The impact of Public-Private Partnership on Facility Management Costs: evidence from health care in England

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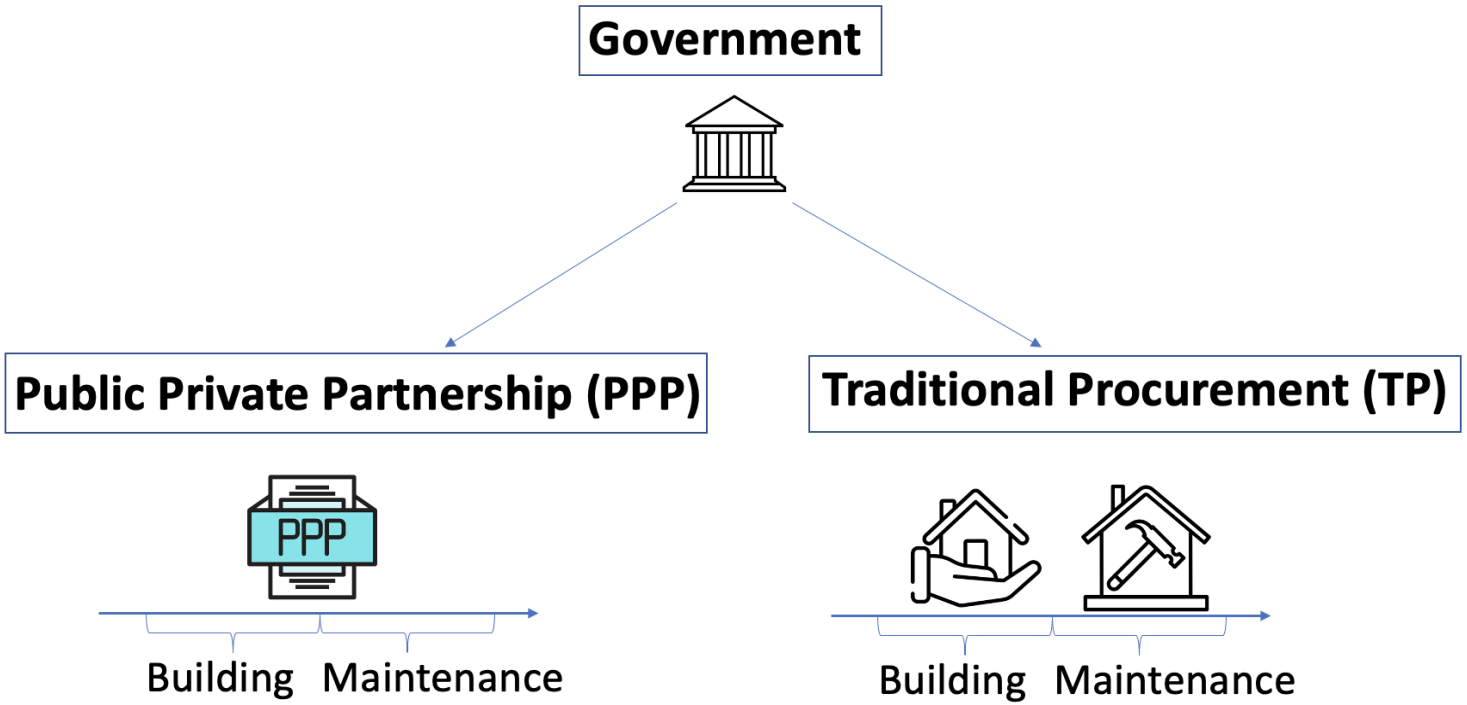
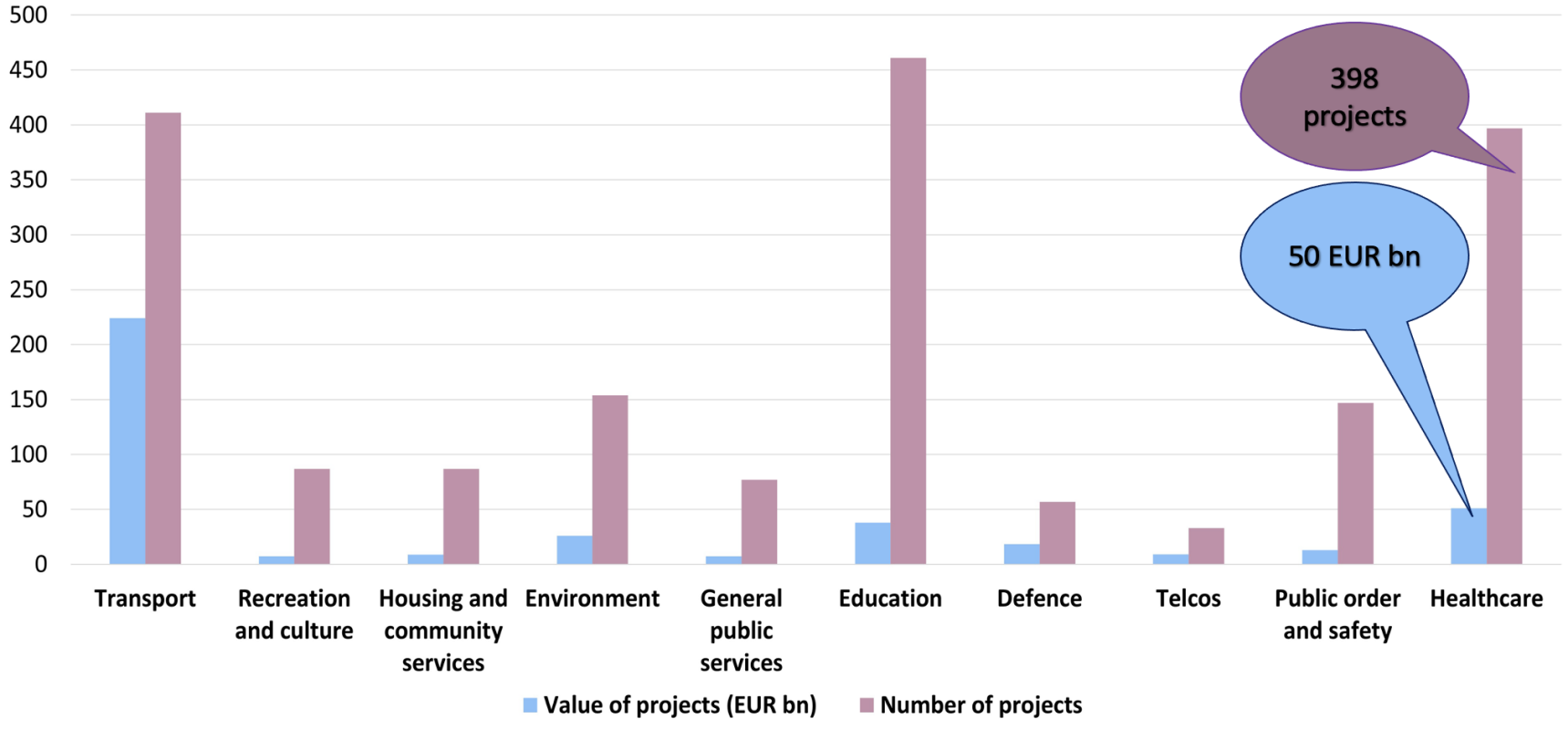
Procurement types

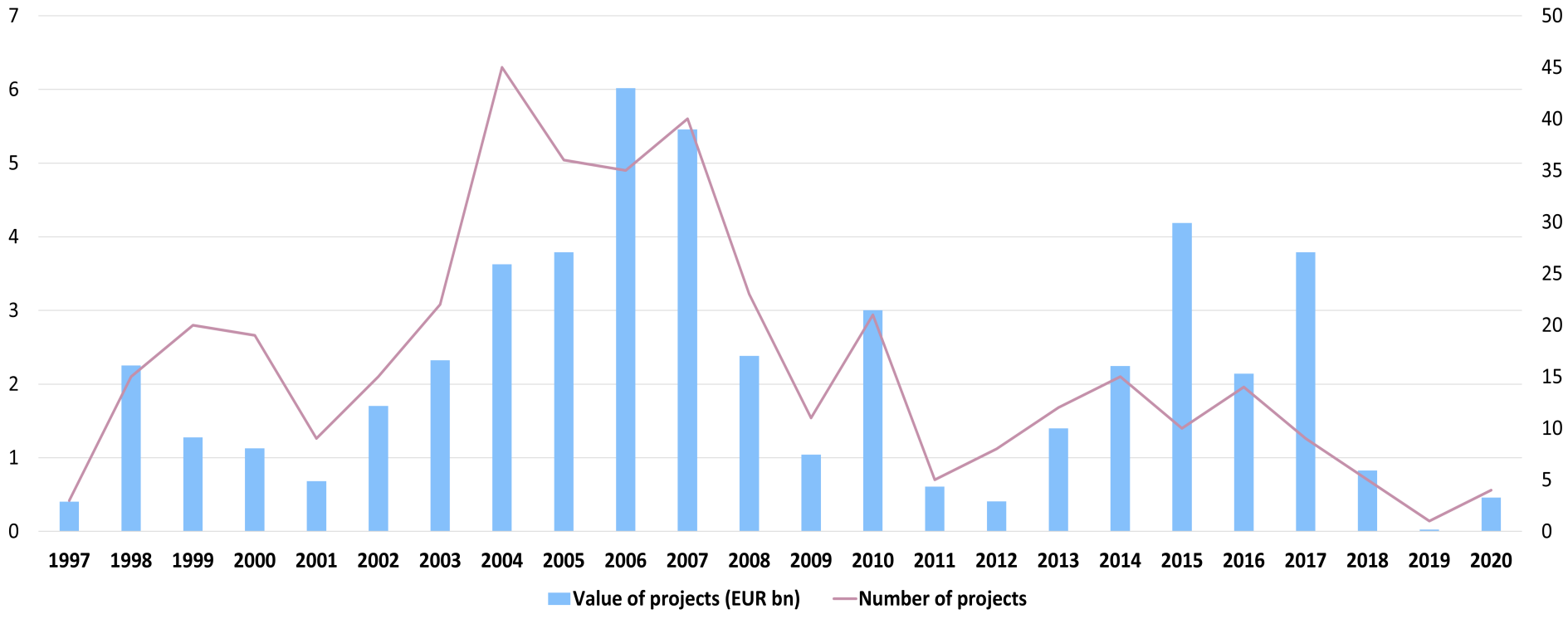
- Public procurement refers to the
  - purchase by governments of goods, services and works
  - choice of model to fund and develop public infrastructure projects



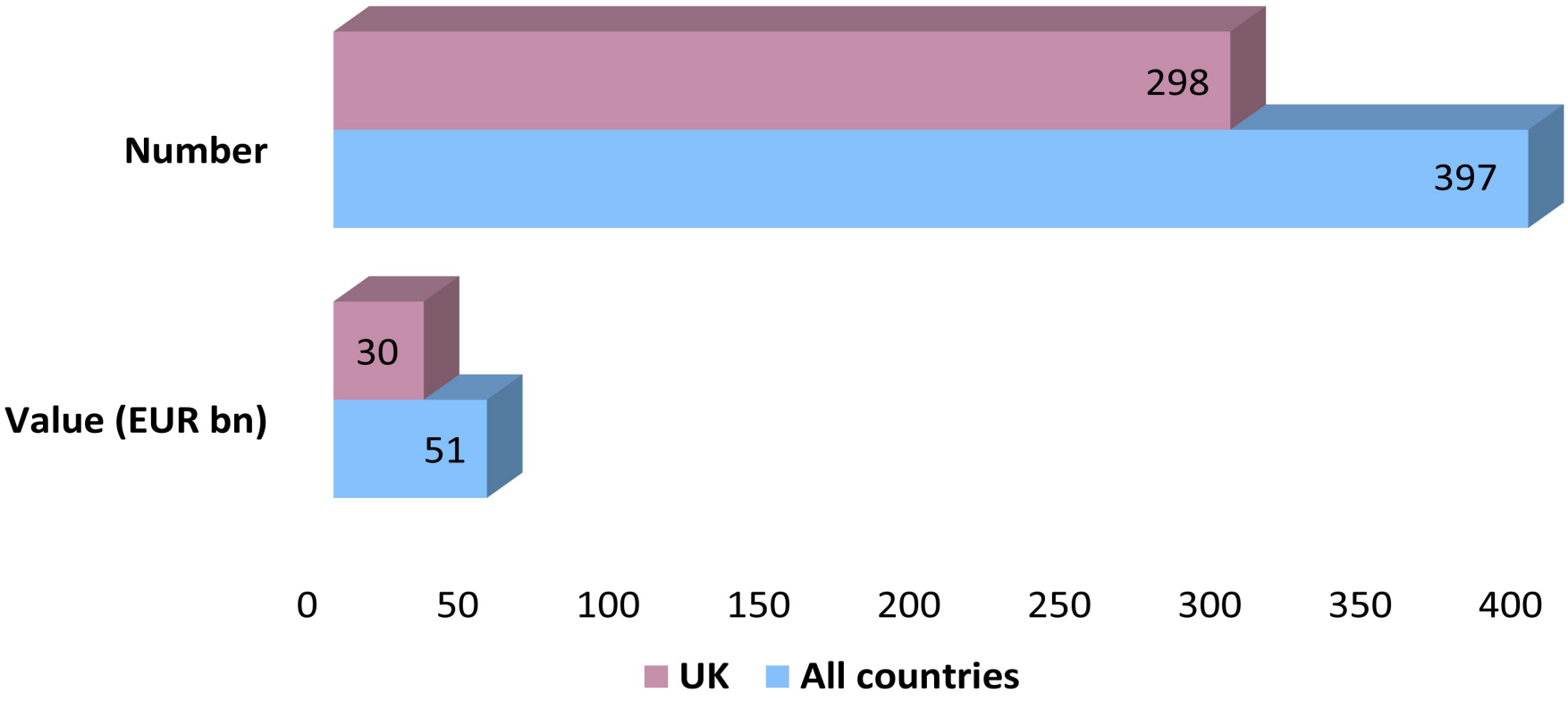
Total value and number of PPP projects within EU and in the UK by sector, 1997 - 2020



PPPs in the EU healthcare market

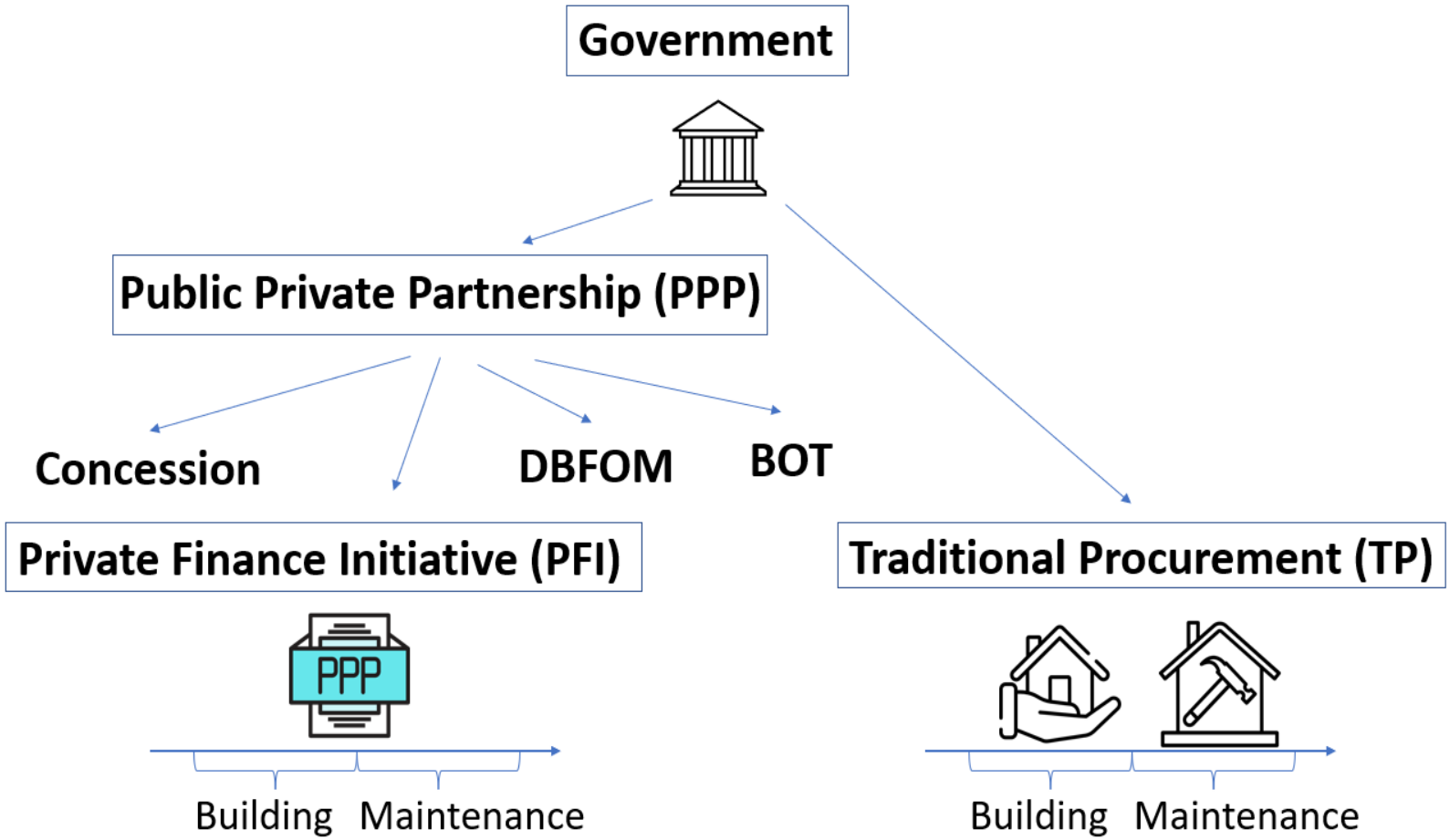


PPPs in the UK healthcare sector



- 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



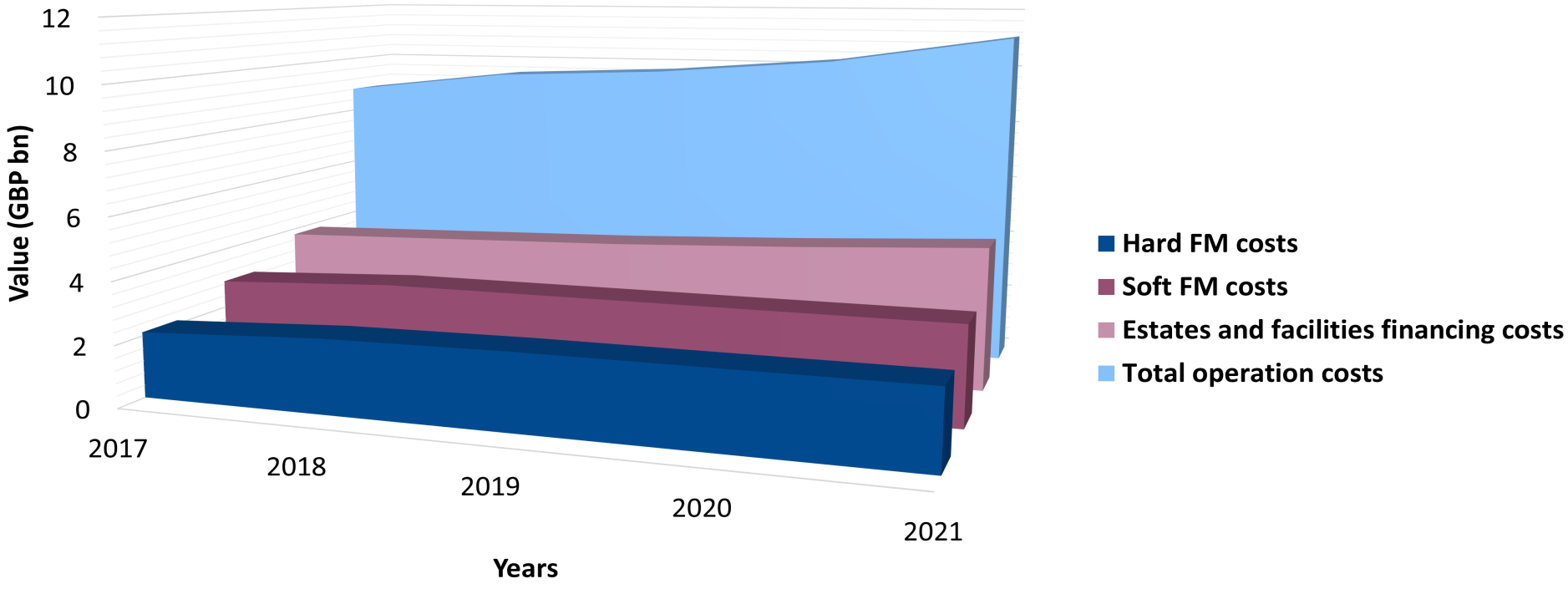
Research question

- 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

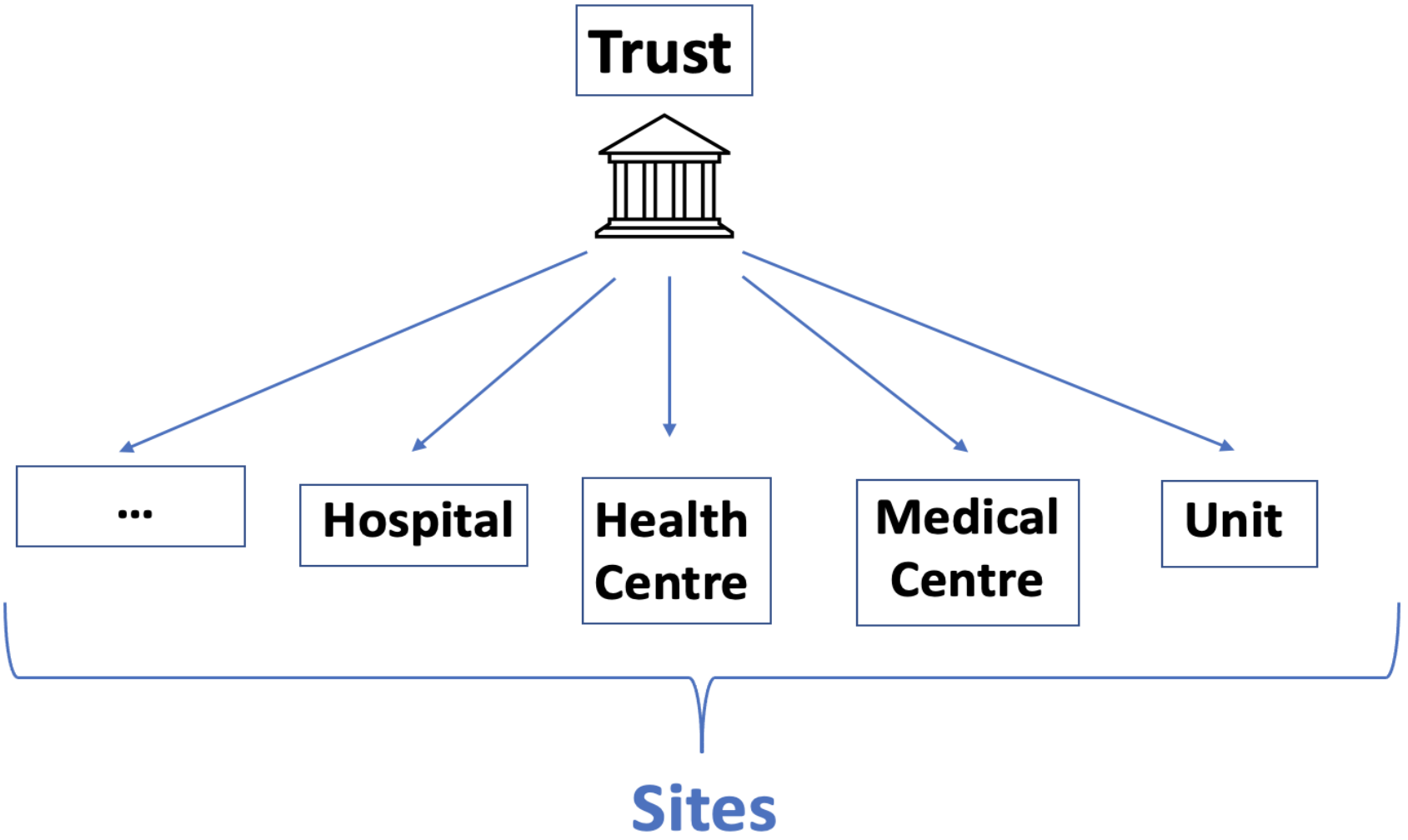


- Total operation costs hold for 13% of England hospital sites' total costs

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

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

2SLS: first stage

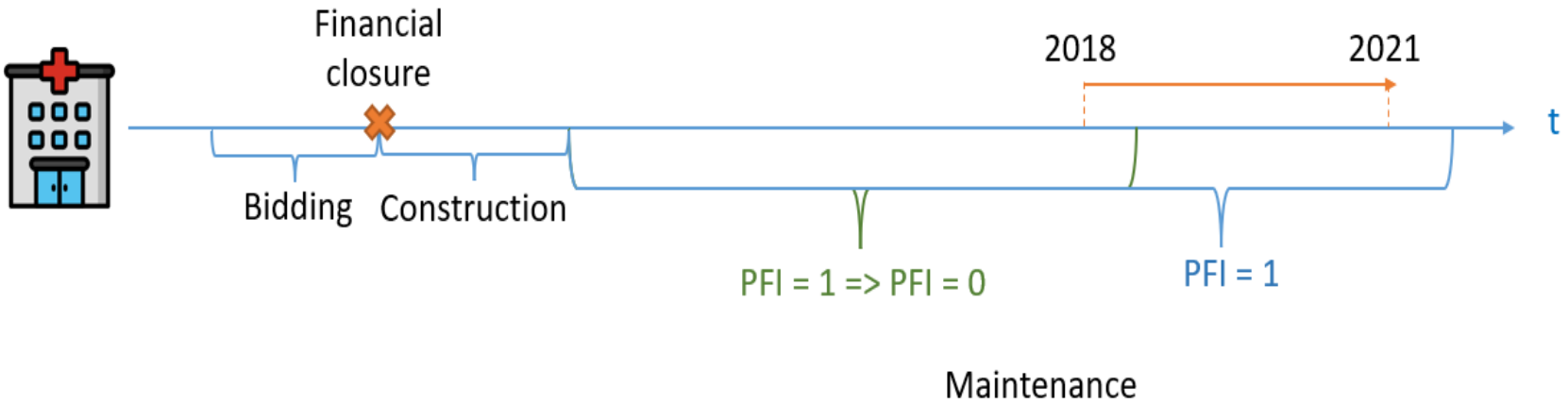
$$PFI_{ht} = \beta_0 + \beta Z_h + A'_{ht}\delta + FE_p \times FE_t + \eta_{ht}$$

2SLS: second stage

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

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

PFI


Financial
closure
2018
2021
t
Bidding
Construction
PFI = 1 => PFI = 0
PFI = 1
Maintenance

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

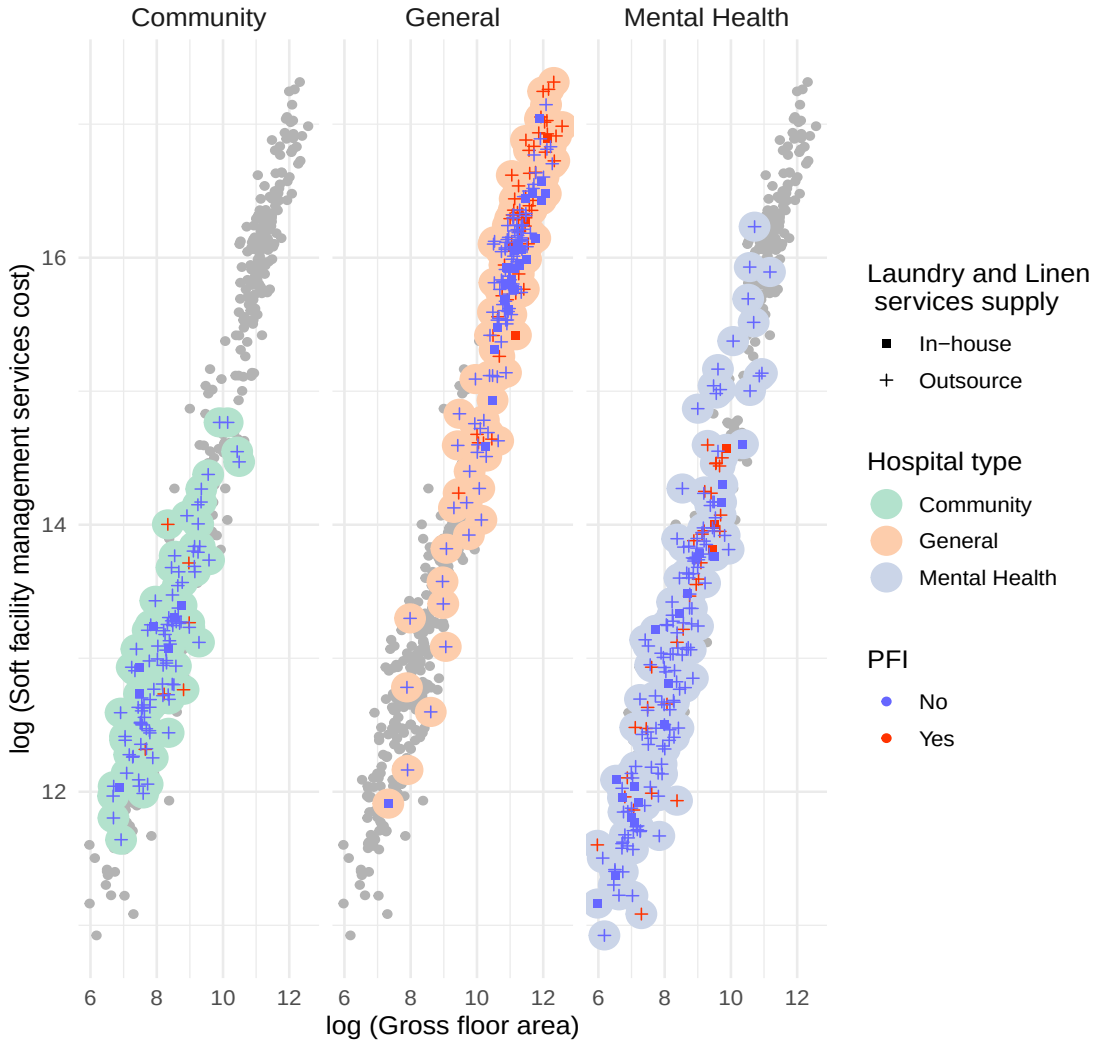
$$Z_h = \sum_{i=1}^{n} K_{hi} * Z_i$$

- 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^2)							
	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***	0.039***		0.042	0.063***	0.036**		0.011
	(0.018)	(0.015)		(0.092)	(0.017)	(0.014)		(0.111)
LIBOR (%)			−0.028***				−0.022***	
			(0.003)				(0.003)	
log Age		0.014	−0.115***	0.015		0.005	−0.120***	0.001
		(0.010)	(0.014)	(0.021)		(0.010)	(0.014)	(0.021)
Inpatient main meals requested (Nb/m^2)		0.032***	0.000	0.032***		0.030***	−0.002	0.030***
		(0.001)	(0.002)	(0.002)		(0.001)	(0.002)	(0.001)
Laundered pieces per annum (Nb/m^2)		0.008***	0.001*	0.008***		0.009***	0.003***	0.009***
		(0.001)	(0.001)	(0.002)		(0.000)	(0.001)	(0.001)
Outsourced laundry and linen services (1/0)		0.062***	0.058**	0.062***		0.024	0.021	0.025
		(0.021)	(0.026)	(0.018)		(0.020)	(0.027)	(0.020)
log Portering staff (WTE/m^2)		0.003***	0.001*	0.003***		0.003***	0.003***	0.004***
		(0.000)	(0.001)	(0.001)		(0.000)	(0.001)	(0.001)
log Cleaning staff (WTE/m^2)		0.033***	0.001	0.034***		0.029***	0.003	0.029***
		(0.004)	(0.005)	(0.011)		(0.004)	(0.005)	(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^2	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^2)							
	OLS		2SLS		OLS		2SLS	
			First stage	Second stage			First stage	Second stage
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PFI (1/0)	0.152***	0.127***		0.251**	0.218***	0.164***		0.195
	(0.018)	(0.017)		(0.101)	(0.018)	(0.017)		(0.187)
LIBOR (%)			−0.025***				−0.019***	
			(0.003)				(0.003)	
log Age		0.010	−0.115***	0.030		0.012	−0.106***	0.016
		(0.011)	(0.013)	(0.025)		(0.011)	(0.013)	(0.029)
Clinical space (%)		0.002***	−0.000	0.002***		0.001	−0.002***	0.001
		(0.000)	(0.000)	(0.001)		(0.000)	(0.000)	(0.001)
log Single bedrooms for patients without en-suite facilities (Nb/m^2)		0.002***	0.001	0.002**		0.003***	0.002***	0.003***
		(0.001)	(0.001)	(0.001)		(0.001)	(0.001)	(0.001)
CHP Units (1/0)		−0.080***	−0.112***	-0.066***		0.058***	−0.001	0.059***
		(0.019)	(0.020)	(0.022)		(0.017)	(0.018)	(0.016)
log Total energy consumption (kWh/m^2)		0.233***	0.048***	0.227***		0.287***	0.089***	0.284***
		(0.013)	(0.014)	(0.018)		(0.013)	(0.014)	(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^2	0.169	0.265	0.139	0.261	0.105	0.272	0.090	0.281

PFI differantiation

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_{full} - a hospital site built **entirely** under a PFI contract
- PFI_{part} - 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_{old} - a hospital site **with** buildings prior to a PFI contract signing
- PFI_{new} - 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_{full}	0.143***	0.113***	0.087***	0.057***	0.155***	0.132***	0.094***	0.060***
	(0.024)	(0.024)	(0.024)	(0.021)	(0.025)	(0.024)	(0.024)	(0.020)
PFI_{part}	0.161***	0.139***	0.020	0.024	0.271***	0.191***	0.038*	0.016
	(0.023)	(0.022)	(0.023)	(0.019)	(0.023)	(0.021)	(0.022)	(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^2	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?

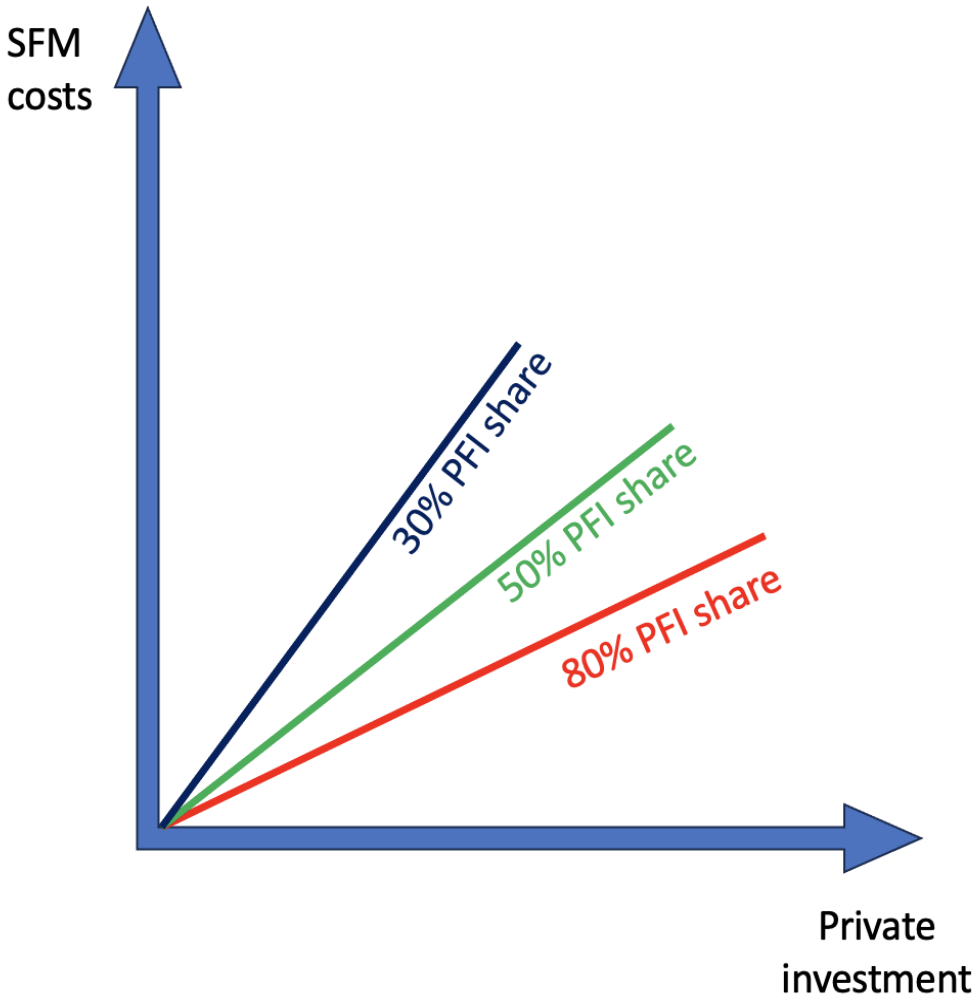
	log HFM costs		log SFM costs		log HFM costs		log SFM costs	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PFI_{old}	0.255	0.262*	−0.165	−0.033	0.391**	0.307**	−0.057	−0.020
	(0.156)	(0.147)	(0.134)	(0.111)	(0.162)	(0.147)	(0.133)	(0.108)
PFI_{new}	0.224***	0.205***	0.062**	0.074***	0.303***	0.257***	0.076***	0.056**
	(0.027)	(0.026)	(0.028)	(0.024)	(0.028)	(0.026)	(0.027)	(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^2	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***	0.240***	0.061**	0.327	0.100***	0.223***	0.040	0.675**
	(0.027)	(0.041)	(0.028)	(0.261)	(0.028)	(0.043)	(0.029)	(0.267)
log Private investment (GBP)	0.003		0.006**		−0.001		0.004	
	(0.002)		(0.003)		(0.003)		(0.003)	
log Private investment (GBP) · PFI_{share} (%)	−0.002		−0.010**		0.003		−0.006	
	(0.004)		(0.004)		(0.004)		(0.004)	
log Public investment (GBP)	0.000		−0.000		0.001		−0.000	
	(0.002)		(0.002)		(0.002)		(0.002)	
log Capital investment for improving existing buildings (GBP)		0.009*		0.032***		0.001		0.028***
		(0.005)		(0.009)		(0.006)		(0.009)
log Capital investment for new build (GBP)		0.004***		0.002		0.005***		0.003**
		(0.002)		(0.001)		(0.002)		(0.001)
log Capital investment for equipment (GBP)		−0.002		0.002		−0.002		0.001
		(0.002)		(0.002)		(0.002)		(0.002)
log Capital investment for new build (GBP) · PFI_{share} (%)		−0.009***				−0.010***		
		(0.003)				(0.003)		
log Capital investment for improving existing buildings (GBP) · PFI_{share} (%)				−0.018				−0.042**
				(0.017)				(0.017)
log GIA	0.950***	0.940***	0.863***	0.840***	1.079***	1.075***	1.000***	0.979***
	(0.017)	(0.017)	(0.019)	(0.019)	(0.011)	(0.012)	(0.012)	(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^2	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!

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^2)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
PFI (1/0)	0.218***	0.224***	0.222***	0.218***	0.207***	0.164***	−0.662**
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.017)	(0.260)
log Age		0.017	0.015	0.014	0.030**	0.012	0.010
		(0.012)	(0.012)	(0.012)	(0.012)	(0.011)	(0.011)
Clinical space (%)			−0.000	0.001	0.001	0.001	0.000
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CHP units (1/0)				0.154***	0.135***	0.058***	0.054***
				(0.018)	(0.018)	(0.017)	(0.017)
log Single bedrooms for patients with en-suite facilities (Nb/m^2)					0.005***	0.003***	0.003***
					(0.001)	(0.001)	(0.001)
log Total energy consumption (kWh/m^2)						0.287***	0.276***
						(0.013)	(0.013)
log Total energy consumption (kWh/m^2) · PFI							0.139***
							(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^2	0.105	0.105	0.105	0.128	0.143	0.272	0.274

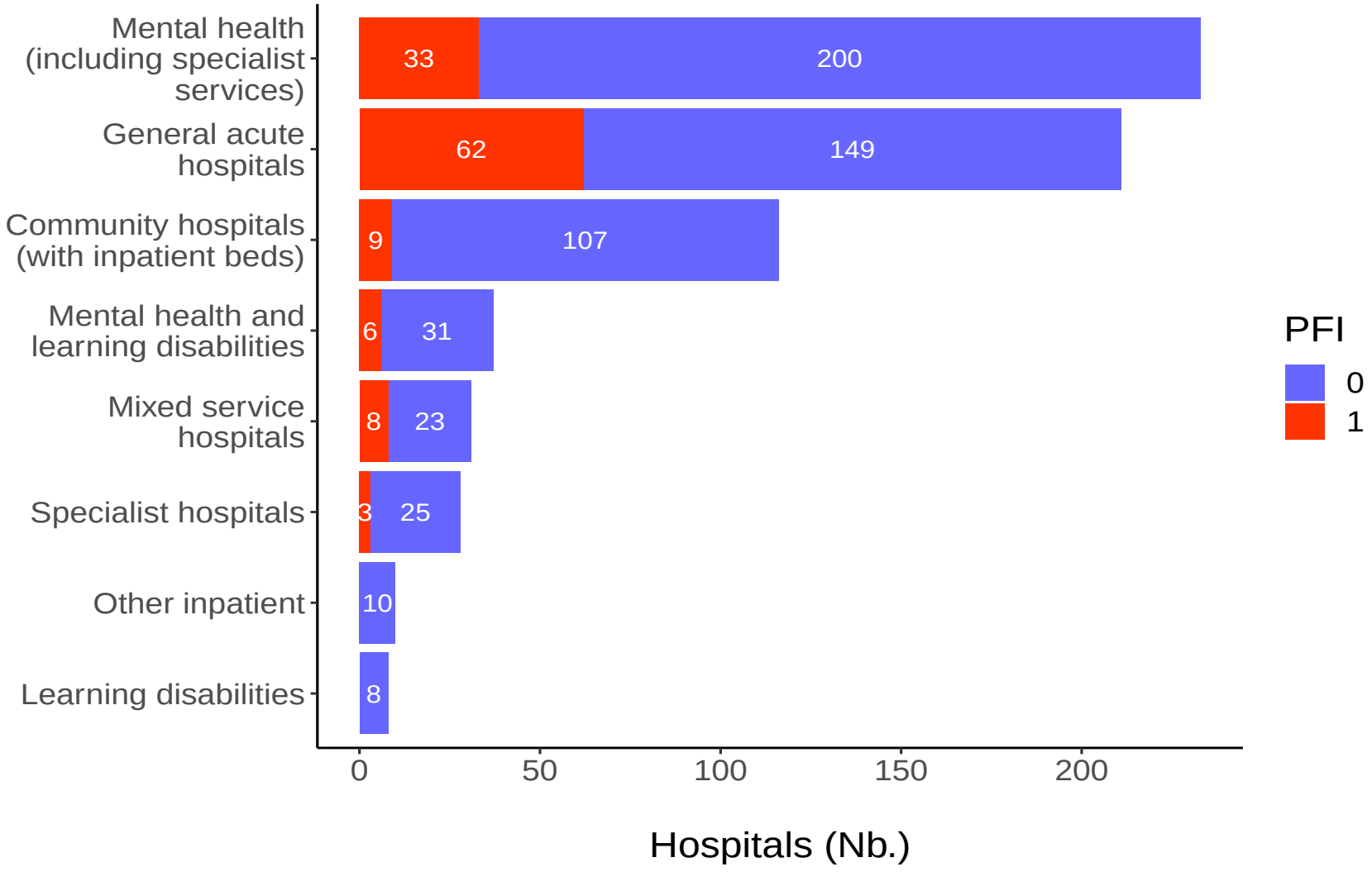
Backlog

	log HFM costs							
	No lag		1 year lag		No lag		1 year lag	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PFI	0.122***	0.155***	0.123***	0.143***	0.170***	0.198***	0.175***	0.193***
	(0.018)	(0.018)	(0.021)	(0.021)	(0.017)	(0.018)	(0.020)	(0.020)
log High + Significant risk backlog cost (GBP/m^2)	0.001		0.003*		0.006***		0.008***	
	(0.002)		(0.002)		(0.001)		(0.002)	
log Moderate + Low risk backlog cost (GBP/m^2)		0.011***		0.008***		0.013***		0.011***
		(0.002)		(0.002)		(0.002)		(0.002)
log High + Significant risk backlog cost (GBP/m^2) · PFI	−0.004		−0.004		−0.005*		−0.005*	
	(0.003)		(0.003)		(0.003)		(0.003)	
log Moderate + Low risk backlog cost (GBP/m^2) · PFI		−0.013***		−0.008**		−0.014***		−0.009***
		(0.003)		(0.003)		(0.003)		(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^2	0.265	0.273	0.250	0.252	0.276	0.284	0.267	0.267

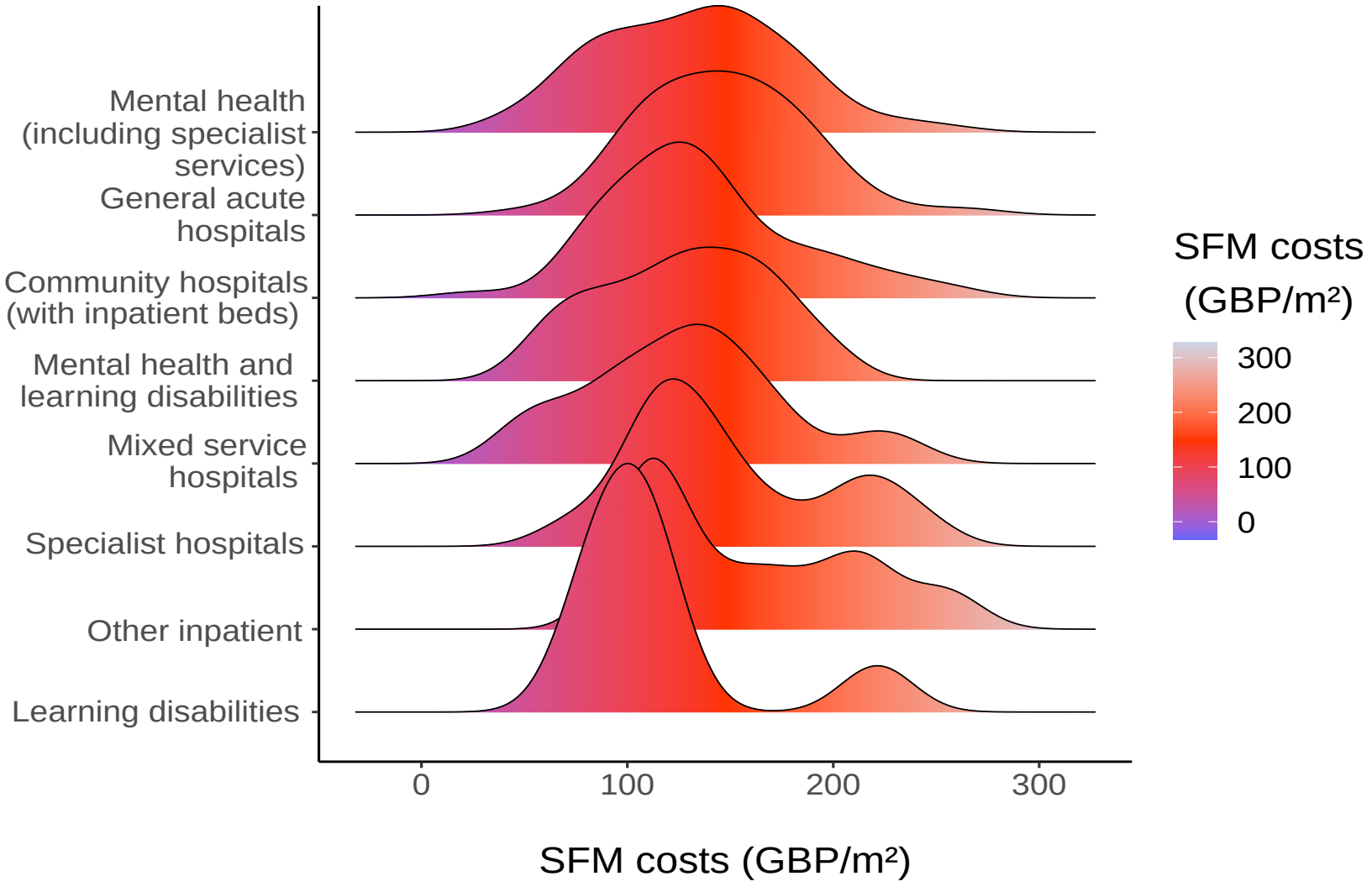
Regressors

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 laundry services	Laundered pieces per annum	Nb
	Inpatient main meals requested	Nb
	Outsourced laundry and linen services	1/0

Hospitals in the samples: types and procurement method (SFM)



Distribution of Soft FM costs by types of hospitals



Hospitals on the map

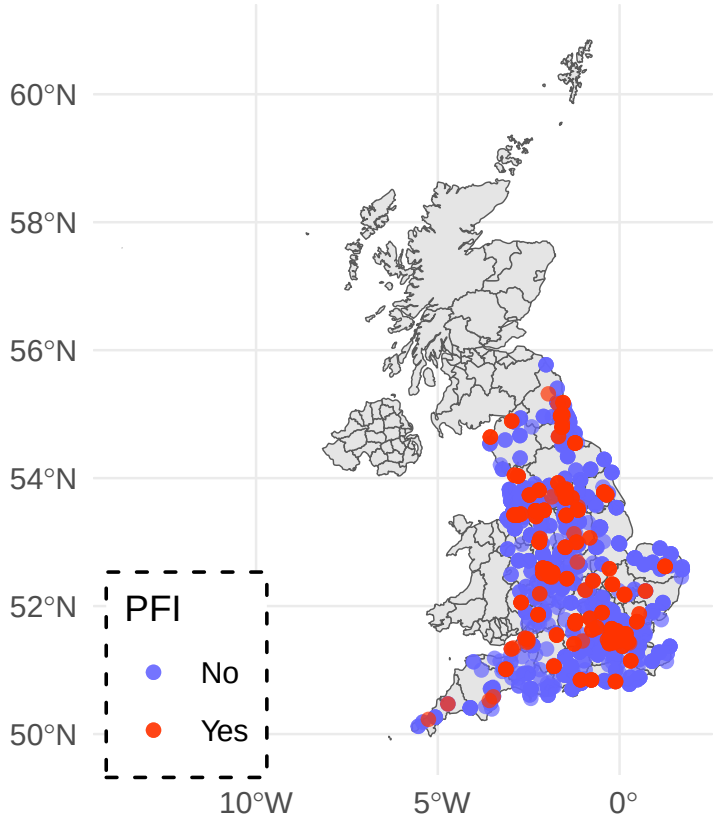


Figure 1: soft FM subsample

Hospitals on the map

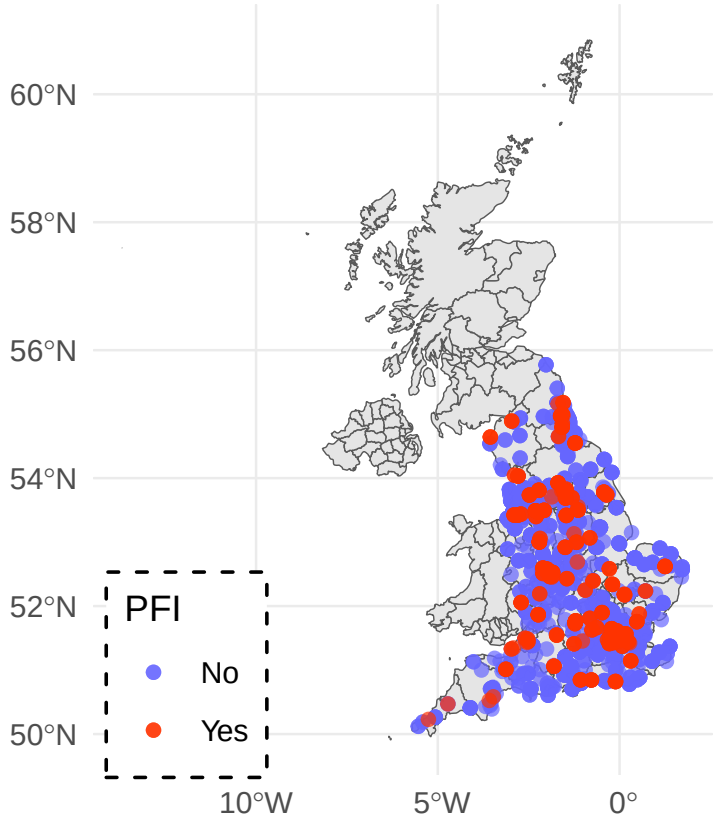
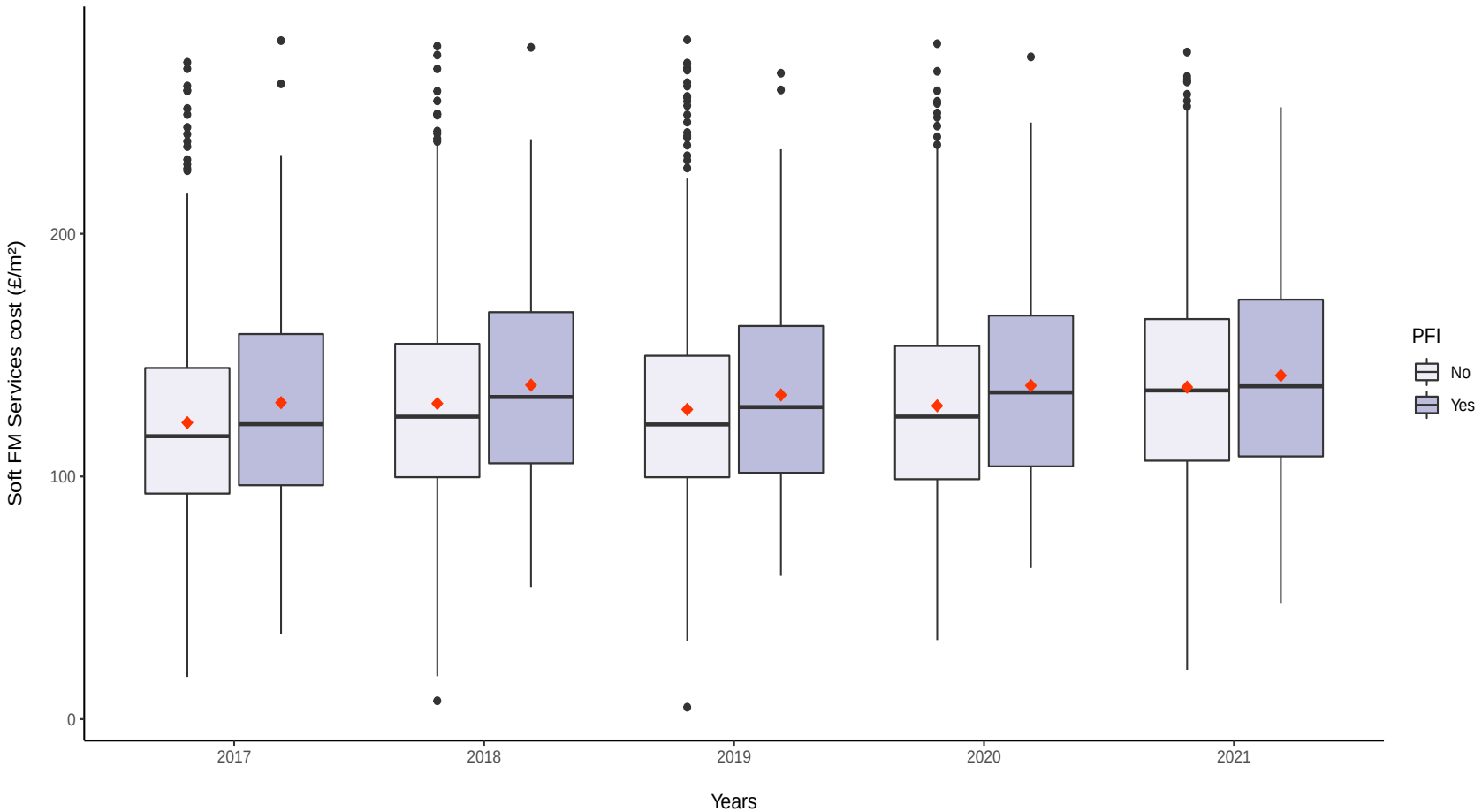
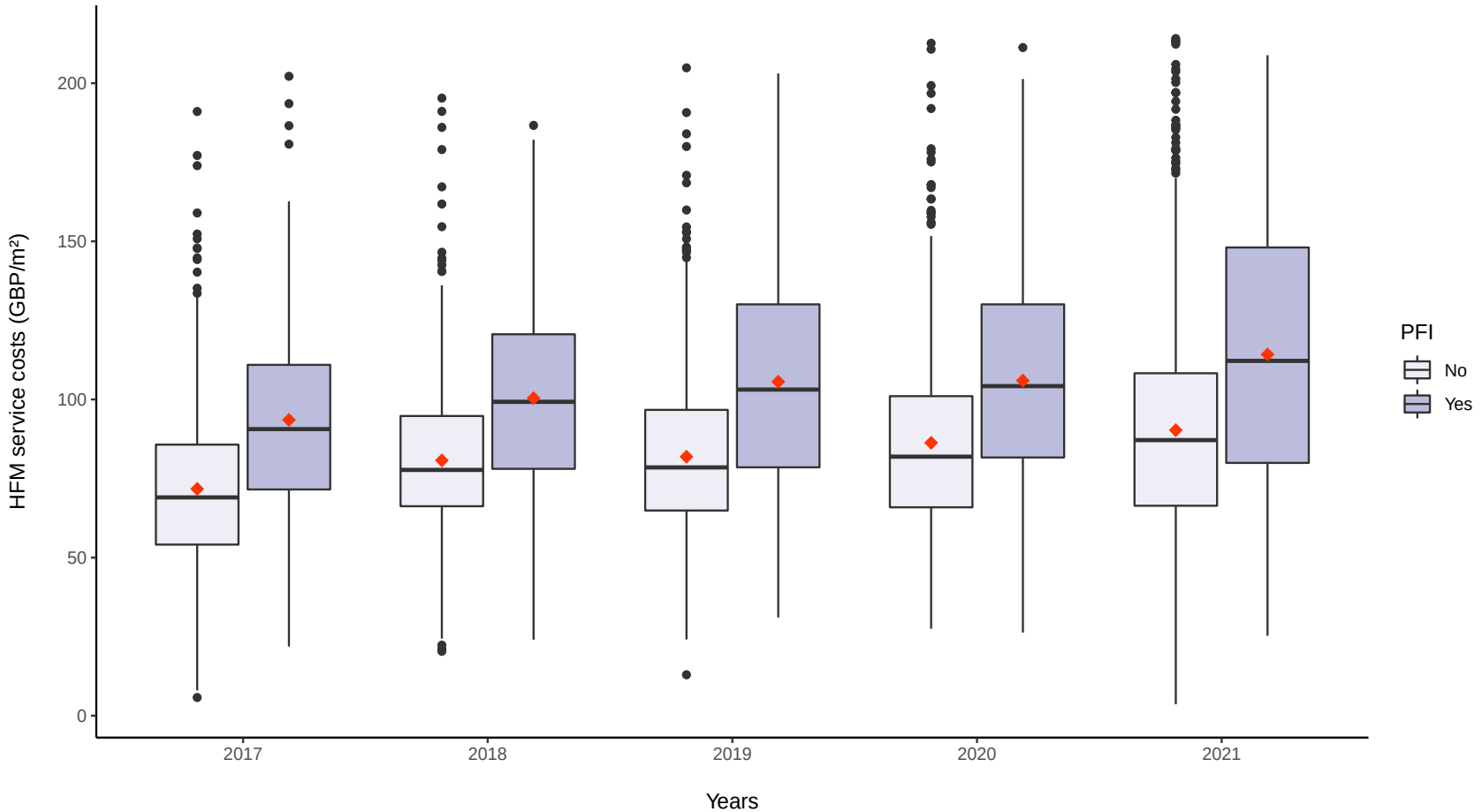


Figure 2: hard FM subsample

Boxplots (SFM)



Boxplots (HFM)



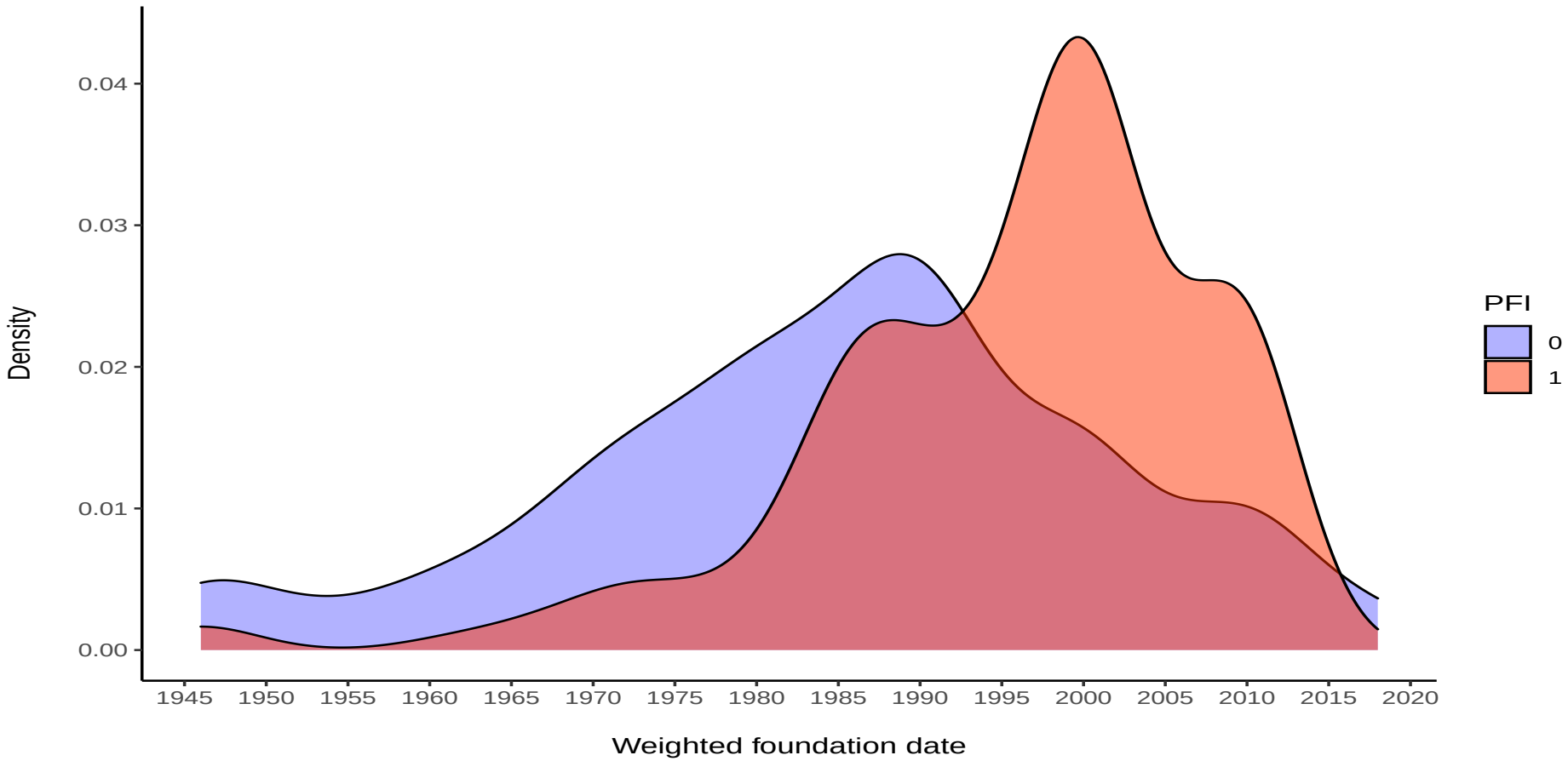
Weighted age

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

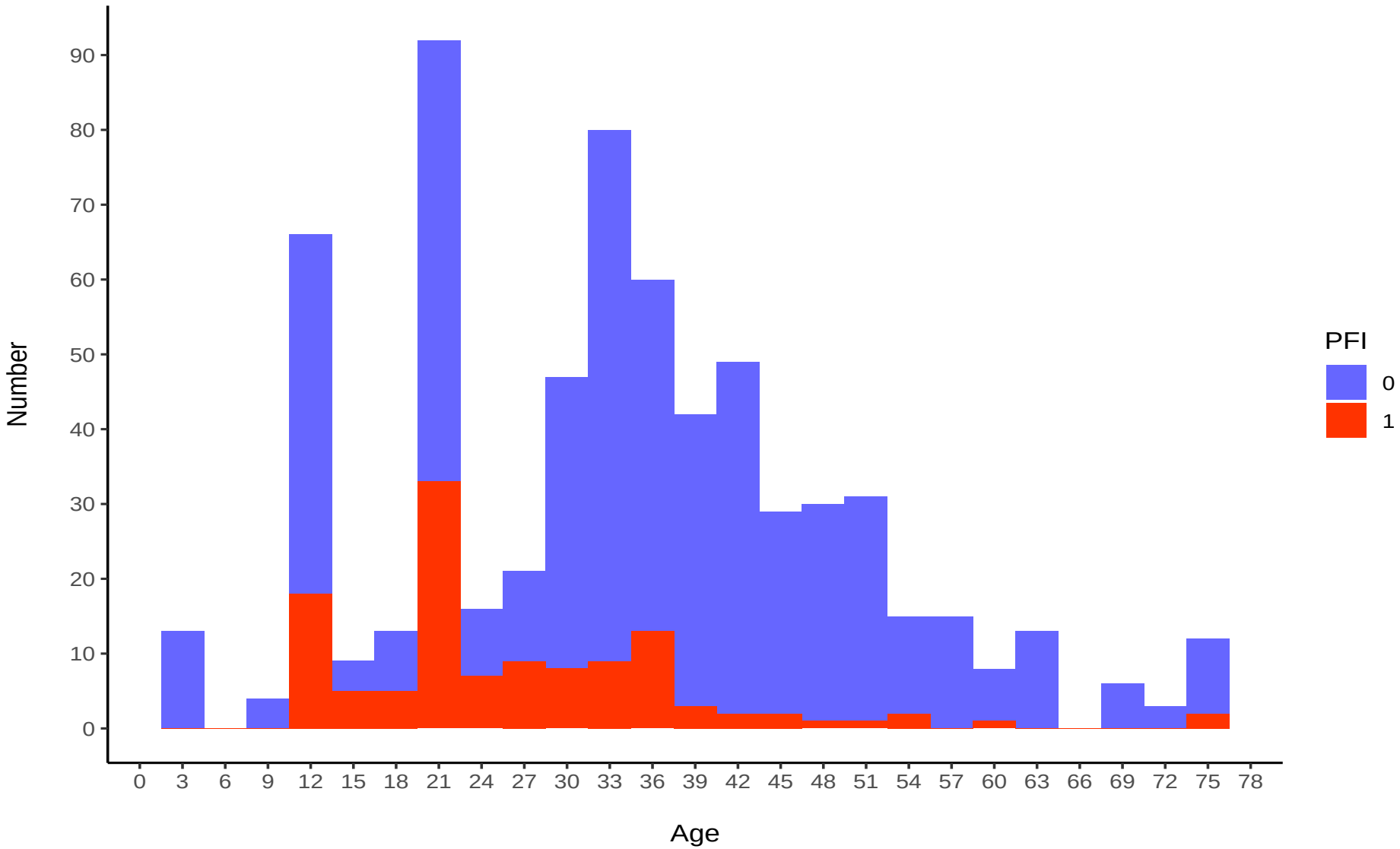
$$Age_{ht} = Year_{ht} - FD_h$$

- $h = 1....N$ - 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
- $t = 2017, ..., 2021$

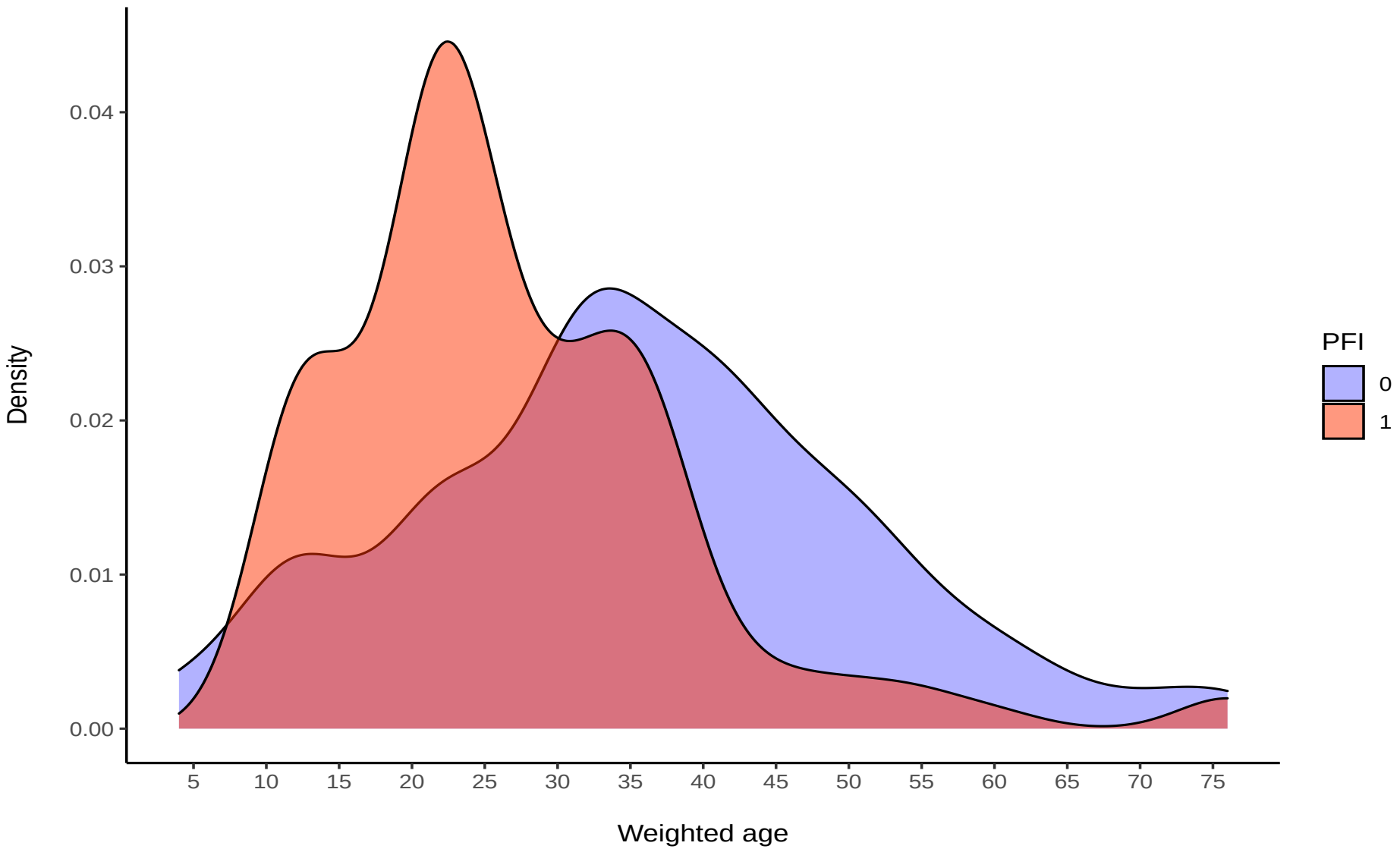
Weighted foundation date, all unique hospitals



Weighted age distribution of hospitals, subsample for 2021



Age of hospitals by PFI procurement type, subsample for 2021



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**	0.041**	0.030*	0.035**	0.032*	0.034**	0.026	0.029*
	(0.019)	(0.017)	(0.017)	(0.017)	(0.019)	(0.017)	(0.017)	(0.016)
PFI ($X_1 \leq$ X $\leq$ X_2)	0.038**	0.039**	0.059***	0.041*	0.038**	0.037**	0.051***	0.042*
	(0.017)	(0.019)	(0.020)	(0.022)	(0.016)	(0.019)	(0.019)	(0.022)
PFI (X $<$ X_1)			0.016	0.059*			0.017	0.049
			(0.043)	(0.034)			(0.043)	(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^2	0.030	0.369	0.031	0.369	0.062	0.398	0.063	0.398