

# The impact of the UK Hospitals Procurement Type on Facility Management Costs

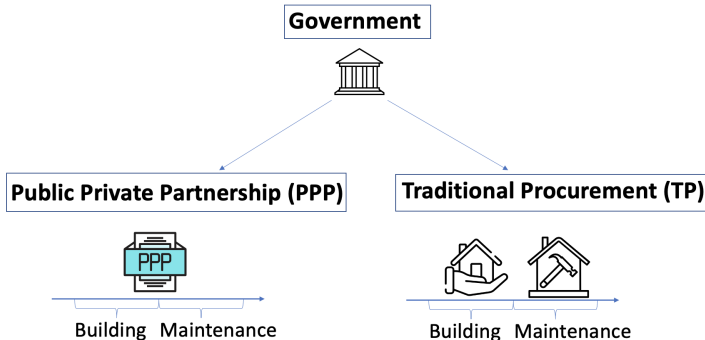
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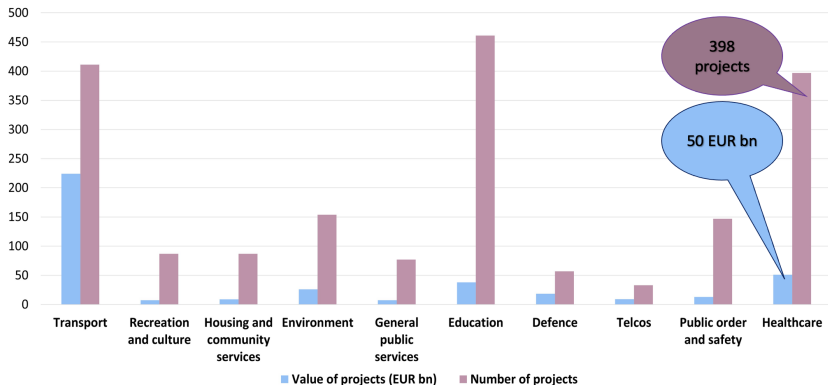
December 3, 2023

# Procurement types

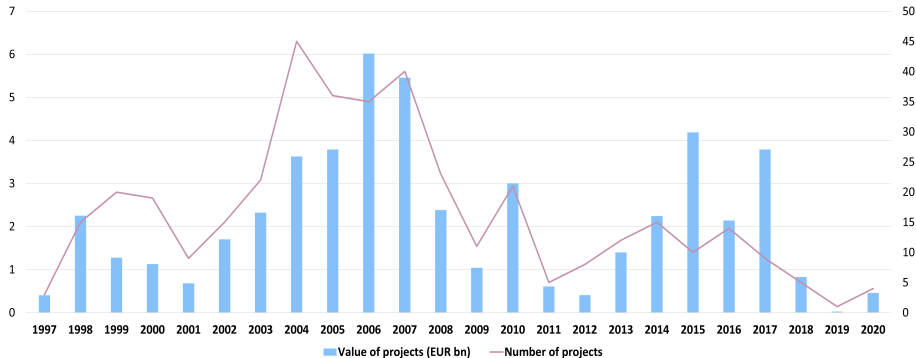
- Public procurement refers to the
  - purchase by governments of goods, services and works
  - choice of model to fund and develop public infrastructure projects



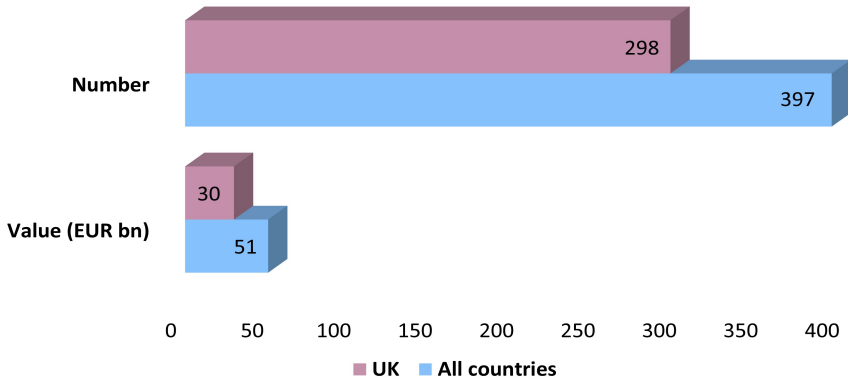
# Total value and number of PPP projects within EU and in the UK by sector, 1997 - 2020



# PPPs in the EU healthcare market

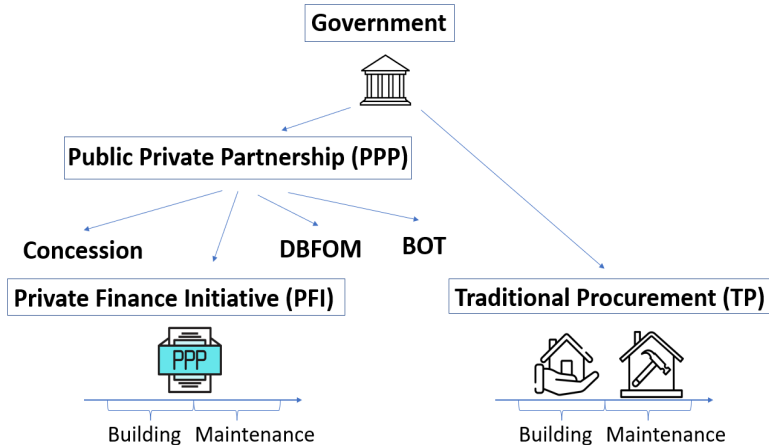


## PPPs in the UK healthcare sector



- The UK market is responsible for a large share of PPP projects
- PFIs are mainly used in the UK healthcare sector

# PFI is a specific type of Public-Private Partnerships



## Research question

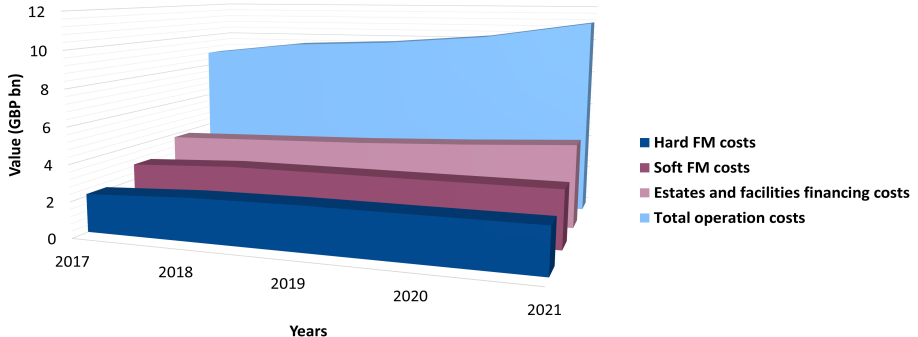
- How does England hospitals' procurement type impact their hard and soft facility management costs?

## Facility management services

- **Hard Facility Management (HFM)** services maintain the internal and external conditions of the hospital buildings:
  - electricity
  - lighting
  - plumbing
  - heating
  - air conditioning
  - fire safety systems
  - building maintenance
  - other
- **Soft Facility Management (SFM)** services make hospital's internal environment a better place:
  - cleaning
  - catering
  - access and security services
  - parking
  - portering
  - other



## Total costs of running the England hospitals



- Total operation costs hold for 13% of England hospital sites' total costs

# This paper

- **Research question:**

- How does England hospitals' procurement type impact their hard and soft facility management costs?

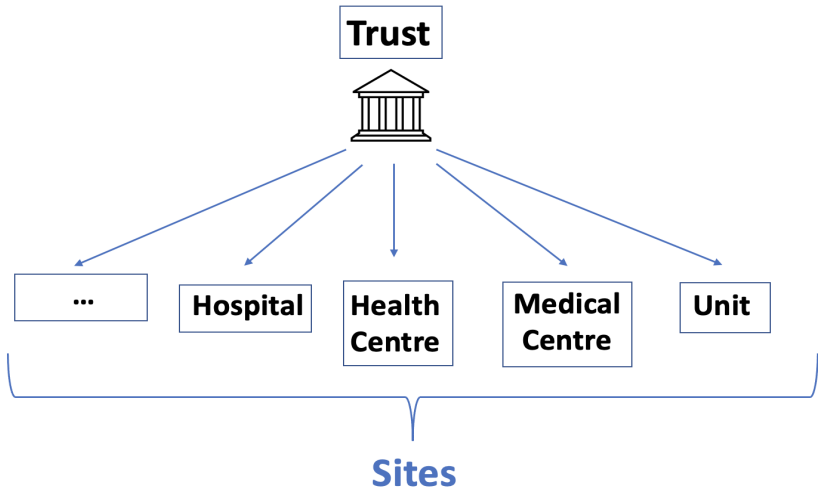
- **Method:** Panel data empirical analysis using

- OLS
- IV 2SLS

- **Data:**

- Sources:
  - ERIC dataset by NHS Digital
  - Bank of England
  - PFI and PF2 projects by HM Treasury
- Coverage: 2018 - 2021
- Number of observations:
  - 2737 observations in the SFM dataset
  - 2928 observations in the HFM dataset
- Observations: hospital sites and hospitals

## Hospital sites and hospitals



## Literature review

- General PPP literature on cost efficiency: Pollock et al. (2007), Blanc-Brude et al. (2009), Raisbeck et al. (2010) and Hoppe et al. (2013)
- Qualitative comparison between PFI and non-PFI: NAO (2012, 2018, 2020), Murray A. (2016)
  - → Quantitative comparison between PFI and non-PFI
- Comparing PPP projects across their principal stages of the life-cycle in various sectors:
  - construction (Blanc-Brude et al., 2006; Hoppe et al., 2013; Raisbeck et al., 2010)
  - maintenance (Devapriya, 2006; Ng & Wong, 2006)
  - → Our study is the first one that empirically estimates the role of PPP, on a specific PFI type, in healthcare sector
  - → An accent on a facility management costs at the maintenance stage

# Empirical specifications

## OLS

$$\log(\text{Costs}_{ht}) = \alpha_0 + \alpha_1 PFI_{ht} + A'_{ht} \gamma + FE_{p(h)} \times FE_t + \epsilon_{ht}$$

## 2SLS: first stage

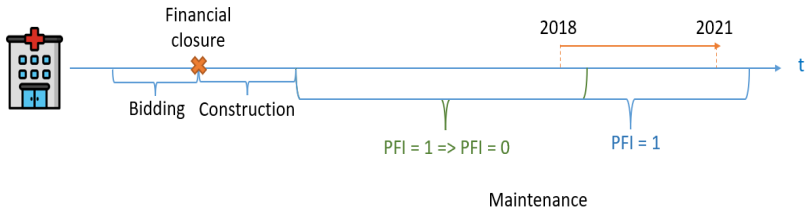
$$PFI_{ht} = \beta_0 + \beta Z_h + A'_{ht} \delta + FE_p \times FE_t + \eta_{ht}$$

## 2SLS: second stage

$$\log(\text{Costs}_{ht}) = \phi_0 + \phi PFI_{ht} + A'_{ht} \psi + FE_p \times FE_t + \zeta_{ht}$$

- $h = 1 \dots H$
- $t = 2018 \dots 2021$
- $FE_{p(h)}$  - hospital site profile or England region fixed effect
- $FE_t$  - year fixed effect
- $Z_h$  - an instrumental variable

# PFI



## Instrument: LIBOR

- We postulate that the LIBOR rate influences the decision-making process and accessibility of financiers, subsequently impacting the government's choice of hospital procurement type
- If the UK bank rate at the time of PFI contract bidding fails to meet the requirements of private sector lending, the likelihood of the public contract being procured through PFI diminishes

## Instrument: LIBOR

### Weighted IV

$$Z_h = \sum_{i=1}^n K_{hi} * Z_i$$

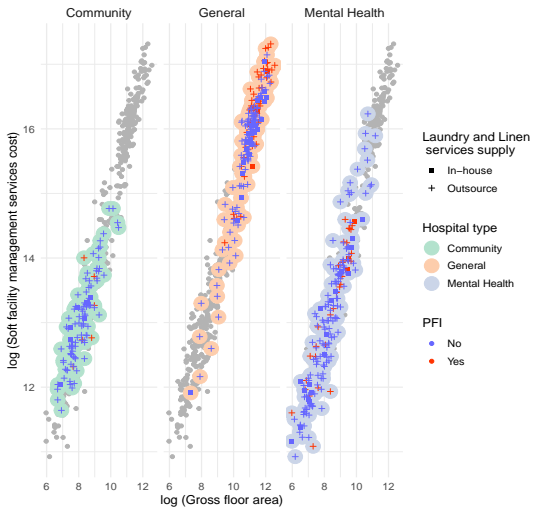
- $i$  is an age profile, a ten year period,  $i = 1....n$ ,  $n = 9$
- $K_{hi}$  a share of hospitals' new construction or renovation at each ten-year period,  $\sum K_{hi} = 1$
- $Z_i$  (%) is an average LIBOR bank rate for a certain age profile period  $i$



# OLS and 2SLS for SFM costs

|   | log SFM cost (GBP/m <sup>2</sup> ) |                     |                      |                     |                     |                     |                      |                     |
|---|------------------------------------|---------------------|----------------------|---------------------|---------------------|---------------------|----------------------|---------------------|
|   | OLS                                |                     | 2SLS                 |                     | OLS                 |                     | 2SLS                 |                     |
|   | (1)                                | (2)                 | First stage (3)      | Second stage (4)    | (5)                 | (6)                 | First stage (7)      | Second stage (8)    |
| PFI (1/0)   | 0.052***<br>(0.018)                | 0.039***<br>(0.015) |                      | 0.042<br>(0.092)    | 0.063***<br>(0.017) | 0.036**<br>(0.014)  |                      | 0.011<br>(0.111)    |
| LIBOR (%)   |                                    |                     | -0.028***<br>(0.003) |                     |                     |                     | -0.022***<br>(0.003) |                     |
| log Age   |                                    | 0.014<br>(0.010)    | -0.115***<br>(0.014) | 0.015<br>(0.021)    |                     | 0.005<br>(0.010)    | -0.120***<br>(0.014) | 0.001<br>(0.021)    |
| Inpatient main meals requested (Nb/m <sup>2</sup> ) |                                    | 0.032***<br>(0.001) | 0.000<br>(0.002)     | 0.032***<br>(0.002) |                     | 0.030***<br>(0.001) | -0.002<br>(0.002)    | 0.030***<br>(0.001) |
| Laundered pieces per annum (Nb/m <sup>2</sup> )     |                                    | 0.008***<br>(0.001) | 0.001*<br>(0.001)    | 0.008***<br>(0.002) |                     | 0.009***<br>(0.000) | 0.003***<br>(0.001)  | 0.009***<br>(0.001) |
| Outsourced laundry and linen services (1/0)         |                                    | 0.062***<br>(0.021) | 0.058**<br>(0.026)   | 0.062***<br>(0.018) |                     | 0.024<br>(0.020)    | 0.021<br>(0.027)     | 0.025<br>(0.020)    |
| log Portering staff (WTE/m <sup>2</sup> )           |                                    | 0.003***<br>(0.000) | 0.001*<br>(0.001)    | 0.003***<br>(0.001) |                     | 0.003***<br>(0.000) | 0.003***<br>(0.001)  | 0.004***<br>(0.001) |
| log Cleaning staff (WTE/m <sup>2</sup> )            |                                    | 0.033***<br>(0.004) | 0.001<br>(0.005)     | 0.034***<br>(0.011) |                     | 0.029***<br>(0.004) | 0.003<br>(0.005)     | 0.029***<br>(0.009) |
| Cragg-Donald F stat                                 |                                    |                     | 86.00                |                     |                     |                     | 53.71                |                     |
| Kleibergen-Paap rk Wald F stat                      |                                    |                     | 19.60                |                     |                     |                     | 44.23                |                     |
| Other controls                                      | No                                 | Yes                 | Yes                  | Yes                 | No                  | Yes                 | Yes                  | Yes                 |
| Hospital site profile x year FE                     | Yes                                | Yes                 | Yes                  | Yes                 | No                  | No                  | No                   | No                  |
| England region x year FE                            | No                                 | No                  | No                   | No                  | Yes                 | Yes                 | Yes                  | Yes                 |
| Individual FE                                       | No                                 | No                  | No                   | No                  | No                  | No                  | No                   | No                  |
| Observations  | 2,737                              | 2,737               | 2,737                | 2,737               | 2,730               | 2,730               | 2,730                | 2,730               |
| Adjusted R <sup>2</sup>                             | 0.027                              | 0.363               | 0.131                | 0.349               | 0.059               | 0.392               | 0.092                | 0.358               |

# Laundry and linen services outsourcing



# OLS and 2SLS for HFM costs

|  | log HFM cost (GBP/m <sup>2</sup> ) |                      |                      |                      |                     |                     |                      |                     |
|--|------------------------------------|----------------------|----------------------|----------------------|---------------------|---------------------|----------------------|---------------------|
|  | OLS                                |                      | 2SLS                 |                      | OLS                 |                     | 2SLS                 |                     |
|  | (1)                                | (2)                  | First stage<br>(3)   | Second stage<br>(4)  | (5)                 | (6)                 | First stage<br>(7)   | Second stage<br>(8) |
| PFI (1/0)  | 0.152***<br>(0.018)                | 0.127***<br>(0.017)  |                      | 0.251**<br>(0.101)   | 0.218***<br>(0.018) | 0.164***<br>(0.017) |                      | 0.195<br>(0.187)    |
| LIBOR (%)  |                                    |                      | -0.025***<br>(0.003) |                      |                     |                     | -0.019***<br>(0.003) |                     |
| log Age  |                                    | 0.010<br>(0.011)     | -0.115***<br>(0.013) | 0.030<br>(0.025)     |                     | 0.012<br>(0.011)    | -0.106***<br>(0.013) | 0.016<br>(0.029)    |
| Clinical space (%)   |                                    | 0.002***<br>(0.000)  | -0.000<br>(0.000)    | 0.002***<br>(0.001)  |                     | 0.001<br>(0.000)    | -0.002***<br>(0.000) | 0.001<br>(0.001)    |
| log Single bedrooms for patients<br>without en-suite facilities (Nb/m <sup>2</sup> ) |                                    | 0.002***<br>(0.001)  | 0.001<br>(0.001)     | 0.002**<br>(0.001)   |                     | 0.003***<br>(0.001) | 0.002***<br>(0.001)  | 0.003***<br>(0.001) |
| CHP Units (1/0)  |                                    | -0.080***<br>(0.019) | -0.112***<br>(0.020) | -0.066***<br>(0.022) |                     | 0.058***<br>(0.017) | -0.001<br>(0.018)    | 0.059***<br>(0.016) |
| log Total energy consumption<br>(kWh/m <sup>2</sup> )                                |                                    | 0.233***<br>(0.013)  | 0.048***<br>(0.014)  | 0.227***<br>(0.018)  |                     | 0.287***<br>(0.013) | 0.089***<br>(0.014)  | 0.284***<br>(0.027) |
| Cragg-Donald F stat  |                                    |                      | 81.7                 |                      |                     |                     | 48.5                 |                     |
| Kleibergen-Paap rk Wald F stat   |                                    |                      | 13.79                |                      |                     |                     | 8.04                 |                     |
| Other controls   | No                                 | Yes                  | Yes                  | Yes                  | No                  | Yes                 | Yes                  | Yes                 |
| Hospital site profile x year FE  | Yes                                | Yes                  | Yes                  | Yes                  | No                  | No                  | No                   | No                  |
| England region x year FE   | No                                 | No                   | No                   | No                   | Yes                 | Yes                 | Yes                  | Yes                 |
| Individual FE  | No                                 | No                   | No                   | No                   | No                  | No                  | No                   | No                  |
| Observations   | 2,928                              | 2,928                | 2,928                | 2,928                | 2,917               | 2,917               | 2,917                | 2,917               |
| Adjusted R <sup>2</sup>  | 0.169                              | 0.265                | 0.139                | 0.261                | 0.105               | 0.272               | 0.090                | 0.281               |

## PFI differentiation

| HFM costs                              | (1)       | (2)       | SFM costs                      | (3)       | (4)       |
|--|-----------|-----------|--------------------------------|-----------|-----------|
| Estates and property maintenance (36%) | 0.082**   | 0.106***  | Cleaning service (33%)         | -0.011    | -0.012    |
| Grounds and gardens maintenance (1%)   | 0.205***  | 0.058     | Inpatient food service (21%)   | 0.042*    | -0.017    |
| Electro bio medical equipment (17%)    | 0.082     | 0.493***  | Laundry and linen service (7%) | 0.193***  | 0.222***  |
| Car parking (3%)                       | -0.007    | 0.264***  | Portering service (11%)        | 0.037**   | 0.033**   |
| Energy (28%)                           | 0.038**   | 0.067***  | SFM management (3%)            | -0.426*** | -0.370*** |
| Water and sewerage (4%)                | -0.038    | -0.025    | Other SFM service (25%)        | 0.104     | 0.256***  |
| Waste (5%)                             | 0.022     | 0.100***  |                                |           |           |
| HFM management (3%)                    | -0.464*** | -0.396*** |                                |           |           |
| Other HFM service (3%)                 | 0.269***  | 0.118     |                                |           |           |
| Hospital site profile x year FE        | Yes       | No        |                                | Yes       | No        |
| England region x year FE               | No        | Yes       |                                | No        | Yes       |

## Heterogeneity of PFI contracts

### Case 1: Based on **tenure**

- PFI<sub>full</sub> - a hospital site built **entirely** under a PFI contract
- PFI<sub>part</sub> - a hospital site where only a **certain part** of the buildings is within a PFI project

### Case 2: Based on presence of **constructions prior to a PFI contract signing**

- PFI<sub>old</sub> - a hospital site **with** buildings prior to a PFI contract signing
- PFI<sub>new</sub> - a hospital site **without** buildings prior to a PFI contract signing

## Heterogeneity of PFI contracts over tenure

|                                 | log HFM costs       |                     | log SFM costs       |                     | log HFM costs       |                     | log SFM costs       |                     |
|---------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
|                                 | (1)                 | (2)                 | (3)                 | (4)                 | (5)                 | (6)                 | (7)                 | (8)                 |
| PFI <sub>full</sub>             | 0.143***<br>(0.024) | 0.113***<br>(0.024) | 0.087***<br>(0.024) | 0.057***<br>(0.021) | 0.155***<br>(0.025) | 0.132***<br>(0.024) | 0.094***<br>(0.024) | 0.060***<br>(0.020) |
| PFI <sub>part</sub>             | 0.161***<br>(0.023) | 0.139***<br>(0.022) | 0.020<br>(0.023)    | 0.024<br>(0.019)    | 0.271***<br>(0.023) | 0.191***<br>(0.021) | 0.038*<br>(0.022)   | 0.016<br>(0.018)    |
| F-statistic                     | 28.71               |                     | 41.08               |                     | 27.01               |                     | 42.06               |                     |
| Other controls                  | No                  | Yes                 | No                  | Yes                 | No                  | Yes                 | No                  | Yes                 |
| Hospital site profile x year FE | Yes                 | Yes                 | Yes                 | Yes                 | No                  | No                  | No                  | No                  |
| England region x year FE        | No                  | No                  | No                  | No                  | Yes                 | Yes                 | Yes                 | Yes                 |
| Observations                    | 2,928               | 2,928               | 2,737               | 2,737               | 2,917               | 2,917               | 2,730               | 2,730               |
| Adjusted R <sup>2</sup>         | 0.169               | 0.265               | 0.028               | 0.364               | 0.108               | 0.273               | 0.060               | 0.393               |

- Hospital sites delivered fully or partially under PFI projects exhibit higher costs for both HFM and SFM services compared to non-PFI.
- Hospital sites that have the entire site delivered under the PFI project may achieve greater efficiency in HFM cost savings.

# Whether old buildings matter?

|                                 | log HFM costs       |                            | log SFM costs      |                            | log HFM costs       |                     | log SFM costs       |                    |
|---------------------------------|---------------------|----------------------------|--------------------|----------------------------|---------------------|---------------------|---------------------|--------------------|
|                                 | (1)                 | (2)                        | (3)                | (4)                        | (5)                 | (6)                 | (7)                 | (8)                |
| $PFI_{old}$                     | 0.255<br>(0.156)    | <b>0.262*</b><br>(0.147)   | -0.165<br>(0.134)  | <b>-0.033</b><br>(0.111)   | 0.391**<br>(0.162)  | 0.307**<br>(0.147)  | -0.057<br>(0.133)   | -0.020<br>(0.108)  |
| $PFI_{new}$                     | 0.224***<br>(0.027) | <b>0.205***</b><br>(0.026) | 0.062**<br>(0.028) | <b>0.074***</b><br>(0.024) | 0.303***<br>(0.028) | 0.257***<br>(0.026) | 0.076***<br>(0.027) | 0.056**<br>(0.023) |
| Other controls                  | No                  | Yes                        | No                 | Yes                        | No                  | Yes                 | No                  | Yes                |
| Hospital site profile x year FE | Yes                 | Yes                        | Yes                | Yes                        | No                  | No                  | No                  | No                 |
| England region x year FE        | No                  | No                         | No                 | No                         | Yes                 | Yes                 | Yes                 | Yes                |
| Observations                    | 2,613               | 2,613                      | 2,416              | 2,416                      | 2,602               | 2,602               | 2,409               | 2,409              |
| Adjusted R <sup>2</sup>         | 0.162               | 0.256                      | 0.026              | 0.343                      | 0.096               | 0.261               | 0.054               | 0.375              |

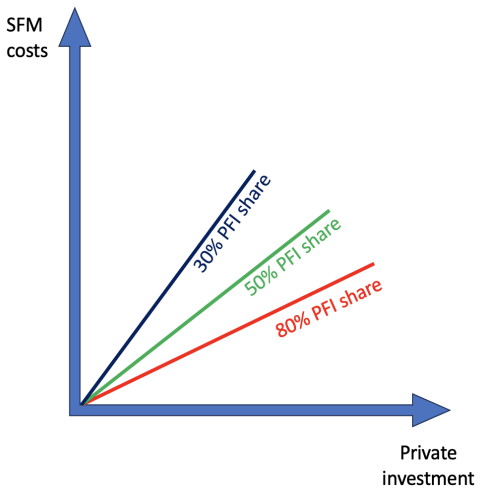
- The difference in HFM costs between PFI and non-PFI hospital sites is higher for those owing buildings prior to PFI contract signing, while for SFM costs, the results are opposite.

# Capital investment

|   | log HFM costs       |                      | log SFM costs       |                     | log HFM costs       |                      | log SFM costs       |                     |
|---|---------------------|----------------------|---------------------|---------------------|---------------------|----------------------|---------------------|---------------------|
|   | (1)                 | (2)                  | (3)                 | (4)                 | (5)                 | (6)                  | (7)                 | (8)                 |
| $PFI_{share}$ (%)   | 0.141***<br>(0.027) | 0.240***<br>(0.041)  | 0.061**<br>(0.028)  | 0.327<br>(0.261)    | 0.100***<br>(0.028) | 0.223***<br>(0.043)  | 0.040<br>(0.029)    | 0.675**<br>(0.267)  |
| log Private investment (GBP)  | 0.003<br>(0.002)    |                      | 0.006**<br>(0.003)  |                     | -0.001<br>(0.003)   |                      | 0.004<br>(0.003)    |                     |
| log Private investment (GBP) · $PFI_{share}$ (%)  | -0.002<br>(0.004)   |                      | -0.010**<br>(0.004) |                     | 0.003<br>(0.004)    |                      | -0.006<br>(0.004)   |                     |
| log Public investment (GBP)   | 0.000<br>(0.002)    |                      | -0.000<br>(0.002)   |                     | 0.001<br>(0.002)    |                      | -0.000<br>(0.002)   |                     |
| log Capital investment<br>for improving existing buildings (GBP)                        |                     | 0.009*<br>(0.005)    |                     | 0.032***<br>(0.009) |                     | 0.001<br>(0.006)     |                     | 0.028***<br>(0.009) |
| log Capital investment<br>for new build (GBP)   |                     | 0.004***<br>(0.002)  |                     | 0.002<br>(0.001)    |                     | 0.005***<br>(0.002)  |                     | 0.003**<br>(0.001)  |
| log Capital investment<br>for equipment (GBP)   |                     | -0.002<br>(0.002)    |                     | 0.002<br>(0.002)    |                     | -0.002<br>(0.002)    |                     | 0.001<br>(0.002)    |
| log Capital investment<br>for new build (GBP) · $PFI_{share}$ (%)                       |                     | -0.009***<br>(0.003) |                     |                     |                     | -0.010***<br>(0.003) |                     |                     |
| log Capital investment<br>for improving existing<br>buildings (GBP) · $PFI_{share}$ (%) |                     |                      |                     | -0.018<br>(0.017)   |                     |                      |                     | -0.042**<br>(0.017) |
| log GIA   | 0.950***<br>(0.017) | 0.940***<br>(0.017)  | 0.863***<br>(0.019) | 0.840***<br>(0.019) | 1.079***<br>(0.011) | 1.075***<br>(0.012)  | 1.000***<br>(0.012) | 0.979***<br>(0.013) |
| Trust profile x year FE   | Yes                 | Yes                  | Yes                 | Yes                 | No                  | No                   | No                  | No                  |
| England region x year FE  | No                  | No                   | No                  | No                  | Yes                 | Yes                  | Yes                 | Yes                 |
| Observations  | 811                 | 811                  | 811                 | 811                 | 811                 | 811                  | 811                 | 811                 |
| Adjusted R <sup>2</sup>   | 0.944               | 0.945                | 0.924               | 0.925               | 0.940               | 0.941                | 0.919               | 0.921               |



## Private investment



## Discussion

### Implemented: Robustness checks

- estimate results at the hospital subsample
- change thresholds of grouping PFIs based on the share of buildings constructed after 1995
- substitute old buildings with the backlog maintenance costs

### Next steps: Robustness checks

- use another IV - presence of right/left-wing party at the launch of contract bidding
- first difference

*Thanks!*

## 1 Other results

## 2 Descriptive statistics: tables

## 3 Descriptive statistics: graphs

## 4 Weighted age

## 5 Robustness checks

## Key results

- HFM and SFM costs are higher for PFI than for traditional hospitals by 25.1% and 3.9%, respectively, controlling for hospital profile FE
- HFM and SFM costs are higher for PFI than for traditional hospitals by 19.5% and 3.6%, respectively, controlling for England region FE
- The difference in HFM and SFM costs between PFI and non PFI is higher for hospitals partly built under PFI contract
- The difference in HFM costs between PFI and non PFI is larger for hospitals owing buildings before PFI contract sign

## Total energy consumption

|   | log HFM cost (GBP/m <sup>2</sup> ) |                     |                     |                     |                     |                     |                     |
|---|------------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
|   | (1)                                | (2)                 | (3)                 | (4)                 | (5)                 | (6)                 | (7)                 |
| PFI (1/0)   | 0.218***<br>(0.018)                | 0.224***<br>(0.018) | 0.222***<br>(0.018) | 0.218***<br>(0.018) | 0.207***<br>(0.018) | 0.164***<br>(0.017) | -0.662**<br>(0.260) |
| log Age   |                                    | 0.017<br>(0.012)    | 0.015<br>(0.012)    | 0.014<br>(0.012)    | 0.030**<br>(0.012)  | 0.012<br>(0.011)    | 0.010<br>(0.011)    |
| Clinical space (%)  |                                    |                     | -0.000<br>(0.000)   | 0.001<br>(0.000)    | 0.001<br>(0.000)    | 0.001<br>(0.000)    | 0.000<br>(0.000)    |
| CHP units (1/0)   |                                    |                     |                     | 0.154***<br>(0.018) | 0.135***<br>(0.018) | 0.058***<br>(0.017) | 0.054***<br>(0.017) |
| log Single bedrooms for patients<br>with en-suite facilities (Nb/m <sup>2</sup> ) |                                    |                     |                     |                     | 0.005***<br>(0.001) | 0.003***<br>(0.001) | 0.003***<br>(0.001) |
| log Total energy<br>consumption (kWh/m <sup>2</sup> )                             |                                    |                     |                     |                     |                     | 0.287***<br>(0.013) | 0.276***<br>(0.013) |
| log Total energy<br>consumption (kWh/m <sup>2</sup> ) · PFI                       |                                    |                     |                     |                     |                     |                     | 0.139***<br>(0.044) |
| UK region × year FE   | Yes                                | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Observations  | 2,917                              | 2,917               | 2,917               | 2,917               | 2,917               | 2,917               | 2,917               |
| Adjusted R <sup>2</sup>   | 0.105                              | 0.105               | 0.105               | 0.128               | 0.143               | 0.272               | 0.274               |

## Backlog

|   | log HFM costs       |                      |                     |                     |                     |                      |                     |                      |
|---|---------------------|----------------------|---------------------|---------------------|---------------------|----------------------|---------------------|----------------------|
|   | No lag              |                      | 1 year lag          |                     | No lag              |                      | 1 year lag          |                      |
|   | (1)                 | (2)                  | (3)                 | (4)                 | (5)                 | (6)                  | (7)                 | (8)                  |
| PFI   | 0.122***<br>(0.018) | 0.155***<br>(0.018)  | 0.123***<br>(0.021) | 0.143***<br>(0.021) | 0.170***<br>(0.017) | 0.198***<br>(0.018)  | 0.175***<br>(0.020) | 0.193***<br>(0.020)  |
| log High + Significant risk<br>backlog cost (GBP/ $m^2$ )       | 0.001<br>(0.002)    |                      | 0.003*<br>(0.002)   |                     | 0.006***<br>(0.001) |                      | 0.008***<br>(0.002) |                      |
| log Moderate + Low risk<br>backlog cost (GBP/ $m^2$ )           |                     | 0.011***<br>(0.002)  |                     | 0.008***<br>(0.002) |                     | 0.013***<br>(0.002)  |                     | 0.011***<br>(0.002)  |
| log High + Significant risk<br>backlog cost (GBP/ $m^2$ ) · PFI | -0.004<br>(0.003)   |                      | -0.004<br>(0.003)   |                     | -0.005*<br>(0.003)  |                      | -0.005*<br>(0.003)  |                      |
| log Moderate + Low risk<br>backlog cost (GBP/ $m^2$ ) · PFI     |                     | -0.013***<br>(0.003) |                     | -0.008**<br>(0.003) |                     | -0.014***<br>(0.003) |                     | -0.009***<br>(0.003) |
| Other controls  | Yes                 | Yes                  | Yes                 | Yes                 | Yes                 | Yes                  | Yes                 | Yes                  |
| Hospital profile x year FE                                      | Yes                 | Yes                  | Yes                 | Yes                 | No                  | No                   | No                  | No                   |
| England region x year FE  | No                  | No                   | No                  | No                  | Yes                 | Yes                  | Yes                 | Yes                  |
| Observations  | 2,924               | 2,924                | 2,031               | 2,031               | 2,913               | 2,913                | 2,027               | 2,027                |
| Adjusted R <sup>2</sup>   | 0.265               | 0.273                | 0.250               | 0.252               | 0.276               | 0.284                | 0.267               | 0.267                |

- 1 Other results
- 2 Descriptive statistics: tables
- 3 Descriptive statistics: graphs
- 4 Weighted age
- 5 Robustness checks

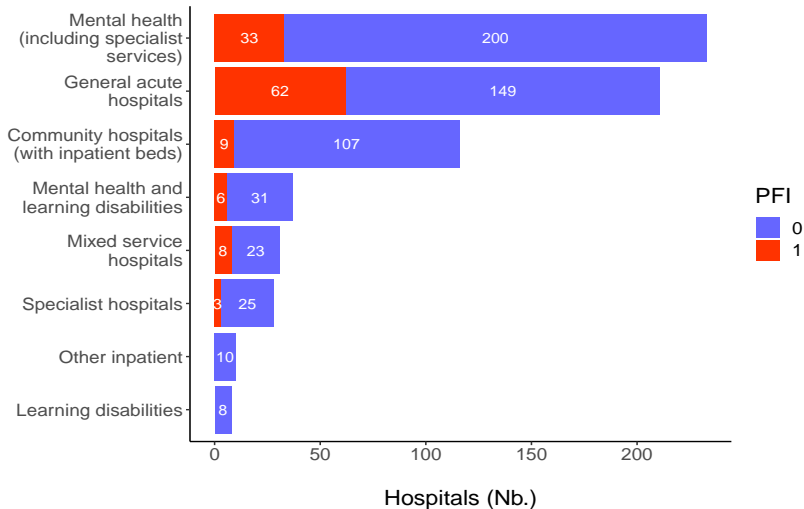


# Regressors

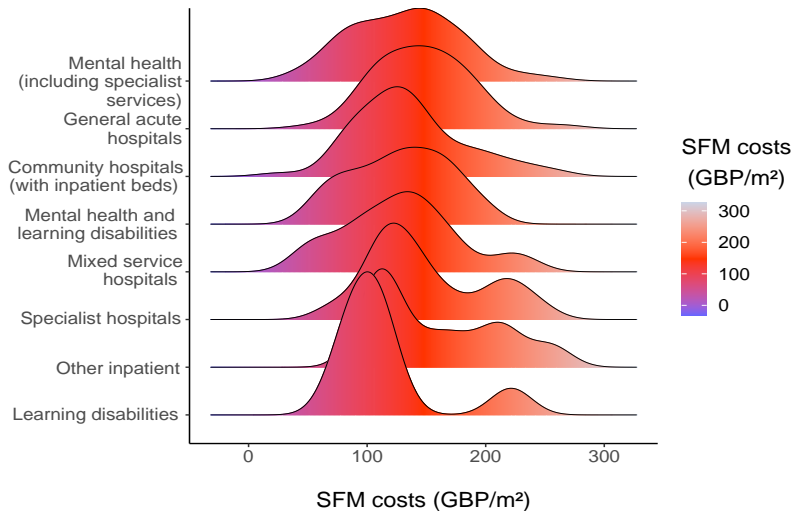
| Group                               | Variable                                 | Measurement  |
|-------------------------------------|--|--------------|
| Descriptive                         | PFI                                      | 1/0          |
|                                     | Age                                      | Weighted age |
| Instrument                          | LIBOR rate                               | Weighted %   |
| Labour                              | Cleaning staff                           | WTE          |
|                                     | Portering staff                          | WTE          |
| Areas                               | Gross floor area                         | $m^2$        |
|                                     | Clinical space                           | %            |
|                                     | Single bedrooms with en-suite facilities | Nb           |
| Energy                              | Total energy consumption                 | kWh          |
|                                     | CHP units                                | 1/0          |
| Catering and<br>laundry<br>services | Laundered pieces per annum               | Nb           |
|                                     | Inpatient main meals requested           | Nb           |
|                                     | Outsourced laundry and linen services    | 1/0          |

- 1 Other results
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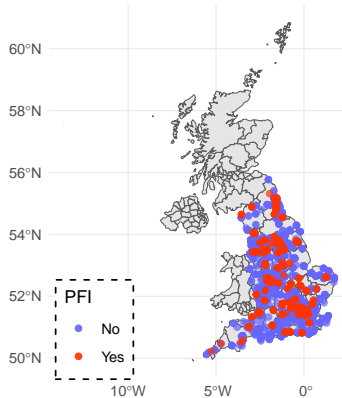
# Hospitals in the samples: types and procurement method (SFM)



# Distribution of Soft FM costs by types of hospitals

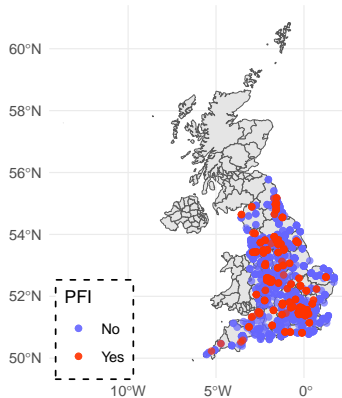


# Hospitals on the map



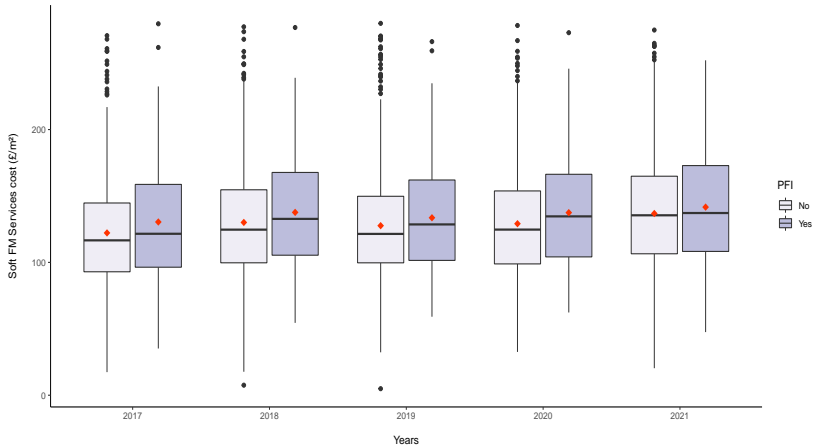
**Figure 1:** soft FM subsample

# Hospitals on the map

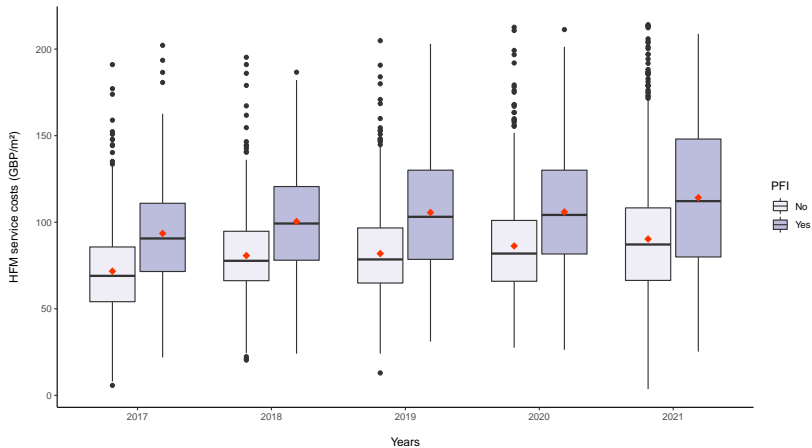


**Figure 2:** hard FM subsample

# Boxplots (SFM)



# Boxplots (HFM)





- 1 Other results
- 2 Descriptive statistics: tables
- 3 Descriptive statistics: graphs
- 4 Weighted age**
- 5 Robustness checks

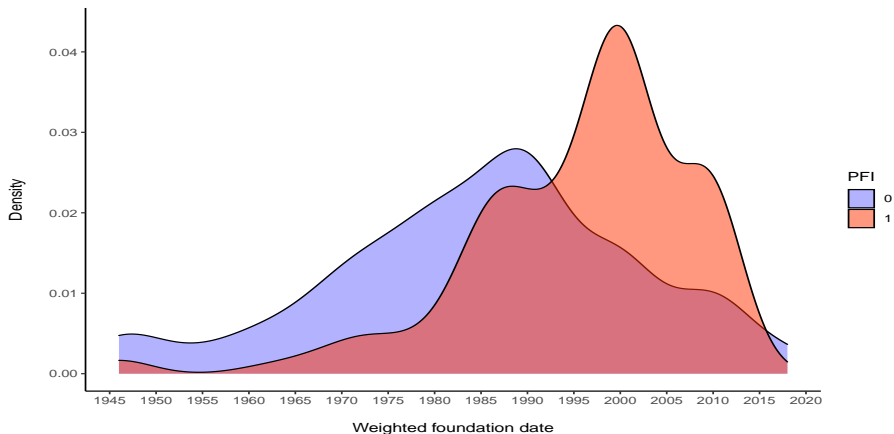
## Weighted age

$$FD_h = \sum_{i=1}^n K_{hi} * M_i$$

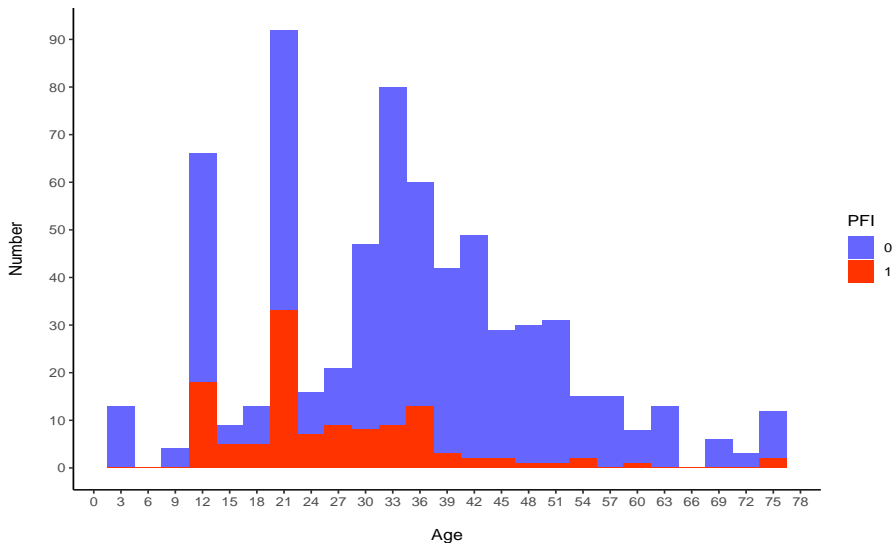
$$Age_{ht} = Year_{ht} - FD_h$$

- $h = 1....N$  - hospitals
- $i$  is an age profile, a ten year period,  $i = 1....n$ ,  $n = 9$
- $K_{hi}$  a share of hospitals' new construction or renovation at each ten-year period,  $\sum K_{hi} = 1$
- $M_i$  is a mean year for each period
- $t = 2017, ..., 2021$

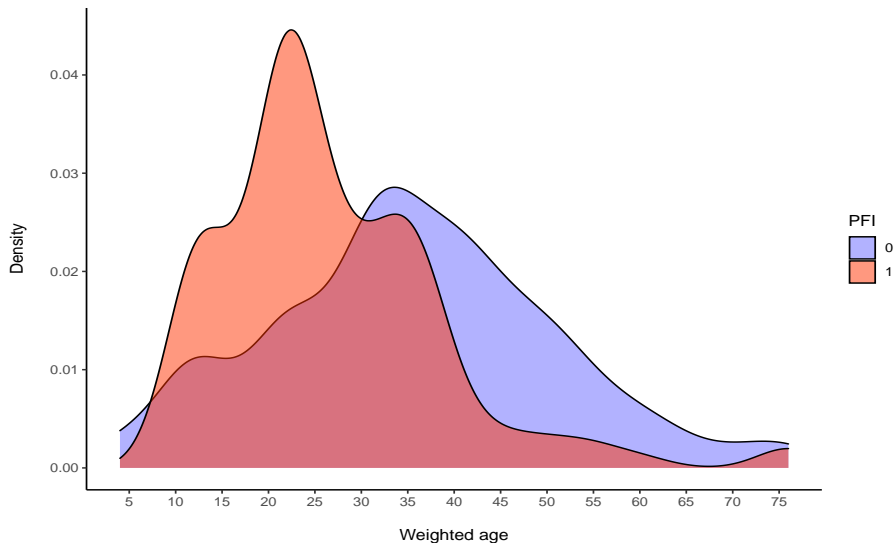
# Weighted foundation date, all unique hospitals



# Weighted age distribution of hospitals, subsample for 2021



# Age of hospitals by PFI procurement type, subsample for 2021



- 1 Other results
- 2 Descriptive statistics: tables
- 3 Descriptive statistics: graphs
- 4 Weighted age
- 5 Robustness checks**

# Alternative PFI breaks: SFM costs (GBP/ $m^2$ )

|                               | Hospital profile fixed effect |                    |                     |                    | England region fixed effect |                    |                     |                   |
|-------------------------------|-------------------------------|--------------------|---------------------|--------------------|-----------------------------|--------------------|---------------------|-------------------|
| $X_1$ (%) =                   | 0                             | 0                  | 20                  | 33                 | 0                           | 0                  | 20                  | 33                |
| $X_2$ (%) =                   | 90                            | 70                 | 80                  | 66                 | 90                          | 70                 | 80                  | 66                |
|                               | (1)                           | (2)                | (3)                 | (4)                | (5)                         | (6)                | (7)                 | (8)               |
| PFI ( $X_2 < X$ )             | 0.042**<br>(0.019)            | 0.041**<br>(0.017) | 0.030*<br>(0.017)   | 0.035**<br>(0.017) | 0.032*<br>(0.019)           | 0.034**<br>(0.017) | 0.026<br>(0.017)    | 0.029*<br>(0.016) |
| PFI ( $X_1 \leq X \leq X_2$ ) | 0.038**<br>(0.017)            | 0.039**<br>(0.019) | 0.059***<br>(0.020) | 0.041*<br>(0.022)  | 0.038**<br>(0.016)          | 0.037**<br>(0.019) | 0.051***<br>(0.019) | 0.042*<br>(0.022) |
| PFI ( $X < X_1$ )             |                               |                    | 0.016<br>(0.043)    | 0.059*<br>(0.034)  |                             |                    | 0.017<br>(0.043)    | 0.049<br>(0.033)  |
| Other controls                | Yes                           | Yes                | Yes                 | Yes                | Yes                         | Yes                | Yes                 | Yes               |
| Hospital profile x year FE    |                               |                    |                     |                    | Yes                         | Yes                | Yes                 | Yes               |
| England region x year FE      | Yes                           | Yes                | Yes                 | Yes                |                             |                    |                     |                   |
| Observations                  | 3,415                         | 3,415              | 3,415               | 3,415              | 3,408                       | 3,408              | 3,408               | 3,408             |
| Adjusted R <sup>2</sup>       | 0.030                         | 0.369              | 0.031               | 0.369              | 0.062                       | 0.398              | 0.063               | 0.398             |