value 1 if a Trust merged in 2000/01, M_{i2} takes value 1 if a Trust merged in 2001/02, and so on. Note that M_{i1}, M_{i5} and M_{i6} are dropped as there were no mergers occurring in 2000/01, 2004/05 and 2005/06. D_t is a year dummy for $t = 2$ (2001/02), $t = 3$ (2002/03), and so on, being year 2000/01 the baseline year of our analysis (D_1 is dropped). X_{kit} is the kth observable factor affecting the dependent variable for Trust i in year t.
The merger main effect M_{ij} controls for all time invariant differences between merged Trusts and the control group. The year dummy D_t controls for all other unobserved temporal factors affecting the dependent variable. The interaction of the year and merger dummies ($M_{ij}D_t$) identifies the change in the level of activity from the baseline year for merged Trusts relative to control Trusts. The DID methodology assumes that all other temporal factors affecting the dependent variable have the same effects for merged Trusts and the control group.
The effect of a merger on merged Trusts (the ATT) is the DID for the year during which the merger takes place against the previous year. Therefore, for the wave of Trust mergers occurring in 2001/02, the DID measure of year 2001/02 against year 2000/01 is:

$$\begin{aligned}&[E(y_{it}|X_{it}, M_{i2}=1, D_2=1) - E(y_{it}|X_{it}, M_{i2}=1, D_1=1)] - [E(y_{it}|X_{it}, M_{i2}=0, D_2=1) - E(y_{it}|X_{it}, M_{i2}=0, D_1=1)] = \\ &= \left[\left(\beta_0 + \beta_{12} + \beta_{22} + \sum_{k=1}^{5}\beta_{3k} + \delta_{22}\right) - \left(\beta_0 + \beta_{12} + \beta_{21} + \sum_{k=1}^{5}\beta_{3k}\right)\right] - \left[\left(\beta_0 + \beta_{22} + \sum_{k=1}^{5}\beta_{3k}\right) - \left(\beta_0 + \beta_{21} + \sum_{k=1}^{5}\beta_{3k}\right)\right] = \\ &= \delta_{22}\end{aligned} \qquad (4)$$

This is the effect of a merger taking place in 2001/02 against year 2000/01 for the wave of Trust mergers occurring in 2001/02, but we also measure it as the effect between 2001/02 and 2002/03 $(\delta_{23} - \delta_{22})$, between 2002/03 and 2003/04 $(\delta_{24} - \delta_{23})$ and so on.[3]
In a similar way, for the wave of Trust mergers occurring in 2002/03, the DID measure of year 2002/03 against year 2001/02 is $(\delta_{33} - \delta_{32})$. This is the effect of a merger taking place in 2002/03 against year 2001/02 for the wave of Trust mergers occurring in 2002/03, but we also measure it as the effect between 2002/03 and 2003/04 $(\delta_{34} - \delta_{33})$, between 2003/04 and 2004/05 $(\delta_{35} - \delta_{34})$ and so on. For the wave of Trust mergers occurring in 2003/04, the

[3] Note that δ_{j1} does not appear either in the (4) or in any other formula, as year 1 is the baseline year. As a consequence, δ_{j1} is automatically dropped and replaced with β_{1j}. Instead, $\delta_{1t}, \delta_{5t}, \delta_{6t}$ are always dropped as there were no mergers occurring in 2000/01, 2004/05 and 2005/06.

DID measure of year 2003/04 against year 2002/03 is $(\delta_{44} - \delta_{43})$, while for the wave of Trust mergers occurring in 2006/07, the DID measure of year 2006/07 against year 2005/06 is $(\delta_{77} - \delta_{76})$ and for the wave of Trust mergers occurring in 2007/08, the DID measure of year 2007/08 against year 2006/07 is $(\delta_{88} - \delta_{87})$. Therefore, once we have calculated all the measures of interest, we test for the effect of a merger on merged Trusts by checking whether the DID coefficients are significantly different from zero.

We use two types of comparators to estimate the effects of a merger: all non-merged Trusts in the rest of England and a matched control group of non-merged Trusts using propensity score matching.

The first control group, all non-merged Trusts, is intuitively plausible, since we wish to test whether changes in the dependent variable are the result of a specific merger and how this impacts on all Trusts in England. The advantage of this control group is that coefficient estimates in the regressions may be more robust since we have a large control group (between 159 and 170 Trusts). The disadvantage of this control group is that it may be very heterogeneous, including also Trusts that may have unobserved differences in performance time trends, thereby violating the identifying assumption of the DID method (Dawson et al., 2007).

As an alternative comparator group, we use the propensity score matching method to match merged Trusts with non-merged Trusts on the basis of observable characteristics, other than their level of activity. The advantage of this method is that statistically there is a strong match between merged and non-merged Trusts on their observable pre-treatment characteristics, although the control group is still smaller (between 130 and 144 Trusts).

Using the DID methodology, for each of the above control groups we ran three types of estimation techniques: Ordinary Least Squares (OLS), fixed effects and random effects models.

We ran OLS clustering on Trusts. We also specified the Huber / White sandwich estimator of variance to calculate robust standard errors. We ran a fixed effects model using the xtreg, fe command in Stata 10 (Stata, 2007). The model allows the option of clustering on Trusts and the calculation of robust standard errors. The third estimation method is the random effects model. Using the xtreg, re command in Stata 10 (Stata, 2007), this method fits a random effects model by using the GLS estimator (producing a matrix-weighted average of the between and within results). The model again allows the option of clustering on Trusts and the calculation of robust standard errors.

We tested for multicollinearity using the variance inflation factors (VIFs) for the independent variables specified in the fitted model and dropped variables if there was evidence of excessive collinearity. In all three estimation methods the regression equation specification error test (RESET test) (Ramsey, 1969) was performed in order to control for potential model's mis-specifications.

The three estimation techniques provide a useful comparison to one another regarding the stability of coefficient estimates. However, the fixed effects model may pick up much of the unobserved heterogeneity in the Trust-specific effect. Hence when comparing the DID results under different estimation techniques, the fixed effects are the preferred results. The fixed effects model does not however provide an estimate of the β_{1j} coefficients, which both the OLS and random effects models do provide. For the graphical representations of the DID models, the random effects results have been used.

DATA

Our data are annual and cover all acute and specialist Trusts in England for a period of 8 years starting in 2000/01.

The dependent variable y is the level of activity and it is measured either by the total number of admitted patients, the total number of outpatient attendances or the total number of A&E attendances.
Some control variables are included in the model to assess Trust-specific characteristics such as the average length of stay, the average number of available beds, the patient load, the competition between Trusts, the ownership status and the teaching status. The average length of stay (X_1) 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 average number of available beds (X_2) is included in the empirical specification to control for the size of each Trust. Competition between Trusts is measured by the number of Trusts within a 20km range of each Trust (X_3). 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 ownership status is identified by a dummy variable (X_4) which takes value 1 if the Trust is an independent not-for-profit public benefit corporation (also known as Foundation Trust – see the Health and Social Care Act, 2003) and value 0 otherwise. The teaching status is identified by a dummy variable (X_5) which takes value 1 if the Trust is a teaching hospital and value 0 otherwise.

RESULTS

Table 2 shows the descriptive statistics for the dependent variables and the explanatory variables included in the models.

[Table 2 about here]

Figures 1 to 3 plot the three dependent variables from 2000/01 onwards, for the five waves of merged Trusts against all non-merged Trusts.
Regarding inpatient activity (Figure 1), all waves of merged Trusts have increased the number of admitted patients over time relative to non-merged Trusts. Concerning outpatient and A&E attendances (Figures 2 and 3), Trusts that merged in 2006/07 and 2007/08 seem to have a higher level of activity than Trusts that merged in different years. In general, merged Trusts seem to work more intensively than non-merged Trusts.

[Figure 1 about here]

[Figure 2 about here]

[Figure 3 about here]

In Table 3 we present some t-tests on the differences between merged and non-merged Trusts. Given the degrees of freedom, $(N_{merged} - 1) + (N_{non-merged} - 1)$, the critical value of the 2-tailed t-statistic is equal to 1.960. If the t-statistic is lower than the critical value 1.960, we fail to reject the null and we conclude that the difference between merged and non-merged Trusts is significantly not different from zero. Therefore, looking at Table 3, differences between merged and non-merged Trusts are significantly not different from zero regarding the number of admitted patients and the number of outpatient and A&E attendances. As we fail to reject the null, we can conclude that the difference in the level of activity between merged and non-merged Trusts is significantly not different from zero. In other words, differences in production between merged and non-merged Trusts are not due to the fact that they operate at different points on the same production function: merged and non-merged Trusts effectively operate on different production functions.

[Table 3 about here]

The matched control group

The results for the logit model are shown in Table 4.

[Table 4 about here]

The sample consisted of 1,300 observations, of which 1,088 relative to non-merged Trusts and 212 to merged Trusts. The model produced a Pseudo R-squared of 0.0135 percent. There were 4 blocks of Trusts in the final propensity score model, although these were pooled together to produce a control group of 1,076 observations under common support, compared to 212 observations in the treatment group with the balancing property satisfied. Once merged and non-merged Trusts 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).
As matching variables, three dummy variables were selected in order to control for the ownership status, the teaching status and the geographical position of each trust. The three selected variables have in fact a considerable importance in determining a merger and they also produced the highest number of Trusts in the control group under the common support assumption.
According to the results in Table 4, it is more likely that a merged Trust is also a teaching hospital and less likely that a merged Trust is also a Foundation Trust or a Trust in the London area.

Total number of admitted patients

Table 5 shows the regression results for the DID models in which we test whether the treatment group (merged Trusts) relative to the two control groups (all non-merged Trusts and matched non-merged Trusts) were any different in terms of number of admitted patients.

[Table 5 about here]

The coefficients β_{12} to β_{18} (variables _Imerged_wave_2 to _Imerged_wave_8) in the OLS and the random effects models indicate the overall difference in the number of admitted patients between wave 2, 3, 4, 7 and 8 merged Trusts and the control groups.[4] These parameters are mostly significant for all waves suggesting overall higher number of admitted patients for merged Trusts relative to the all non-merged Trusts control group and the matched control group.
The coefficients β_{22} to β_{28} (variables _Iyear_2 to _Iyear_8) give the change in the number of admitted patients for all waves of merged Trusts between year *t* and the baseline year.[5] These coefficients are all positive and highly significant suggesting an increase in the number of admitted patients for each year relative to the baseline year.
The next δ_{22} to δ_{88} (variables _ImerXyea_2_2 to _ImerXyea_8_8) coefficients give the interaction effects between the status of merged Trust and the year during which the merger takes place. These pick up differences for merged Trusts over and above the overall year trends in the β_2 coefficients.
The last β_{31} to β_{35} (variables alos to ft) coefficients represent the set of observable factors affecting the dependent variable. Not surprisingly, an increase in the average length of stay enables a significant reduction in the number of admitted patients, while the availability of new beds enables a significant augment in the number of admitted patients; an increase in the number of competitor Trusts reduces significantly the number of admitted patients; finally, while the presence of teaching units and being a Foundation Trust both enable an increase in the number of admitted patients.[6]

[4] Remind that the coefficients β_{11}, β_{15}, and β_{16} are dropped as there were no mergers occurring in 2000/01, 2004/05 and 2005/06.
[5] Remind that the coefficient β_{21} is automatically dropped as year 1 (2000/01) is the baseline year.
[6] Note that the teaching status dummy variable, being a time-invariant regressor, is automatically excluded from the fixed effects models.

The R-squared is 0.904 for the OLS models, around 0.514 for the fixed effects models and 0.845 for the random effects models. The RESET test is passed in four of the six models, meaning that the model is correctly specified.

Our main interest in these results is to test the overall DID in the number of admitted patients for the 5 waves of merged Trusts relative to the comparator groups in the year during which the merger took place versus the previous year. We therefore test whether _ImerXyea_2_2 (δ_{22}) minus _Imerged_wave_2 (β_{12}) is significantly different from zero for Trusts that merged in 2001/02, whether _ImerXyea_3_3 (δ_{33}) minus _ImerXyea_3_2 (δ_{32}) is significantly different from zero for Trusts that merged in 2002/03, whether _ImerXyea_4_4 (δ_{44}) minus _ImerXyea_4_3 (δ_{43}) is significantly different from zero for Trusts that merged in 2003/04, whether _ImerXyea_7_7 (δ_{77}) minus _ImerXyea_7_6 (δ_{76}) is significantly different from zero for Trusts that merged in 2006/07, and whether _ImerXyea_8_8 (δ_{88}) minus _ImerXyea_8_7 (δ_{87}) is significantly different from zero for Trusts that merged in 2007/08.

The DID is positive for waves 2 and 7 and negative for wave 8, suggesting that on average the effect of a merger on merged Trusts is to increase (reduce) the number of admitted patients by 3,924 and 9,368 patients (4,885 patients) for waves 2 and 7 (wave 8) compared to the different control groups.

Figures 4a and 4b show the change in the number of admitted patients between years plotted for merged Trusts relative to non-merged Trusts comparator group. We use the random effects estimates from the previous results to show this. We choose the random effects estimates because they are very similar to the fixed effects estimates and because we require the overall merger effect, the β_{12} to β_{18} coefficients, to calculate the changes over time. We estimate the treatment outcome for merged Trusts in each year using equation (1), test whether the difference between each year is significant and produce confidence intervals for each estimate. The overall DID in the number of admitted patients for the 5 waves of merged Trusts has been presented in the results above. The other changes are calculated in a similar fashion. For example for wave 2, the difference between year 2 and 3 is the test of whether _ImerXyea_2_3 (δ_{23}) minus (_ImerXyea_2_2) (δ_{22}) is significant; the difference between year 3 and 4 is the test of whether _ImerXyea_2_4 (δ_{24}) minus (_ImerXyea_2_3) (δ_{23}) is significant; and so on. Changes from one year to the next are all relative to zero and show either a positive increase or a negative decrease and hence fluctuate around zero. A confidence interval is a range of values (one of the vertical bars in the Figures) that has a high probability (usually set at a 95% certainty) of containing the parameter being estimated. Thus is the confidence intervals are very long we have less certainty about the precision of the parameter estimate. If the confidence intervals overlap zero, the change is not significant.

Looking at Figures 4a and 4b, we see that there is an increase in the number of admitted patients relative to all non-merged Trusts and the matched control group from year 1 to year 2 for wave 2 merged Trusts, from year 3 to year 4 for wave 4 merged Trusts, and from year 6 to year 7 for wave 7 merged Trusts; also there is a decline in the number of admitted patients relative to all non-merged Trusts and the matched control group from year 2 to year 3 for wave 3 merged Trusts and from year 7 to year 8 for wave 8 merged Trusts. The confidence intervals overlap zero for wave 2, 3 and 4, while it does not for waves 7 and 8.

[Figure 4a about here]

[Figure 4b about here]

Figures 5a and 5b show the total number of admitted patients for merged Trusts relative to each comparator group for each of the eight years. Again we use the random effects estimates from the previous results to show this. We estimate the treatment outcome for merged Trusts in each year using equation (1) and produce confidence intervals for each estimate. In this case, zero represents the comparator group. Thus, if the confidence intervals overlap zero, the difference between merged and non-merged Trusts is not significant. For example, for wave 2 merged Trusts, the coefficient estimate for the baseline year 1 is the β_{12} coefficient. The coefficient estimate for year 2 is the main merger effect (β_{12}) plus the interaction effect in year 2 (δ_{23}); the coefficient estimate for year 3 is the main merger effect (β_{12}) plus the interaction effect in year 3 (δ_{24}); and so on. Changes from one year to the next are all relative to zero and show either a positive increase or a negative decrease and hence fluctuate around zero. A confidence interval is a range of values (one of the vertical bars in the Figures) that has a high probability (usually set at a 95% certainty) of containing the parameter being estimated. Thus is the confidence intervals are very long we have less certainty about the precision of the parameter estimate. If the confidence intervals overlap zero, the change is not significant.

Figures 5a and 5b show an upward trend between year 1 and 2 followed by a stable trend for wave 2, a stable trend until 2004/05 followed by an upward trend for wave 3, a generally upward trend for wave 4, a stable trend until 2004/05 followed by an upward trend until 2006/07 and by a stable trend from 2006/07 onwards for wave 7, and an unstable trend for wave 8. Of particular interest is the change in the trend direction for wave 8 before and after the merger: it is upward in 2006/07 and downward in 2007/08.

The number of admitted patients is always significantly higher compared to the all non-merged Trusts and the matched control group under the common support for all waves in all years with the exception for wave 2 in 2000/01.

[Figure 5a about here]

[Figure 5b about here]

Total number of outpatient attendances and total number of A&E attendances

Due to restrictions on the size of papers submitted to the HESG, regressions results for the DID models in which we test whether the treatment group (merged Trusts) relative to the two control groups (all non-merged Trusts and matched non-merged Trusts) were any different in terms of number of outpatient attendances and A&E attendances are not reported. ***A more detailed version of the paper is available on request*** (giorgia.marini@uniroma2.it).

Concerning the overall DID in the number of outpatient attendances for the 5 waves of merged Trusts, the DID is negative for wave 4 and positive for wave 7, suggesting that on average the effect of a merger on merged Trusts is to decrease (increase) the number of outpatient attendances by 154,321 patients (17,166 patients) for wave 4 (wave 7) compared to the different control groups. Figures 6a and 6b (not reported) show the change in the number of outpatient attendances between years plotted for merged Trusts relative to non-merged Trusts comparator group. There is an increase in the number of outpatient attendances relative to all non-merged Trusts and the matched control group from year 2 to year 3 for wave 3 merged Trusts, from year 3 to year 4 for wave 4 merged Trusts, and from year 6 to year 7 for wave 7 merged Trusts; also there is a decline in the number of outpatient attendances relative to all non-merged Trusts and the matched control group from year 1 to year 2 for wave 2 merged Trusts and from year 7 to year 8 for wave 8 merged Trusts. The confidence intervals overlap zero for wave 2, 3 and 4, while it does not for waves 7 and 8. Figures 7a and 7b (not reported) show the total number of outpatient attendances for merged Trusts relative to each comparator group for each of the eight years. There is a hump-shaped trend for wave 2, a relatively stable trend for wave 3, a reversed hump-shaped trend for wave 4, an unstable trend for wave 7 and a relatively stable trend for wave 8. The number of outpatient attendances is significantly higher compared to the all non-merged Trusts and the matched control group under the common support for wave 2 in 2002/03, for wave 3 in 2007/08, for wave 4 in 2002/03 and 2004/05, for wave 7 in 2001/02 and from 2005/06 onwards, and for wave 8 for 2002/03 and from 2004/05 onwards.

Concerning the overall DID in the number of A&E attendances for the 5 waves of merged Trusts, the DID is negative for waves 3 and 4 and positive for waves 7 and 8, suggesting that on average the effect of a merger on merged Trusts is to decrease (increase) the number of A&E attendances by 16,653 and 74,622 patients (5,909 and 4,903 patients) for waves 3 and 4 (waves 7 and 8) compared to the different control groups. Figures 8a and 8b (not reported) show the change in the number of A&E attendances between years plotted for merged Trusts relative to non-merged Trusts comparator group. There is an increase in the number of A&E attendances relative to all non-merged Trusts and the matched control group from year 1 to year 2 for wave 2 merged Trusts, from year 2 to year 3 for wave 3 merged Trusts, and from year 3 to year 4 for wave 4 merged Trusts; the number of A&E attendances relative to all non-merged Trusts and the matched control group from year 6 to year 7 for wave 7 merged Trusts and from year 7 to year 8 for wave 8 merged Trusts is basically unchanged. The confidence intervals overlap zero for wave 2, 3 and 4, while it does not for waves 7 and 8. Figures 9a and 9b (not reported) show the total number of A&E attendances for merged Trusts relative to each comparator group for each of the eight years. There is a relatively stable trend for waves 2, 3 and 7, an unstable trend for wave 4 and an upward trend for wave 8. The number of A&E attendances is significantly higher compared to the all non-merged Trusts and the matched control group under the common support for wave 2 from 2004/05 onwards, for wave 3 in 2006/07 and 2007/08, for wave 4 in 2000/01 only, and for wave 8 from 2001/02 onwards. For wave 7 it is never significant.

DISCUSSION AND CONCLUSIONS

Over the past fifteen years, there has been a distinct change in the NHS "market" in England with widespread merger activity taking place – in 1994 there were around 262 Trusts, reducing to 169 by 2008. The industrial economics literature offers a number of explanations about the driving forces behind merger activity and the impact of mergers on the performance of Trusts. For example, Trusts may have used mergers as a strategic tool to reconfigure their activities, improve their performance, change staff composition and benefit from scale and scope economies, with important policy implications in terms of the quality of the service provided to the patients and the efficient use of available resources.
In this paper, we investigate whether merged Trusts are able to reconfigure their service-mix offer more significantly than non-merged Trusts and achieve a relative advantage.
In order to answer this question, we use a DID model in which we check whether being a merged Trust has a significant impact on the level of activity.
Our results show that hospital mergers in England change both the level and the composition of Trusts' activity, with merged Trusts offering a mix of services in favour of inpatient care, against less outpatient care.
In terms of policy implications, these results suggest that the institution monitoring Trusts' merging decisions (the Monitor for the Foundation Trusts and the Department of Health for all the other Trusts) should be very careful in giving authorisation to any hospital merger as this may have irreversible consequences in terms of services offered to the public.

REFERENCES

1. Ahgren B. Is it better to be big? The reconfiguration of 21st century hospitals: Responses to a hospital merger in Sweden. *Health Policy* **87**: 92-99.
2. Blundell R, Costa Dias M. 2002. *Alternative Approaches to Evaluation in Empirical Microeconomics*. Cemmap Working Papers CWP10/02. Also available at http://cemmap.ifs.org.uk/wps/cwp0210.pdf [12 October 2009]
3. Dawson D, Gravelle H, Jacobs R, Martin S, Smith P.C. 2007. The effects of expanding patient choice of provider on waiting times: evidence from a policy experiment. *Health Economics* **16**: 113-128.

4. Dehejia, RH, Wahba S. 2002. Propensity score matching methods for non-experimental causal studies. *Review of Economics and Statistics* **84**: 151-161.
5. Dranove D. 1998. Economies of scale in non-revenue producing cost centers: implications for hospital mergers. *Journal of Health Economics* **17**: 69-83.
6. Harrison, T.D., 2006. Trust mergers: who merges with whom? Applied Economics **38**: 637-647.
7. The Health and Social Care (Community Health and Standards) Act. 2003. Also available at http://www.opsi.gov.uk/acts/acts2003/20030043.htm [12 October 2009]
8. Ho V, Hamilton BH. 2000. Hospital mergers and acquisitions: does market consolidation harm patients? *Journal of Health Economics* **19**: 767-791.
9. Kjekshus L, Hagen T. 2007. Do hospital mergers increase hospital efficiency? Evidence from a National Health Service country. Journal of Health Services Research and Policy **12**: 230-235.
10. Krishnan RA, Joshi S, Krishnan H. 2004. The influence of mergers on firms' product-mix strategies. *Strategic Management Journal* **25**: 587-611.
11. Kroneman M, Siegers JJ. 2004. The effect of hospital bed reduction on the use of beds: A comparative study of 10 European countries. *Social Science & Medicine* **59**: 1731-1740.
12. Marini G, Miraldo M. 2009. *Economies of scale and scope in the English hospital sector.* Imperial College London. Business School Discussion paper 2009/05. Also available at http://spiral.imperial.ac.uk/bitstream/10044/1/4202/1/Miraldo%202009-05.pdf [12 October 2009]
13. Preyra C, Pink G. 2006. Scale and scope efficiencies through hospital consolidations. Journal of Health Economics **25**: 1049-1068.
14. Propper C, Burgess S, Green K. 2004. Does competition between hospitals improve the quality of care?: Hospital death rates and the NHS internal market. *Journal of Public Economics* **88**: 1247-1272.
15. Radach Spang H, Arnould RJ, Bazzoli GJ. 2009. The effect of non-rural hospital mergers and acquisitions: An examination of cost and price outcomes. *Quarterly Review of Economics and Finance* **49**: 323-342.
16. Ramsey JB. Tests for specification error in classical linear least squares regression analysis. *Journal of the Royal Statistical Society: Series B* **31**: 350-371.
17. Sinay UT. Hospital mergers and closures: survival of rural hospitals. *Journal of Rural Health* 1998; **14**: 357–365.
18. Stata. 2007. *Stata Reference Manual Release 10*. Stata Press: College Station, Texas.
19. Town RJ, Wholey DR, Feldman R and Burns LR. 2006. *The Welfare Consequences of Hospital Mergers.* NBER Working Paper No. W12244. Available at SSRN: http://ssrn.com/abstract=902596
20. Wooldridge JM. 2002. *Econometric Analysis of Cross Section and Panel Data*, The MIT Press: Cambridge, Massachusetts.

Table 1. Levels and composition of hospital acitivity, 2000/01-2007/08

Hospital activity	2000/01 (shares)	2007/08 (shares)	(2007/08)-(2000/01) (Δ Shares)
Admitted patients	57783.270	73847.180	16063.910
	(17.3)	(16.2)	(-1.1)
Outpatient attendances	230715.400	292569.300	61853.900
	(69.1)	(64.4)	(-4.8)
A&E attendances	45147.110	88154.390	43007.280
	(13.5)	(19.4)	(5.9)
Total	333645.780	454570.870	120925.090

Table 2. Descriptive statistics and variable definitions, pooled data 2000/01-2007/08

Variable name	Definition	Source	n	Mean	S.D.	Min	Max
ip_adm	Total number of admitted patients	HES	1296	65152.280	38425.440	1040	205734
op_att	Total number of outpatient attendances	HES	1296	254058.900	164547.600	0	1634689
ae_att	Total number of emergency attendances	HES	1296	77611.920	52229.780	0	426295
alos	Average length of stay	HES	1296	5.640	3.662	0.615	53.400
beds	Average number of available beds	HAS	1295	744.965	441.449	0	2838.143
comp	Number of trusts within a 20km range of each trust	derived	1299	8.744	11.285	0	49
ft*	Dummy variable =1 if Trust is Foundation Trust; =0 otherwise	derived	1300	0.132	0.339	0	1
london*	Dummy variable =1 if Trust is in the London area; =0 otherwise	derived	1300	0.191	0.393	0	1
teaching*	Dummy variable =1 if Trust is teaching hospital; =0 otherwise	derived	1300	0.123	0.329	0	1

* used in logit model for the propensity score matching

Table 3. t-tests on the differences between merged and non-merged Trusts

	$N_{non-merged}$ / N_{merged}	$\mu_{non-merged}$ / μ_{merged}	$\mu_{non-merged} - \mu_{merged}$	σ^2_{merged} / σ^2_{merged}	$\sigma^2_{non-merged} / N_{non-merged}$ / $\sigma^2_{merged} / N_{merged}$	$\sqrt{\frac{\sigma^2_{non-merged}}{N_{non-merged}} + \frac{\sigma^2_{merged}}{N_{merged}}}$	$t = \frac{\lvert \mu_{non-merged} - \mu_{merged} \rvert}{\sqrt{\frac{\sigma^2_{non-merged}}{N_{non-merged}} + \frac{\sigma^2_{merged}}{N_{merged}}}}$	d.f.
Admitted patients								
non-merged Trusts	1084	56693.54	51710	1044307698	963383.49	2797.41	18.48	1294
merged Trusts	212	108403.6		1454772497	6862134.42			
Outpatients attendances								
non-merged Trusts	1084	221791.5	197257.4	19173220863	17687473.12	13531.29	14.58	1294
merged Trusts	212	419048.9		35066569764	165408347.95			
A&E attendances								
non-merged Trusts	1084	67166.75	63853.45	1876493309	1731082.39	4371.69	14.61	1294
merged Trusts	212	131020.2		3684679386	17380563.14			

Table 4. Logit model for the selection of the appropriate comparator group

ft	-0.231
	(0.233)
london	-0.492**
	(0.214)
teaching	0.757***
	(0.208)
constant	-1.632***
	(0.0908)
Observations	1300
Pseudo R-squared	0.0135
LR Chi-squared (3)	15.61
(p-value)	(0.0014)

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5. Regression results for difference in difference model for overall effect of Trust merger wave analysis on total number of admitted patients

Variable name	Parameter name	All non-merged Trusts			Matched group		
		OLS	FE	RE	OLS	FE	RE
_Imerged_wave_2	β_{12}	-4656		7180	-4719		7186
		(3957)		(5028)	(3963)		(5038)
_Imerged_wave_3	β_{13}	-7672*		19646***	-7754*		19759***
		(4231)		(6832)	(4250)		(6829)
_Imerged_wave_4	β_{14}	-2962		16620**	-3037		16625**
		(6718)		(6603)	(6734)		(6624)
_Imerged_wave_7	β_{17}	11921***		43292***	11748***		43343***
		(2344)		(6446)	(2377)		(6436)
_Imerged_wave_8	β_{18}	6784***		37113***	6769***		37508***
		(1917)		(8862)	(1916)		(8769)
_Iyear_2	β_{22}	3380**	1821**	2646***	3341**	1723**	2601***
		(1619)	(807.5)	(710.2)	(1620)	(789.9)	(701.5)
_Iyear_3	β_{23}	4835***	3223***	3986***	4801***	3025***	3904***
		(1516)	(913.0)	(753.8)	(1517)	(892.7)	(748.9)
_Iyear_4	β_{24}	6159***	4540***	5262***	6128***	4348***	5183***
		(1565)	(944.0)	(892.2)	(1566)	(929.8)	(889.7)
_Iyear_5	β_{25}	8418***	6570***	7490***	8309***	6414***	7452***
		(1474)	(930.7)	(787.5)	(1486)	(913.1)	(784.6)
_Iyear_6	β_{26}	11404***	8975***	10148***	11347***	8873***	10143***
		(1504)	(966.1)	(836.8)	(1517)	(953.0)	(835.0)
_Iyear_7	β_{27}	14367***	10345***	12335***	14371***	10209***	12289***
		(1573)	(1074)	(1015)	(1585)	(1069)	(1019)
_Iyear_8	β_{28}	18006***	12969***	15523***	18112***	12868***	15511***
		(1630)	(1134)	(1030)	(1644)	(1134)	(1037)
_ImerXyea_2_2	δ_{22}	6251	3948*	5751**	6222	3899*	5719**
		(5626)	(2203)	(2352)	(5630)	(2170)	(2338)
_ImerXyea_2_3	δ_{23}	8154*	3054	5846***	8166*	3064	5832***
		(4472)	(2256)	(2034)	(4474)	(2234)	(2028)
_ImerXyea_2_4	δ_{24}	8993**	5003**	7272***	9002**	5007**	7259***
		(4335)	(2379)	(2309)	(4337)	(2361)	(2303)
_ImerXyea_2_5	δ_{25}	8546*	5135	7172**	8678*	5039	7044**
		(4747)	(3577)	(3137)	(4754)	(3555)	(3136)
_ImerXyea_2_6	δ_{26}	7700*	4848	6609*	7784*	4702	6449*
		(4612)	(3703)	(3583)	(4617)	(3681)	(3577)
_ImerXyea_2_7	δ_{27}	6598	3666	5472	6647	3531	5314
		(4660)	(3875)	(4034)	(4662)	(3865)	(4033)
_ImerXyea_2_8	δ_{28}	7619	2352	5303	7594	2162	5064
		(4719)	(3590)	(3852)	(4722)	(3585)	(3868)
_ImerXyea_3_2	δ_{32}	7.991	-1298	-299.3	2.236	-1307	-310.0
		(6418)	(1828)	(2054)	(6434)	(1823)	(2049)
_ImerXyea_3_3	δ_{33}	4448	-2686*	303.5	4456	-2686	278.8
		(5615)	(1606)	(1407)	(5629)	(1634)	(1414)
_ImerXyea_3_4	δ_{34}	2658	-1046	270.4	2661	-1058	253.5
		(6658)	(2035)	(2874)	(6672)	(2059)	(2874)
_ImerXyea_3_5	δ_{35}	4502	-1359	1062	4631	-1463	923.5
		(6368)	(2064)	(3095)	(6386)	(2078)	(3091)
_ImerXyea_3_6	δ_{36}	10706*	1727	5672*	10793*	1585	5493*
		(5939)	(2173)	(2926)	(5950)	(2183)	(2927)
_ImerXyea_3_7	δ_{37}	18579***	5771**	11592***	18636***	5653**	11405***
		(5201)	(2263)	(2762)	(5210)	(2266)	(2763)
_ImerXyea_3_8	δ_{38}	24314***	8728***	15901***	24299***	8558***	15633***
		(5355)	(2549)	(3572)	(5370)	(2516)	(3544)
_ImerXyea_4_2	δ_{42}	7508	5053	6574	7529	5134	6595
		(8750)	(4401)	(4380)	(8760)	(4383)	(4374)
_ImerXyea_4_3	δ_{43}	10160	-192.6	4968**	10187	-35.30	4988**
		(9371)	(2318)	(2304)	(9381)	(2279)	(2277)
_ImerXyea_4_4	δ_{44}	11003	1861	6429***	11028	2015	6452***
		(8320)	(2012)	(1117)	(8331)	(2011)	(1101)

_ImerXyea_4_5	δ_{45}	15762**	5115**	10290***	15872**	5243**	10272***
		(7561)	(2101)	(1649)	(7573)	(2127)	(1645)
_ImerXyea_4_6	δ_{46}	15551**	2687	8951**	15615**	2774	8894**
		(7827)	(5613)	(4509)	(7846)	(5654)	(4534)
_ImerXyea_4_7	δ_{47}	22656***	7739***	14917***	22668***	7877***	14896***
		(7990)	(2451)	(2223)	(8001)	(2460)	(2203)
_ImerXyea_4_8	δ_{48}	27308***	8911***	17699***	27226***	9033***	17634***
		(8494)	(3277)	(2680)	(8506)	(3289)	(2661)
_ImerXyea_7_2	δ_{72}	772.4	1366***	951.8*	774.3	1316**	935.8*
		(1483)	(505.3)	(565.5)	(1484)	(505.7)	(565.4)
_ImerXyea_7_3	δ_{73}	1980	2508***	2207***	1978	2559***	2227***
		(1397)	(475.3)	(546.6)	(1399)	(478.1)	(547.8)
_ImerXyea_7_4	δ_{74}	734.7	1210	1001	727.9	1252	1017
		(1492)	(823.5)	(850.0)	(1493)	(826.0)	(851.0)
_ImerXyea_7_5	δ_{75}	-6.048	-2099***	-1165*	71.38	-2082***	-1194*
		(1415)	(664.9)	(700.8)	(1425)	(665.1)	(701.6)
_ImerXyea_7_6	δ_{76}	9361***	5147***	7139***	9392***	5121***	7070***
		(1487)	(808.7)	(819.1)	(1500)	(809.0)	(819.6)
_ImerXyea_7_7	δ_{77}	21688***	11636***	16408***	21671***	11673***	16365***
		(1576)	(1098)	(1094)	(1589)	(1096)	(1096)
_ImerXyea_7_8	δ_{78}	23807***	10405***	16724***	23696***	10425***	16637***
		(1673)	(1328)	(1408)	(1688)	(1324)	(1411)
_ImerXyea_8_2	δ_{82}	-3246*	-1775*	-2631**	-3252*	-1853*	-2655**
		(1864)	(977.8)	(1208)	(1844)	(1038)	(1232)
_ImerXyea_8_3	δ_{83}	-1805	73.78	-1972	-1842	-170.5	-2054
		(3986)	(2871)	(3641)	(3964)	(2983)	(3684)
_ImerXyea_8_4	δ_{84}	4925	8389***	5569	4886	8140***	5490
		(3811)	(2941)	(3589)	(3789)	(3047)	(3632)
_ImerXyea_8_5	δ_{85}	4612	8536**	5332	4655	8258**	5218
		(3678)	(3295)	(3738)	(3656)	(3403)	(3781)
_ImerXyea_8_6	δ_{86}	22682***	21310***	21118***	22794***	20834***	20762***
		(2301)	(3966)	(3666)	(2351)	(3951)	(3572)
_ImerXyea_8_7	δ_{87}	33694***	29342***	30483***	33757***	28926***	30164***
		(1837)	(2915)	(1970)	(1824)	(2891)	(1888)
_ImerXyea_8_8	δ_{88}	27880***	25471***	25601***	27839***	25017***	25249***
		(1831)	(3550)	(2385)	(1822)	(3528)	(2305)
alos	β_{31}	-1354***	-710.5**	-1177***	-1343***	-693.5**	-1167***
		(269.6)	(276.6)	(242.1)	(268.4)	(271.6)	(239.8)
beds	β_{32}	76.83***	11.43**	43.50***	76.92***	11.64***	43.34***
		(1.553)	(4.422)	(3.939)	(1.566)	(4.389)	(3.925)
comp	β_{33}	-193.1***	-99.76	-279.7***	-197.4***	-136.5	-292.7***
		(26.77)	(133.0)	(77.27)	(28.07)	(127.1)	(74.93)
teaching	β_{34}	1484		18663***	1526		18794***
		(1523)		(5296)	(1528)		(5295)
ft	β_{35}	1195	841.1	114.2	982.2	1184	506.3
		(1104)	(973.8)	(1086)	(1176)	(975.3)	(1086)
constant	β_0	8023***	54921***	28409***	7965***	55362***	28605***
		(1758)	(3663)	(3031)	(1760)	(3651)	(3030)
Observations		1294	1294	1294	1282	1282	1282
R-squared		0.904	0.511	0.846	0.904	0.517	0.844
RESET		83.04***	2.34	14.81***	81.54***	1.11	14.60***
Tests for DID							
$\delta_{22} - \beta_{12}$		10907	3948*	-1429	10942	3900*	-1467
		(8743)	(2203)	(6172)	(8751)	(2170)	(6163)
$\delta_{33} - \delta_{32}$		4440	-1388	603	4454	-1379	589
		(6263)	(1297)	(1936)	6274	(1269)	(1914)
$\delta_{44} - \delta_{43}$		843	2054	1461	841	2050	1464
		(8322)	(1687)	(1824)	8323	(1687)	(1823)
$\delta_{77} - \delta_{76}$		12326***	6489***	9269***	12278***	6552***	9295***
		(1550)	(589)	(584)	1582	(593)	(591)
$\delta_{88} - \delta_{87}$		-5814***	-3871***	-4882***	-5918***	-3909***	-4915***
		(2129)	(913)	(740)	2113	(922)	(752)

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 1. Total number of admitted patients, merged Trusts by waves and all non-merged Trusts

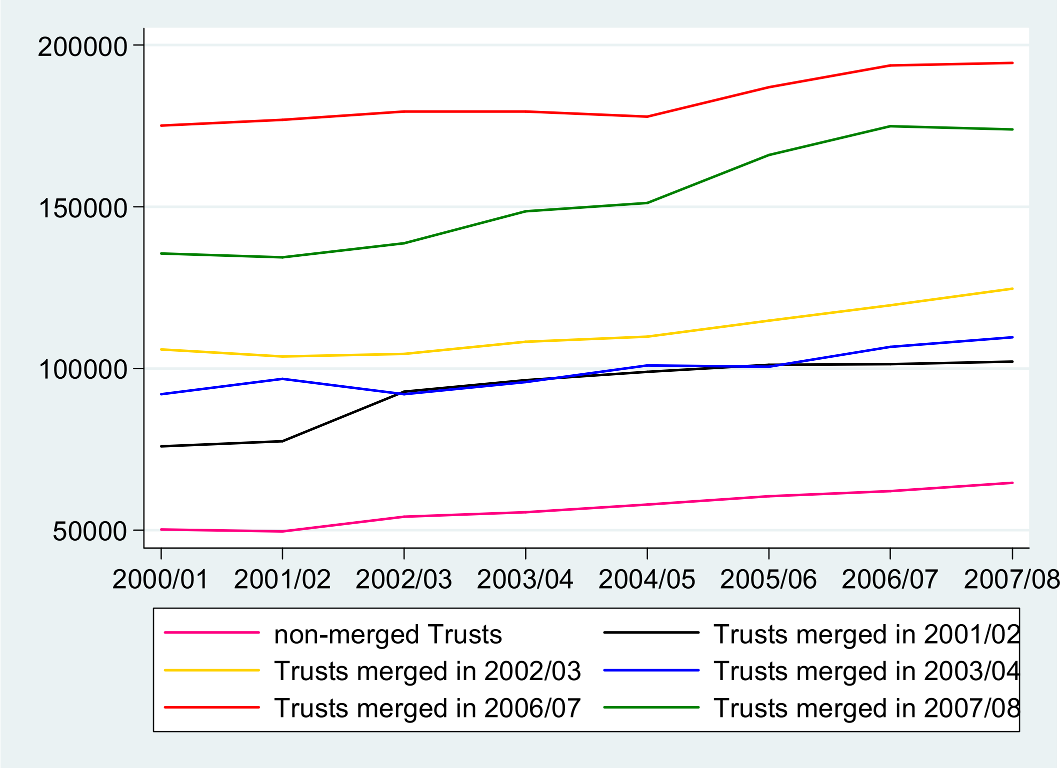

Figure 2. Total number of outpatient attendances, merged Trusts by waves and all non-merged Trusts

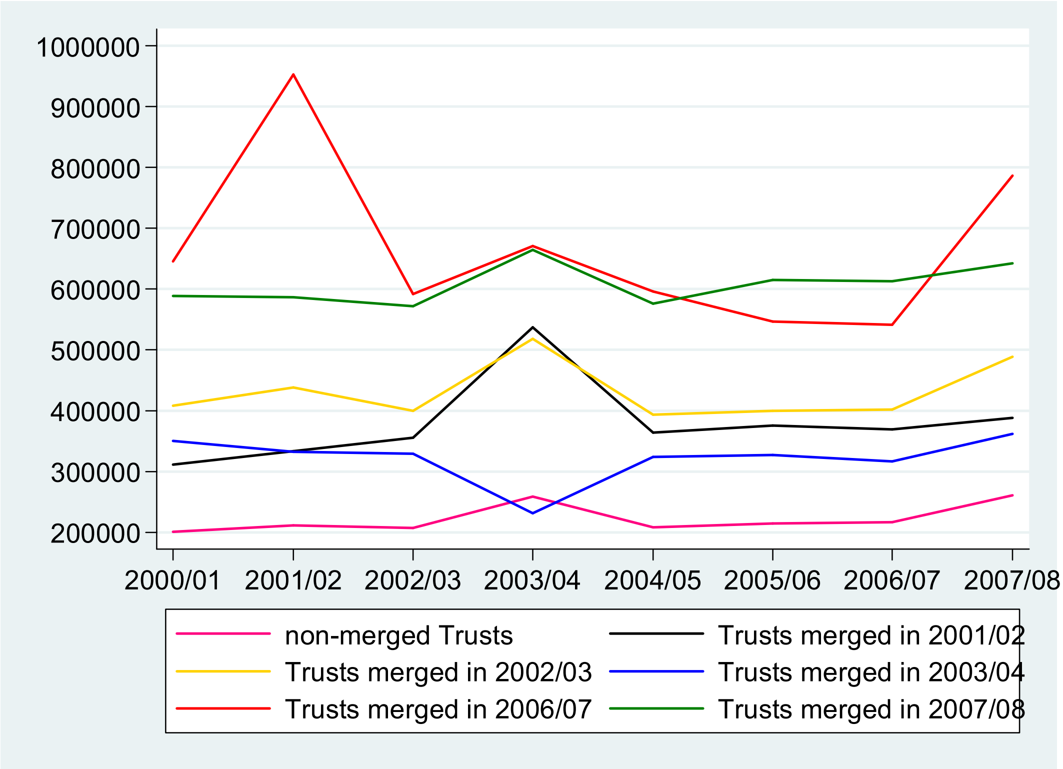

Figure 3. Total number of A&E attendances, merged Trusts by waves and all non-merged Trusts

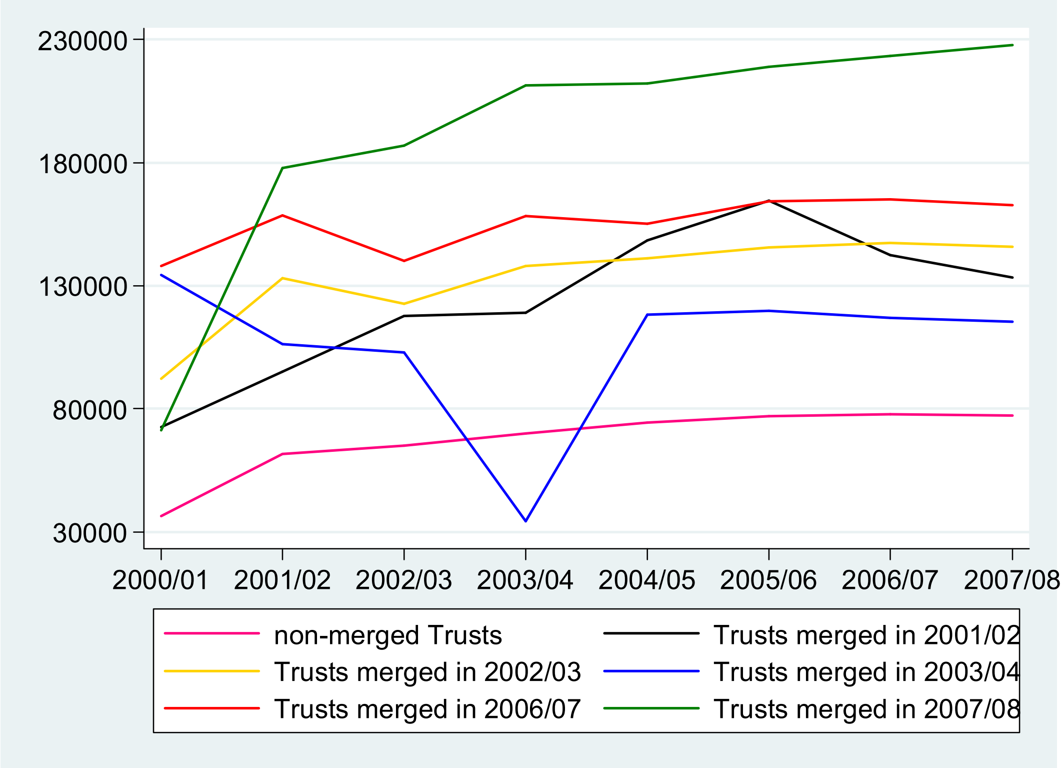

Figure 4a. Change in the total number of admitted patients for merged Trusts relative to all non-merged Trusts

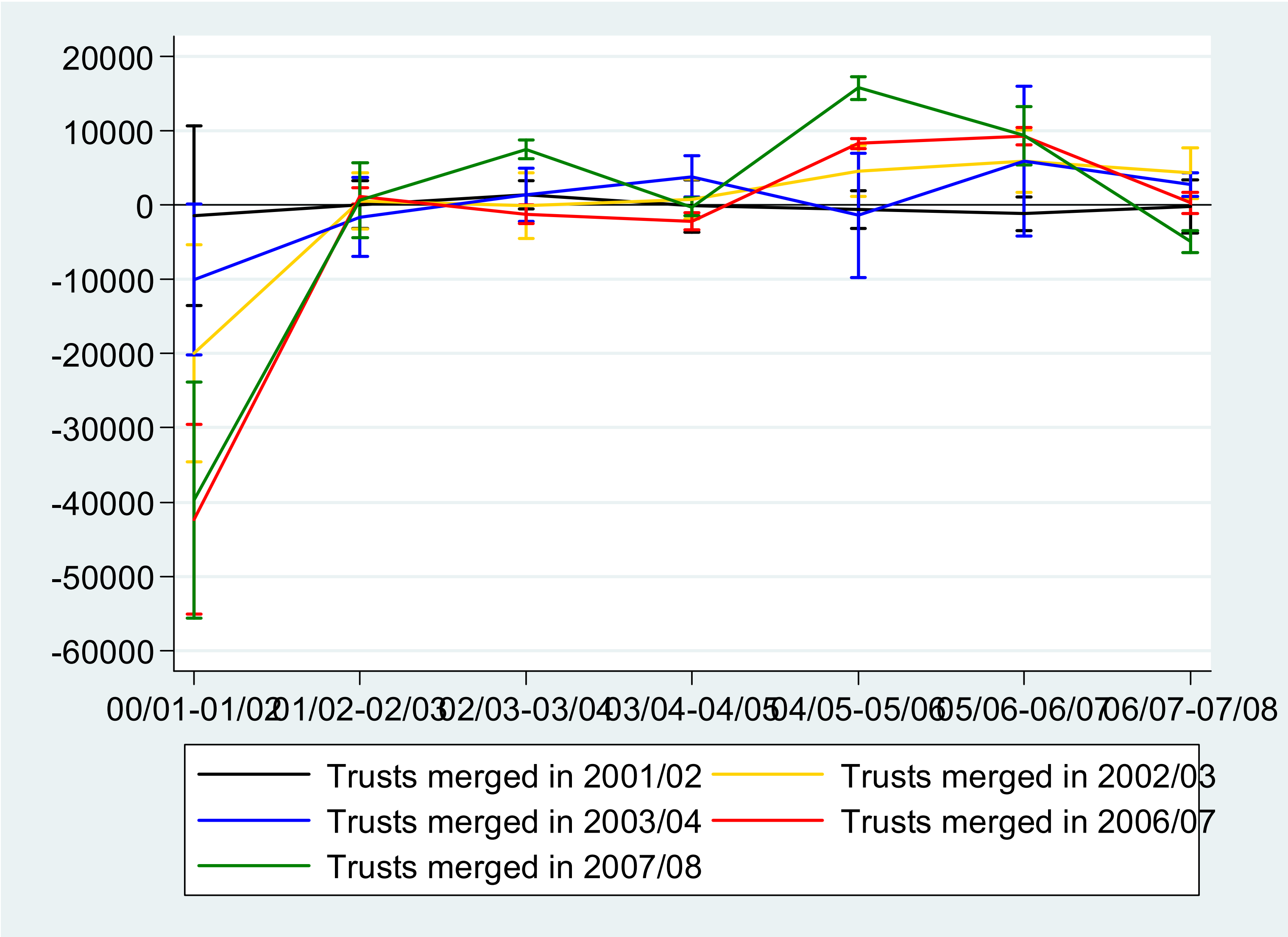

Figure 4b. Change in the total number of admitted patients for merged Trusts relative to matched control group

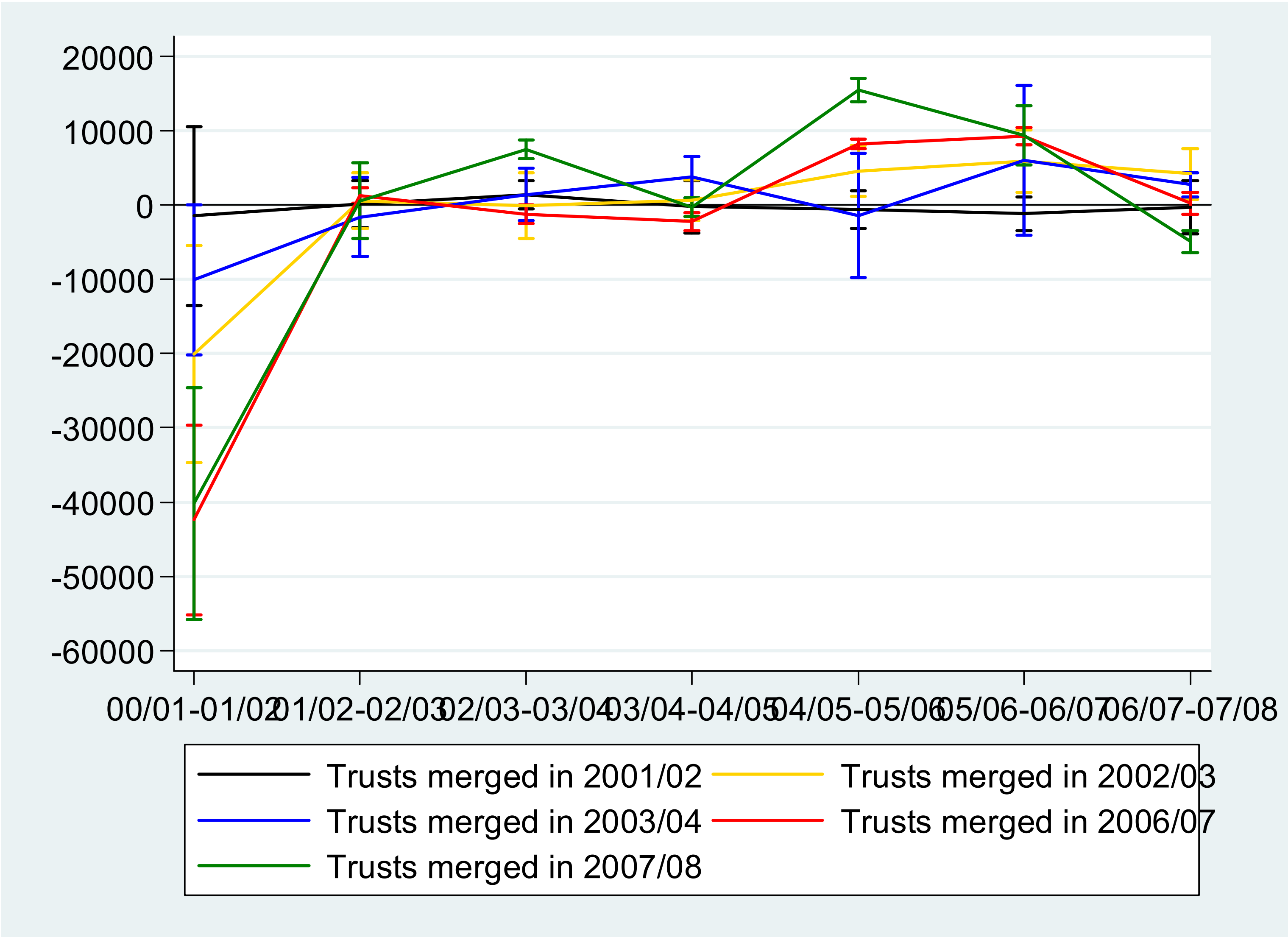

Figure 5a. Total number of admitted patients for merged Trusts relative to all non-merged Trusts

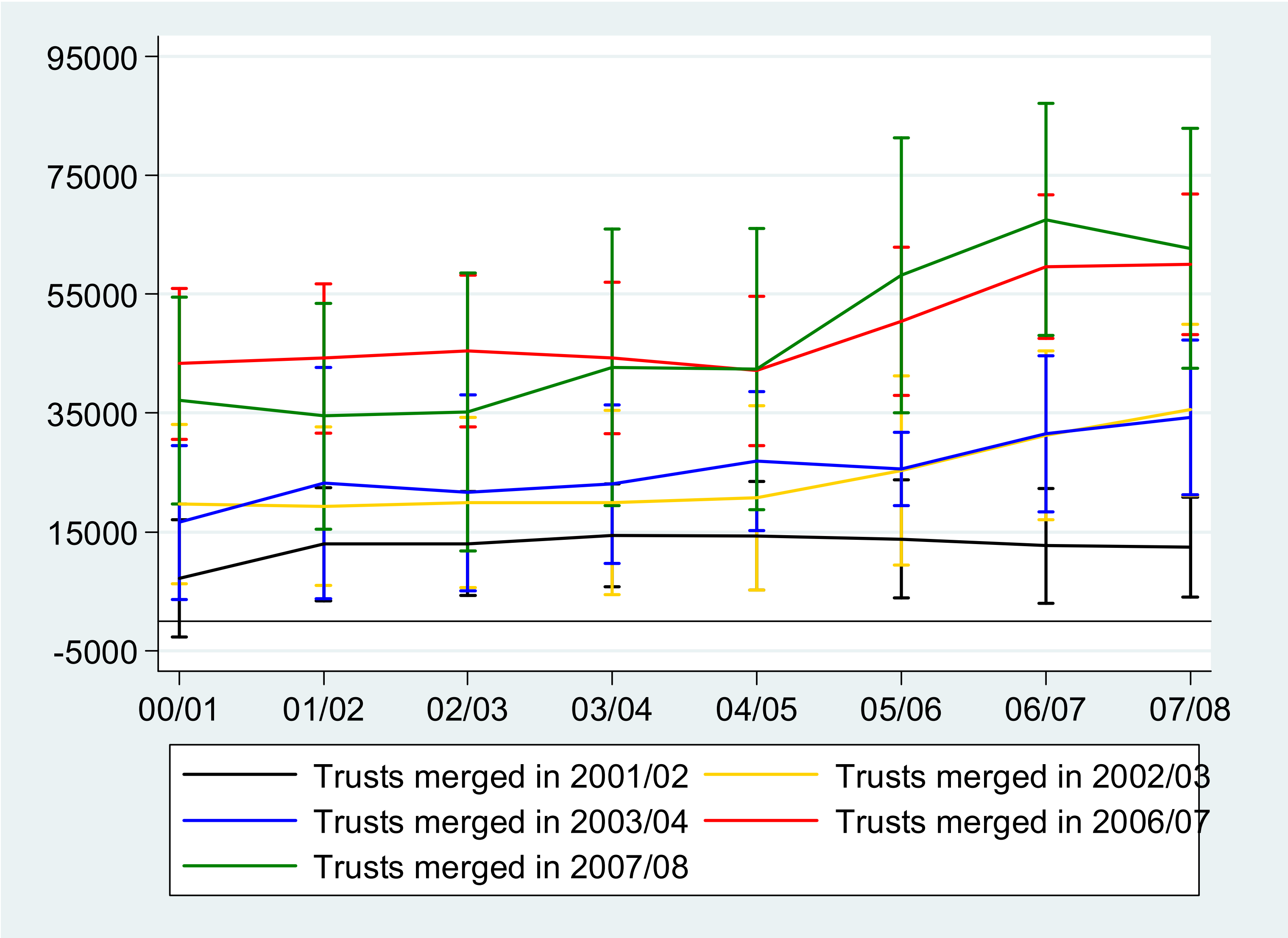

Figure 5b. Total number of admitted patients for merged Trusts relative to matched control group