

The Impact of Public-Private Partnership on Facility Management Costs: Evidence from Healthcare Sector in England

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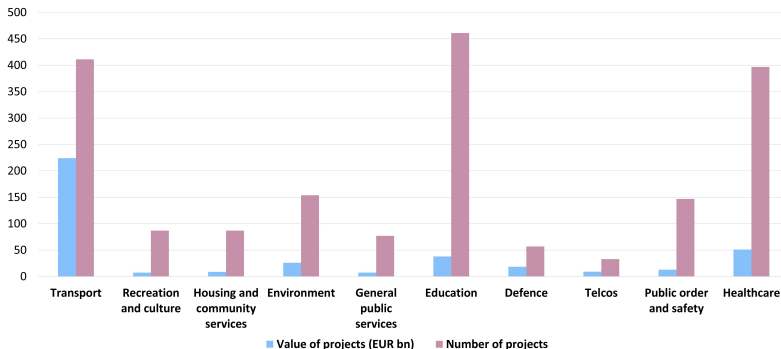
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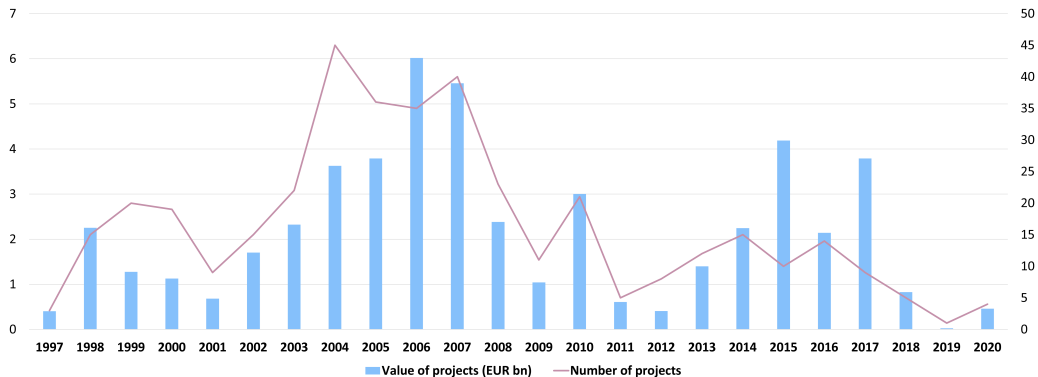
Motivation

- Public Private Partnership (PPP) is a long-term contractual arrangement between government and private partners.
- PPPs became an increasingly popular way to build major public infrastructure projects.
- The Private Finance Initiative (PFI) is a specific form of public – private partnership that has been widely used in England since its introduction in the early 1990s.

Total value and number of European PPP projects by sector, 1997–2020



PPPs in the EU healthcare market



Facility management services

Hard Facility Management (HFM)

services maintain the internal and external conditions of hospital buildings:

- electricity, lighting, plumbing.
- heating and air conditioning.
- fire safety systems.
- building maintenance and other services.

Soft Facility Management (SFM)

services provide amenities and support services:

- cleaning and food services.
- laundry and linen.
- portering and security.
- other services.

This paper

Research question

- How does the procurement type of hospitals in England affect hard and soft facility management costs?

Approach and data

- OLS and IV 2SLS, with PSM and Hausman-Taylor robustness checks.
- ERIC data, plus financial and political instruments, 2018–2021.
- 2,903 SFM and 2,911 HFM observations after preprocessing.

Contribution

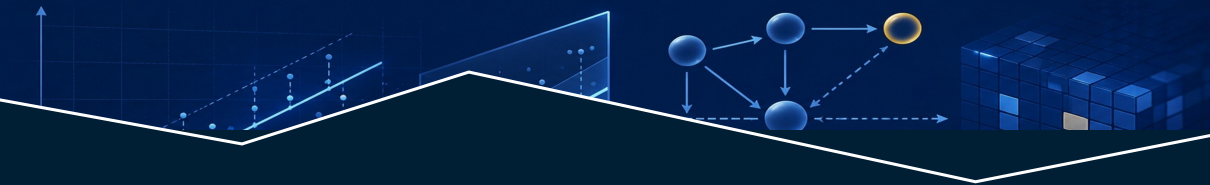
- Among the first panel-data comparisons of procurement types in this context.
- Uses hospital-site panel data from English NHS estate returns.

Key results

- PFI raises HFM costs by up to 37.1% and SFM costs by 20.3%.
- HFM effects are larger for PFI sites with pre-existing buildings, while the SFM pattern goes in the opposite direction.
- Partial PFI raises HFM costs more, while full PFI raises SFM

Briefly about literature

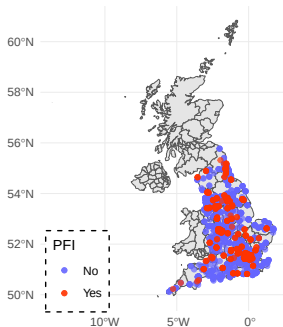
- General PPP literature on cost efficiency: Pollock et al. (2007), Blanc-Brude et al. (2009), Raisbeck et al. (2010), Hoppe et al. (2013).
- PFI-specific evidence and reports: NAO (2010, 2018, 2020), Podaneva and Picard (2023).
- Literature comparing PPP projects across life-cycle stages: construction and maintenance.
- Our study contributes by empirically estimating the role of PPP/PFI in healthcare-sector facility management costs at the maintenance stage.



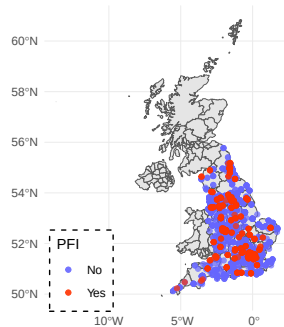
Data and Estimation strategy

Hospitals on the map: SFM and HFM subsamples

Soft FM subsample

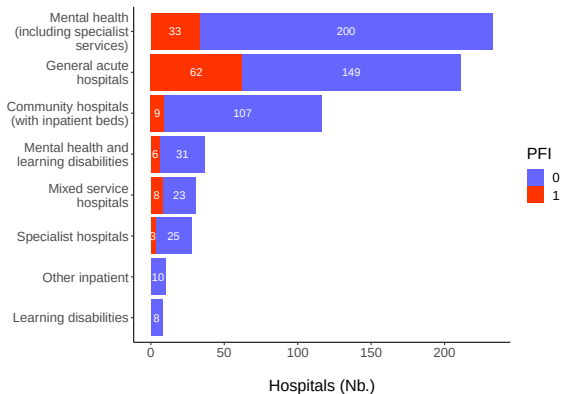


Hard FM subsample



- Hospitals are spread across England but concentrated around urban areas, motivating region-by-year fixed effects.

Hospitals by types and procurement method (SFM)



- Traditional hospitals dominate across profiles, and PFI appears most often among general acute hospitals.

Empirical specifications

OLS

$$\log(\text{Costs}_{ht}) = \alpha_0 + \alpha \text{PFI}_h + A'_{ht}\gamma + FE_{hti} + \epsilon_{ht}.$$

2SLS

$$\text{PFI}_h = \beta_0 + \beta Z_h + A'_{ht}\delta + FE_{hti} + \eta_{ht}, \quad \log(\text{Costs}_{ht}) = \phi_0 + \phi \widehat{\text{PFI}}_h + A'_{ht}\psi + FE_{hti} + \zeta_{ht}.$$

- $h = 1, \dots, H$ indexes hospitals, and $t = 2018, \dots, 2021$ indexes years.
- A'_{ht} is the row vector of controls, while γ , δ , and ψ are the corresponding coefficient vectors.
- FE_{hti} is hospital profile $\times$ year, UK region $\times$ year, or trust $\times$ region plus year fixed effects.
- Z_h is one of the weighted instruments: LIBOR, public sector net debt, or constituency voting.

Outcome variables

HFM costs	SFM costs
Estates and property maintenance (36%)	Cleaning services (33%)
Energy (28%)	Other SFM services (25%)
Electro-bio-medical equipment (17%)	Inpatient food services (21%)
Waste (5%)	Portering services (11%)
Water and sewerage (4%)	Laundry and linen services (7%)
Car parking (3%)	Management (3%)
Management (3%)	
Other HFM services (3%)	
Grounds and gardens maintenance (1%)	

Source: Own calculations based on NHS ERIC estate returns.

Notes: Entries report cost components and their shares in total hard FM (HFM) and soft FM (SFM) costs.

Paper basis: Table 3 and Appendix Table A1.

- We estimate the models first for SFM and then for HFM service costs.

Regressors

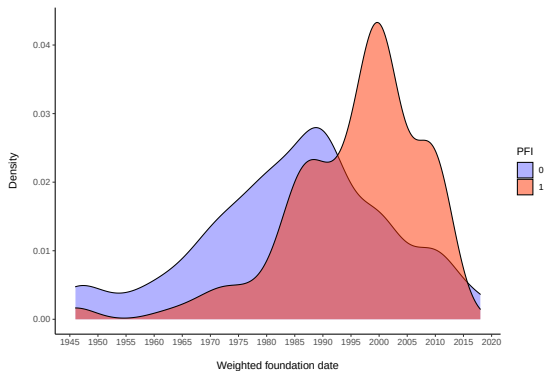
Group	Variable	Measurement
Descriptive	Hospital procurement type Age	1/0 Weighted age
Instruments	LIBOR rate Public sector net debt Constituency voting	Weighted % Weighted % of GDP Weighted category
Labour	Cleaning staff Portering staff	WTE/m ² WTE/m ²
Areas	Gross floor area Clinical space Single bedrooms with en-suite facilities	m ² % Nb
Energy	Total energy consumption CHP units	kWh/m ² 1/0
Catering and laundry services	Laundered pieces per annum Inpatient main meals requested Outsourced laundry and linen services	Nb/m ² Nb/m ² 1/0

Source: Own calculations based on NHS ERIC estate returns, HM Treasury PFI/PF2 project data, Bank of England LIBOR, public sector net debt, and constituency-election data.

Notes: Controls are normalized by gross internal area where indicated, and instruments are weighted by the hospital-site construction profile.

Paper basis: Appendix Table A1 and Section 3 empirical specification.

Weighted foundation date, all unique hospitals



- PFI hospitals are newer on average, and weighted foundation dates proxy age when direct ERIC age is unavailable.

Principal instrument: weighted LIBOR exposure

$$Z_h = \sum_{i=1}^9 K_{hi} Z_i$$

Construction

- K_{hi} : share of construction or renovation in decade i , with $\sum_i K_{hi} = 1$.
- Z_i : average LIBOR bank rate in the corresponding procurement-choice period.
- Weighting maps national credit conditions to the site's likely decision date.

Why LIBOR?

- PFI projects use SPVs, and banks provide most upfront capital as senior debt.
- LIBOR changes debt cost and lender participation, shifting PFI feasibility at bidding.
- This gives first-stage variation in PFI choice, helping address omitted management, technology, and quality factors that also affect FM costs.

Alternative instruments

- **Public sector net debt, % of GDP:** captures the fiscal incentive to use PFI when conventional public borrowing is constrained or politically costly.
- **Constituency voting:** captures local political conditions that may shift procurement choice toward PFI or traditional procurement.
- Both are constructed like LIBOR: weighted by each hospital site's construction and renovation age profile to match the likely procurement-choice period.
- Both instruments are used as alternative sources of first-stage variation for hospital procurement type.



Results

Summary of key results

- PFI hospital sites have higher HFM and SFM costs than traditional hospital sites.
- OLS estimates imply 12.5–16.3% higher HFM costs and 4.2–7.2% higher SFM costs.
- IV estimates are larger: HFM costs increase by up to 37.1%, while SFM costs increase by up to 20.3%.
- Partial PFI is linked to larger HFM differences, while full PFI is linked to larger SFM differences.
- HFM effects are stronger when PFI sites had pre-existing buildings before financial closure, while for SFM the newer-site pattern is stronger.

OLS and 2SLS for SFM and HFM costs

Outcome	Fixed effects	OLS PFI	2SLS PFI	LIBOR FS	Debt FS	Obs.	K-P F
SFM	Profile $\times$ year	0.042**	0.170***	-0.056***	-0.004***	2,903	24.5
	Region $\times$ year	0.054***	0.111*	-0.038***	-0.004***	2,903	141.1
	Trust $\times$ region + year	0.072***	0.203*	-0.032***	-0.003***	2,903	12.5
HFM	Profile $\times$ year	0.125***	0.099	-0.053***	-0.004***	2,911	14.6
	Region $\times$ year	0.163***	0.048	-0.037***	-0.003***	2,911	34.6
	Trust $\times$ region + year	0.134***	0.371*	-0.027***	-0.002***	2,911	6.4

Source: Own calculations based on NHS ERIC estate returns, HM Treasury PFI/PF2 project data, Bank of England LIBOR, and public sector net debt.

Notes: Dependent variables are log SFM and HFM costs per m^2 . The table reports OLS and 2SLS estimates. PFI is instrumented with weighted LIBOR and public sector net debt. Fixed effects are listed by row, FS is the first-stage coefficient and K-P F is the Kleibergen-Paap rk Wald F statistic. ***, ** and * denote significance at the 1%, 5% and 10% levels.

Paper basis: Tables 1 and 2.

Possible next steps

- Calculate and employ hospitals' productivity.
- Explore employee salaries, medical equipment, and broader outsourcing choices.
- Compare active and expired PFIs once enough transferred contracts are observed.
- Study COVID-19 effects on HFM and SFM costs when consistent data are available.

Thank you! / Merci !

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Paper: monastyrenko.eu – Impact of PPPs on FM costs



Appendix

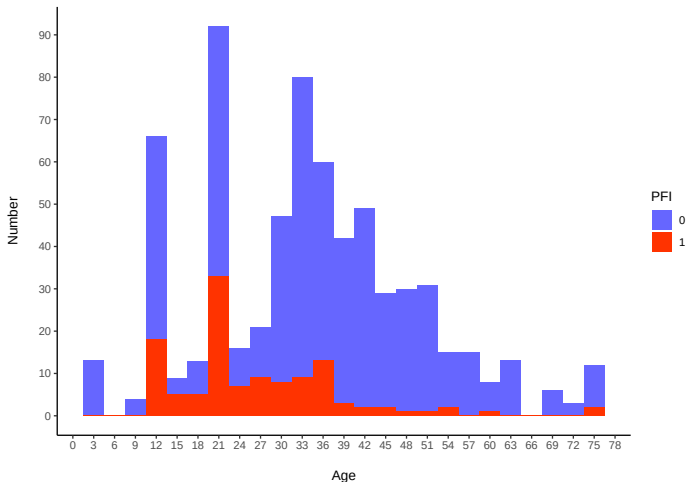
Weighted age

$$FD_h = \sum_{i=1}^n K_{hi} M_i,$$
$$Age_{ht} = Year_{ht} - FD_h.$$

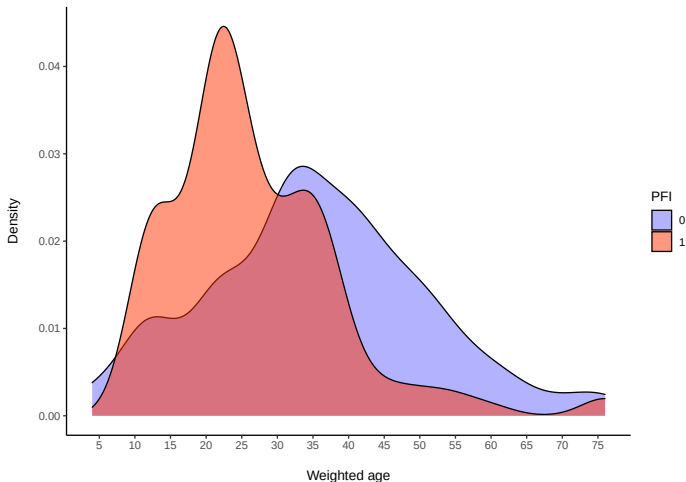
- $h = 1, \dots, N$ indexes hospitals.
- i is an age profile, a ten-year period, $i = 1, \dots, n$, $n = 9$.
- K_{hi} is the share of hospital h 's new construction or renovation in ten-year period i , with $\sum_i K_{hi} = 1$.
- M_i is the mean year for each period.

• $t = 2018, \dots, 2021$.

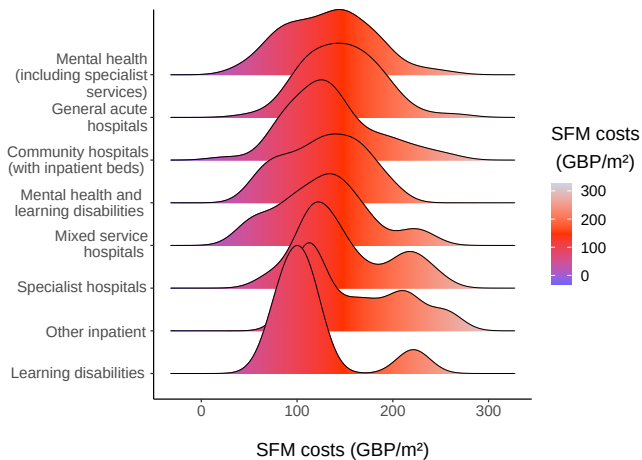
Weighted age distribution of hospitals, subsample for 2021



Age of hospitals by PFI procurement type, subsample for 2021



Distribution of Soft FM costs by types of hospitals



PFI differentiation

Case 1: based on PFI tenure

- Full PFI: the whole site is under PFI procurement.
- Part PFI: only a fraction of the site is supplied under a PFI contract.

Case 2: based on the share of construction within PFI hospitals built after 1995

- $\text{PFI} > 80\% \text{ GFA}$: more than 80% of PFI building built after 1995.
- $\text{PFI} \leq 80\% \text{ GFA}$: less than or equal to 80% of PFI building built after 1995.

PFI contract heterogeneity

	log HFM costs			log SFM costs		
	Profile FE	Region FE	Trust-region FE	Profile FE	Region FE	Trust-region FE
PFI_{full}	0.109***	0.129***	0.142***	0.052**	0.068***	0.099***
PFI_{part}	0.140***	0.191***	0.127***	0.034	0.043**	0.049**
PFI_{old}	0.201***	0.354***	0.336***	0.094	0.122**	0.195***
PFI_{new}	0.225***	0.228***	0.183***	0.084**	0.065*	0.036
Adjusted R^2 : tenure	0.266	0.278	0.476	0.312	0.356	0.508
Adjusted R^2 : old/new	0.253	0.264	0.477	0.293	0.341	0.507

Source: Own calculations based on NHS ERIC estate returns and HM Treasury PFI/PF2 project data.

Notes: Dependent variables are log HFM and SFM costs per m^2 . Columns use profile $\times$ year, region $\times$ year, and trust $\times$ region + year fixed effects. Controls follow the baseline specification. ***, ** and * denote significance at the 1%, 5% and 10% levels.

Paper basis: Table 5.

Gross floor area as an additional control: HFM costs (GBP)

	Dependent variable: log(HFM), profile $\times$ year FE						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
PFI (1/0)	0.586***	0.236***	0.216***	0.281***	0.265***	0.185***	0.138***
Gross internal area (m^2)		0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
log Age			-0.051*				
Clinical space (%)				-0.017***			
CHP Units					0.227***		
log Single bedrooms						0.026***	
log Total energy consumption							0.805***
Observations	2,911	2,911	2,911	2,911	2,911	2,911	2,911
Adjusted R^2	0.712	0.782	0.782	0.802	0.784	0.806	0.941

Source: Own calculations based on NHS ERIC estate returns and HM Treasury PFI/PF2 project data.

Notes: Dependent variable is log HFM costs in GBP. The table reports OLS estimates. All columns include site profile $\times$ year fixed effects. GFA enters as a level control. ***, ** and * denote significance at the 1%, 5% and 10% levels.

Paper basis: Table C5.

Robustness check: SFM

	Dependent variable: $\log(\text{SFM}/m^2)$, hospitals only							
	Profile FE				Region FE			
	OLS	OLS	FS	2SLS	OLS	OLS	FS	2SLS
PFI (1/0)	0.067***	0.059***		0.025	0.081***	0.041***		0.039
LIBOR (%)			-0.039***				-0.030***	
log Age		0.029**	-0.197***	0.020		0.000	-0.204***	-0.001
Inpatient meals		0.042***	-0.001	0.042***		0.038***	-0.002	0.038***
Laundered pieces		0.007***	0.001	0.007***		0.009***	0.003***	0.009***
Outsourced laundry		0.082***	0.036	0.083***		0.061***	-0.028	0.061***
Cleaning staff		0.051***	0.003	0.052**		0.044***	0.001	0.044**
Observations	1,672	1,672	1,672	1,672	1,672	1,672	1,672	1,672
Adjusted R^2	0.049	0.438	0.194	0.413	0.084	0.488	0.134	0.449
K-P F stat			20.6				50.9	

Source: Own calculations based on NHS ERIC estate returns, HM Treasury PFI/PF2 project data, and Bank of England LIBOR.

Notes: Dependent variable is $\log$ SFM costs per m^2 . The table reports OLS, first-stage and 2SLS estimates. 2SLS uses weighted LIBOR. Fixed effects are profile $\times$ year or region $\times$ year. ***, ** and * denote significance at the 1%, 5% and 10% levels.

Paper basis: Table D1.

Robustness check: HFM

	Dependent variable: $\log(\text{HFM}/m^2)$, hospitals only							
	Profile FE				Region FE			
	OLS	OLS	FS	2SLS	OLS	OLS	FS	2SLS
PFI (1/0)	0.152***	0.135***		0.413***	0.208***	0.165***		0.225*
LIBOR (%)			−0.036***				−0.026***	
log Age		0.019	−0.185***	0.086***		0.000	−0.194***	0.014
Clinical space (%)		0.001**	0.000	0.001		0.001*	−0.001	0.001*
CHP Units		−0.089***	−0.096***	−0.059***		0.010	−0.012	0.011
Total energy		0.267***	0.051**	0.255***		0.368***	0.107***	0.362***
Observations	1,673	1,673	1,673	1,673	1,673	1,673	1,673	1,673
Adjusted R^2	0.251	0.335	0.187	0.040	0.160	0.348	0.115	0.270
K-P F stat			17.1				41.0	

Source: Own calculations based on NHS ERIC estate returns, HM Treasury PFI/PF2 project data, and Bank of England LIBOR.

Notes: Dependent variable is $\log$ HFM costs per m^2 . The table reports OLS, first-stage and 2SLS estimates. 2SLS uses weighted LIBOR. Fixed effects are profile $\times$ year or region $\times$ year. ***, ** and * denote significance at the 1%, 5% and 10% levels.

Paper basis: Table D2.

Alternative construction-share breaks: SFM

	Profile FE			Region FE		
	90/0	80/0	70/0	90/0	80/0	70/0
PFI ($X > X_1$)	0.042**	0.027	0.037**	0.033	0.025	0.032*
PFI ($X \leq X_1$)	0.037*	0.053**	0.042*	0.038**	0.048**	0.041**
Observations	2,903	2,903	2,903	2,903	2,903	2,903
Adjusted R^2	0.363	0.363	0.363	0.392	0.392	0.392

Source: Own calculations based on NHS ERIC and HM Treasury PFI/PF2 project data.

Notes: Dependent variable is log SFM costs per m^2 . Controls are included. X is the post-1995 GIA share. ***, ** and * denote significance at the 1%, 5% and 10% levels.

Paper basis: Table D3.

Alternative construction-share breaks: HFM

	Profile FE			Region FE		
	90/0	80/0	70/0	90/0	80/0	70/0
PFI ($X > X_1$)	0.120***	0.129***	0.136***	0.117***	0.152***	0.164***
PFI ($X \leq X_1$)	0.133***	0.123***	0.113***	0.202***	0.178***	0.165***
Observations	2,911	2,911	2,911	2,911	2,911	2,911
Adjusted R^2	0.264	0.264	0.265	0.274	0.272	0.272

Source: Own calculations based on NHS ERIC and HM Treasury PFI/PF2 project data.

Notes: Dependent variable is log HFM costs per m^2 . Controls are included. X is the post-1995 GIA share. ***, ** and * denote significance at the 1%, 5% and 10% levels.

Paper basis: Table D4.