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Can payers use prices to improve quality? Evidence from English hospitals

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Abstract

Prices for hospital care are generally set equal to the average of the historical costs reported across providers. We evaluate the effects of a unique initiative in England in which the price offered to providers for treatments planned and treated as daycases was increased by 24% while the price for inpatient treatment remained unchanged. Using national hospital records for 2008/9-2010/11 for the incentivised procedure and a basket of non-incentivised procedures, we consider whether this price change had the intended effect, produced unintended effects, and/or induced gaming. The price change led to a 7 percentage point increase in the daycase rate. There is no evidence that providers responded by selecting patients more amenable to daycase treatment, by reducing quality or by increasing volume. However, patients were made to wait an additional 14 days for treatment and providers appeared to game the price change by coding more patient complications and increasing the proportion planned as daycases by more than they increased the actual daycase rate. These behaviours were observed to different extents in hospitals rated as financially good or weak. The results suggest that prices can be used purposively to incentivise hospitals but will also produce unintended effects.

JEL classification:

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Keywords:

Financial incentives, quality, health care providers, unintended effects

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1. Introduction

The use of financial incentives to influence individual and organisational behaviour is widespread in the private sector. The most empirically studied example is the Balanced Scorecard (Acemoglu et al. 2007; Lazear 2000; Lazear & Shaw 2007). The rationale is that workers' performance can be improved if managers monitor and reward a range of linked activities. However, the trade-off between risk and incentives, the crowding out of providers' motivation and the multiplicity of outcomes that can cause effort diversion are some of the problems that cast doubt on the applicability of such incentives to the public sector and in particular to the health care market (Baker 1992; Burgess & Ratto 2003; Dixit 2002; Goddard et al. 1998; Grout et al. 2000) .

This paper examines the effects of a normative price change designed to change the way in which hospitals provide a surgical procedure to increase the quality of care for patients. Several papers have considered the unintended effects of changes in prices on the care provided by hospitals. Dafny (2005) examined the impact of a re-classification of the price structure wherein the age cut-off was removed from the price schedule. There was evidence of upcoding of complications where this had the largest impact on price, but no effect of the price changes on volumes and intensity. Dafny therefore concluded that prices could not be used to affect quality. Other papers have concentrated on the effect of the Balanced Budget Act in 1997 which led to a general but non-uniform change in prices across hospitals and activities in the US. Seshamani et al. (2006) found no differences in changes in 30-day mortality rates between hospitals expected to be affected to different degrees by the cuts. Lindrooth et al. (2007) found that high-Medicare share hospitals reduced treatment intensity at higher quantiles in more affected DRGs. Wu & Shen (2011) have examined the longer-term effect on mortality following AMI. They found that an adverse effect became evident in 2001-2005 and that hospitals affected most by the BBA reduced nursing input levels in the longer-term.

There is therefore mixed evidence of the impact of accidental changes in prices on quality. Our focus differs from previous papers by considering hospital responses to a purposive price change designed to improve quality in a highly transparent manner. The link between revenue and the incentivised dimension of quality is easy to measure and observe.

In April 2010 the Department of Health in England introduced a new form of payment for performance, *Best Practice Tariffs* (BPTs), for a small number of healthcare interventions. For other interventions the previous reimbursement system, called *Payment by Results* (PbR), was continued. Under PbR, hospitals are reimbursed for the care they provide based on a tariff for each patient equal to the national average cost of each care package, with top-ups for unexpectedly long lengths of stay and patients with complications. The new BPTs differ because the tariff is set purposively in order to incentivise the hospital to provide treatment in a particular manner.

In the first year, the DH experimented with three models of BPTs, which were applied to different groups of patients. These models: (i) paid more for treatment as a daycase; (ii) paid more for achievement of quality standards; or (iii) did not pay providers for excessive outpatient visits before or after a procedure. We focus on the procedure for which additional payment was paid for daycase care in the first year, cholecystectomy or the removal of the gall bladder. This model was adopted for 12 additional procedures across 5 surgical areas in 2011/12.

The aim of this paper is three-fold. We examine (i) whether the tariff produced the intended effect on the proportion of patients treated as daycases; (ii) whether there were unintended effects of the tariff on patient selection, quality and productivity; and (iii) whether providers gamed to gain the financial incentive. To do this we adopt a difference-in-differences analysis between the pre-2010 payment policy, with prices set at national average costs, and the post-2010 payment policy, following the introduction of the BPTs. We select an appropriate control group comprising other procedures contained in the British Association of Day Surgery (BADS) list of procedures for which daycase activity should be increased .

To preface our findings, we find that the tariff has achieved its objective, daycase rates increase significantly. While patients are on average 6 months younger, no other patient selection is detected. Length of stay and reversions to open surgery fall with no effect on readmissions or deaths. Waiting times have increased by approximately 14 days and the number of comorbidities coded for each patient also increases. We find that the tariff has had a heterogeneous impact depending on the quality of management of the providers.

2. The technology and the price change

I. The technology

The technology that we consider is a cholecystectomy. This is an operation to remove the gall bladder, a small pouch in the upper-right part of the abdomen that stores bile. When bile is out of balance, small stones can form which often cause no symptoms and remain undetected but can cause pain, fever, jaundice, vomiting and nausea. Cholecystectomies are performed under general anaesthetic but can be performed laparoscopically or as open surgery. When the procedure is performed laparoscopically, three to four cuts of one centimetre or less are made in the abdomen, the abdomen is inflated using carbon dioxide gas, a long thin telescope with a tiny light and video camera at the end is inserted through one of the cuts and the gallbladder is removed using specially designed surgical instruments. After the gallbladder is removed, the gas is allowed to escape through the laparoscope and the cuts are closed with dissolvable stitches. The operation takes 60 to 90 minutes. An 'open' cholecystectomy may be required if the patient has had major surgery and has extensive scarring in the abdomen. A single, larger incision is made. If complications occur during laparoscopic surgery, such as bleeding, a surgeon may also have to convert to open surgery. Open surgery usually takes longer to perform than keyhole surgery and patients need to stay in hospital for longer.

First performed in 1985, laparoscopic management of gallstone disease has become the accepted standard. A Cochrane review comparing the outcomes of patient groups that were either discharged the same day as their laparoscopic cholecystectomy or were kept in hospital overnight showed that whether the patient underwent a day-case or had an overnight stay did not make any difference to the incidence of serious complication, timing of re-admission, or the outcome of any further intervention (Gurusamy et al, 2008).

The NHS Institute for Innovation and Improvement produced a report in 2006 designed to improve the care of patients undergoing cholecystectomies (NHS Institute for Innovation and Improvement, 2006). They found that, in 2005/6, the national average day case rate was just 6.4% and there were substantial variations in the proportion of cholecystectomies undertaken laparoscopically, the day case rate and the average length of stay.

Based on a literature review, site visits, and semi-structured interviews, they designed an optimal 'pathway of care' and made a wide range of recommendations on how this could be delivered.

Although day case treatment reduces hospital costs by avoiding overnight stays, their recommended pathway requires changes to care delivery across a wide range of dimensions that will require capital and labour investments:

- Day case care becomes the default intended management for patients
- Patients are admitted on the day of surgery
- Day case facilities are designed to aid the flow of patients and combined with 23-hour/short stay facilities to maximise the flexibility of capacity
- Where day case and 23-hour stay patients are on a mixed list, day case patients are scheduled early in the operating list
- All-day operation lists are developed, which may entail negotiating alterations to consultant job plans
- Opening hours for the day case facility are extended
- Comparative analysis of day case rates across surgeons is performed
- There is surgical sub-specialisation so that surgeons perform a minimum number of 200 laparoscopic cholecystectomies over five years
- An enthusiastic clinician with identified time commitments leads on day surgery/short stay development with a senior manager
- Multidisciplinary team working towards day case treatment is required, involving surgeons, anaesthetists, day surgery managers, nursing staff, radiology staff, operating department staff, theatre staff, recovery staff, waiting list managers, diagnostics staff, technical staff, information analysts and administration staff.
- Adequate and standard post-operative pain relief regimes are used
- Agreed criteria are used for the discharge decision, which are based on patient recovery rather than a minimum postoperative stay
- The discharge process is nurse-led
- Standardised, pre-packed discharge medication is dispensed on the ward

Recent guidelines produced by the Association of Anaesthetists of Great Britain and Ireland (2011) have confirmed that safe and effective day case surgery requires: adequate pre-operative preparation; nurse-led discharge using agreed protocols; decisions on fitness for a day case procedure based on the patient's health and not arbitrary limits on ASA status, age or body mass index; and a self-contained unit that is functionally and structurally separate from inpatient wards and theatres, open from 7am to 8pm or 10pm, and equipped and staffed to deal with common postoperative problems (such as pain, nausea and vomiting) and emergencies (such as haemorrhages and cardiovascular events) including contactable anaesthetists and surgeons.

Clarke et al. (2011) reported on their experience of applying this NHS Institute pathway. Their day case rate increased from 10% to 61% between 2006 and 2009. This was attributed to more focused contacts with potential patients prior to the procedure, expanding the criteria for day-case surgery, reducing clerical errors by ensuring that patients were scheduled on morning operating lists and reducing conversion rates by increasing the proportion of procedures performed by specialist upper gastrointestinal surgeons. Failures to discharge patients as day cases were linked predominantly to uncontrolled pain, nausea, and vomiting which it was thought could be avoided in future by use of intra-operative local anaesthetic, postoperative Paracetamol, and non-steroidal anti-inflammatories, with an avoidance of opiates. These problems were also identified by Toumi et al. (2010) in a small sample, who found that post-operative morphine, longer operation duration, nausea, uncontrolled pain, hypotension, drowsiness, low oxygen saturations, a temperature of 38°c and urinary retention were associated with unplanned overnight stays.

The day case rate can also be successfully increased by reducing the conversion rate to open surgery. Ballal et al. (2009) found that patient-related factors that were good predictors of conversion included male sex, emergency admission, old age, and complicated gallstone disease. They also found lower conversion rates amongst consultant firms that performed more laparoscopic cholecystectomies, with those performing 70 or more procedures a year having the lowest conversion rate. In addition, those surgeons who attempted a higher proportion of their cholecystectomies laparoscopically had a lower conversion rate, with the surgeons undertaking more than 90% of their work primarily laparoscopically having the lowest conversion rate.

II. The price change

The Best Practice Tariff for cholecystectomy, introduced in 2010/11, aims at incentivising hospitals to provide the procedure as a daycase. Table 1 shows the prices that were offered for cholecystectomies in each year from 2007/8 to 2010/11. In all years, higher prices are offered for patients reported as having complications. Until 2008/9, patients aged 70 years and over were paid at the higher rate regardless of whether or not they were reported to have complications. This was abandoned in 2009/10. Between 2009/10 and 2010/11 there was a 1.5% increase in price for patients with complications and a 0.3% increase in price for patients without complications that were not treated as daycases. Treatment of patients as daycases in 2010/11 was paid at a 24% higher rate than in 2009/10.

To qualify for the tariff, hospitals need to both schedule the patient as a daycase and discharge the patient on the day the procedure was undertaken; i.e. plan, and carry out, the procedure as a daycase.

Table 1. Tariff prices for cholecystectomies (2007/8 to 2010/11)

Year	*Without complications*	*With complications*
2007/08	£1,777 (patient <70years and without complications)	£2,328 (patient >69years or with complications)
2008/09	£1,837 (patient <70years and without complications)	£2,371 (patient >69years or with complications)
2009/10	£1,365 (without complications)	£2,131 (with complications)
2010/11	£1,694 (day case without complications) £1,369 (non-day case without complications)	£2,164 (Open or Laparoscopic with complications)

3. Possible behavioural impacts of the tariff

Given the sharp financial incentive, providers could respond to the change in tariff in three ways (Propper et al. 2010). First, they could increase effort on the incentivised task by increasing the proportion of cholecystectomies treated as daycases. Second, they could divert effort from non-incentivised tasks by selecting types of patients that can be treated as daycases, reducing quality, or changing productivity. Third, they could "game" the tariff by changing the coding of patients to increase their revenue.

I. Intended effects of BPT

We assess whether the policy has achieved its objective by looking at the effect of the BPT on the incentivised task. The aim of BPT was to incentivise an increase in the proportion of cholecystectomies performed as a laparoscopic daycase procedure. In order to be eligible for the higher price, providers need to both schedule and treat patients as day cases and this treatment must be laparoscopic.

We examine the effect of the tariff on the proportion of all episodes that were planned and delivered as day cases. We then examine whether changes in the proportion of procedures performed laparoscopically. We would expect an increase in the day case proportion; we might also expect to see a shift from open to laparoscopic procedures.

II. Unintended effects of BPT

Given the high gains from achieving the BPT target, providers could try to increase the proportion of day case laparoscopic cholecystectomies in several ways. First, they could reprioritise patients. Reprioritisation is reflected by inappropriate preferential treatment given to healthier patients, but providers could also select patients who were previously deemed to be too risky for a day case cholecystectomy treatment. We assess the extent of patient selection by looking at the effect of BPT on the age and gender composition of treated patients. Second, the tariff could have a perverse effect on quality. For instance, providers could make more mistakes leading to more deaths, fail to improve post-procedure care leading to longer lengths of stay for some patients, and take risks either with the discharge decision leading to higher probability of readmission or with selecting higher risk patients and then reverting to open cholecystectomy. Finally, they could respond to the price change by changing productivity. They could change the volume of treated patients or make patients wait longer until a daycase slot is available.

III. Gaming effects

Providers could also respond to the new tariff by "gaming" it. We follow Propper et al. (2010) by defining "gaming" as a change in provider behaviour that increases their revenue but has no effect on patients.

Rescheduling occurs when more patients are scheduled as day cases without changing care delivery. The higher tariff is paid for all gall bladder removals that are planned as a daycase and then performed laparoscopically and as a daycase. Providers may increase their planned day case rate as a means to capture as many procedures as possible within the new tariff. This could mean an increase in the number of planned day cases that do not results in a day case cholecystectomy.

Recoding occurs if the coding of complications is changed. Providers are not paid less for inpatient care if patients are classified as having complications.

4. Data and descriptive statistics

I. Data management

Health care records were obtained from Hospital Episode Statistics (HES) for the four financial years between the 1st April 2007 and 31st March 2011. These data contain information on patient characteristics, diagnoses, type of admission, readmissions, discharges and lengths of stay for each provider in England.

Episodes that involve a cholecystectomy were selected using the OPCS-4 codes (J183, J188, J189 and J268). Episodes that involved procedures that were not subjected to the change in tariff were selected using OPCS-4 codes from the BADS Directory of Procedures (British Association of Day Surgery 2008). This directory contains the BADS recommendations for which surgery is appropriate as a daycase or short stay. As the recommended daycase proportion for cholecystectomies is 60%, we restricted the list of control procedures to those for which the recommended daycase proportion is greater than 0% and less than 80%. Given our interest in the effect of a price change, the control category also needed to be selected on the basis that these procedures did not undergo a substantial price change in the final year of the data. We calculated a Laspeyres price index for the initial selection of control procedures by calculating the overall change in revenue for hospitals if they provided the volume of procedures in 2010/11 that they had in 2009/10. This index suggested a 3.2% reduction in revenue was expected. To ensure that the expected revenue change was the same as for cholecystectomies without the introduction of BPTs, we removed the seven procedures that contributed most to the expected revenue reduction. The Laspeyres index for the remaining 58 procedures in the control group was 1.002195, close to the 0.3% increase for non-daycase cholecystectomies.

Having made this initial selection, further restrictions are added. We only use NHS patients who have an admission date no earlier than 1st April 2007, with elective admissions for finished spells where the first episode is from either the control or treatment group. This results in a control category of 1,463,335 episodes and a treatment category of 199,565 episodes. The dataset was then aggregated by financial year and provider.

Summary statistics for the aggregated dataset are provided in Table 2 Volume is measured by the number of episodes involving a cholecystectomy or a control procedure performed by a given provider in a given financial year. The daycase proportion is the proportion of episodes planned and delivered as a daycase. The planned day case proportion is the number of episodes whose intended clinical management was to treat as a daycase as a proportion of total episodes. The laparoscopic proportion gives the number of episodes who have the accompanying procedure code (OPCS4 - Y75.2) indicating a laparoscopic approach, as a proportion of total episodes. Patent complexity is represented by the mean number of co-morbidities. When a laparoscopic procedure is reverted to an open procedure the OPCS4 code Y71.4 is added, this is measured by the proportion of reversions to open variable. The death rate is the proportion of episodes from which the patient is discharged dead. The readmission rate is the proportion of patients discharged alive who were admitted as an emergency within 30 days of discharge from the initial spell. The waiting time is the time that elapses between the decision to admit and the admission date. To account for skewness, we use the mean of the median waiting time. Given that these procedures should be ideally treated as day case or short stay, we use the proportion of patients who stay more than one day to measure length of stay.

In order to find out whether there is a heterogeneous effect of BPT according to the providers' type, we linked the HES data to the 2008/9 "Annual Health Check" results from the Care Quality Commission. We used the quality of financial management rating, measuring how well a provider managed its resources.

Table 2. Descriptive statistics

	Control procedures			*Cholecystectomy*		
Variable	**Obs.**	**Mean**	**S.E.**	**Obs.**	**Mean**	**S.E.**
Volume of episodes	780	1876.071	1337.379	681	293.047	176.488
Daycase proportion	780	0.361	0.110	681	0.219	0.176
Intended daycase proportion	779	0.457	0.123	681	0.425	0.282
Laparoscopic proportion	780	0.059	0.032	681	0.874	0.120
Mean age (years)	780	52.058	5.380	681	51.425	2.103
Proportion of patients 70 and over	780	0.241	0.061	681	0.148	0.034
Proportion of male patients	780	0.450	0.058	681	0.248	0.045
Mean number of co-morbidities	780	1.726	0.715	681	1.493	0.613
Proportion of reversions to open surgery	780	0.001	0.001	681	0.034	0.021
Readmission rate	780	0.051	0.012	680	0.068	0.019
Mean median waiting time	774	44.727	18.105	673	63.698	20.811
Proportion of stays over 1 day	780	0.299	0.090	680	0.273	0.136
Death rate	780	0.001	0.002	681	0.001	0.003

All statistics weighted by volume, except volume.

5. Estimation methods

We analyse the effect of BPT intervention occurring at time $t=k$ on several outcome variables, Y, using a difference-in-difference (DiD) methodology. The policy change and $t=t_1>k$ after the policy. Each provider *i,* is observed before and after BPT was introduced with D_i indicating the treatment period to which it belongs. That is, $D_i=1$ *if* $D_{it}=1$ *for* $t>k$ and $D_i=0$ otherwise. The DiD estimation can be illustrated as follows:

$$Y_{it} = f_t^0(X_i) + \alpha_{it}(X_i)D_{it} + (\varphi_i + \vartheta_t + \varepsilon_{it})$$

where the superscript indicates the treatment status, the subscript $i=1,...,N$ indicates the N providers and t identifies the time period. The error term is composed by a *provider-specific fixed* effect, φ_i, a *common trend* effect, ϑ_t, and a *temporary provider-specific* effect, ε_{it}.

The main assumption of the DiD is that selection into the treatment is independent of the *temporary provider-specific* effect, ε_{it}, so that:

$$E(U_{it}^0|X_i, D_i) = E(\varphi_i|X_i, D_i) + \vartheta_t$$

where D_i indicates the incentivised and non-incentivised BPT areas of provider *i*. This is a sufficient condition because both φ_i and ϑ_t cancel out as a result of the difference. After taking the difference between the periods before and after the introduction of BPT, the DiD estimator can be written as follows:

$$\hat{\alpha}_{DID}(X) = \left[\hat{Y}_{t1}^1(X) - \hat{Y}_{t0}^1(X)\right] - \left[\hat{Y}_{t1}^0(X) - \hat{Y}_{t0}^0(X)\right]$$

In order to measure the impact of the tariff on quality and practice we compare certain indicators for cholecystectomy against the same indicators for a control procedure.

One of the weaknesses of the DiD estimator relates to the *common trend effect*. The DiD assumption is violated if common macro shocks affect differently treatment and control groups. A test for common pre-trends between treatment and controls can be performed by means of a significance test of the interaction between the dummy for the treatment group and the pre-intervention time periods. The common trend assumption is rejected if there is a significant difference between incentivised and non-incentivised areas before BPT was actually introduced. A rejection of the test motivates the use of the differential trend adjusted DiD estimator. A differential trend estimator has been performed by including separate year trends for the treated and control groups.

I. The DiD estimator adjusted for differential trends

In this case, the assumption (A.1) of the DiD estimator is modified as follows:

$$E(U_{it}|D_i) = E(\varphi_i|D_i) + k^D \vartheta_t$$

where k^D is the differential trend effect across the two groups. This assumption states that selection into the treatment is independent of the temporary Provider-specific effect, ε_{it}, under the differential trends.

The DiD estimator now can be written as:

$$E[\hat{\alpha}_{DID}(X)] = \alpha_{TTE}(X) + (k^1 - k^0)[\vartheta_{t1} - \vartheta_{t0}]$$

of which the standard DiD is a specific case when k^1=k^0.

The differentially adjusted estimator has been proposed by (Bell et al. 1999) and it involves finding a pre-BPT period (τ_1 , τ_0) for which the differential trend matched the bias term in the DiD estimator $(k^1 - k^0)[\vartheta_{t1} - \vartheta_{t0}]$. That is:

$$(k^1 - k^0)[\vartheta_{t*} - \vartheta_{t**}] = (k^1 - k^0)[\vartheta_{t1} - \vartheta_{t0}]$$

The intuition of this equation is as follows [see also Blundell & Dias 2002]. The adjusted-differential DiD involves finding a point in the pre-BPT period where the relative conditions of incentivised and non-incentivised BPT areas evolve in the same way as they do in the pre-post BPT period (t1 , t0).

$$\hat{\alpha}_{ADID}(X) = \left\{[\tilde{Y}^1_{t1}(X) - \tilde{Y}^1_{t0}(X)] - [\tilde{Y}^0_{t1}(X) - \tilde{Y}^0_{t0}(X)]\right\} - \left\{[\tilde{Y}^1_{t**}(X) - \tilde{Y}^1_{t*}(X)] - [\tilde{Y}^0_{t**}(X) - \tilde{Y}^0_{t*}(X)]\right\}$$

In practice, we adjust for differential trends by including separate year trends for the treated and control groups.

6. Results

In this section we present the intended and unintended behavioural effects of the BPT. For each of the outcomes variables, we report the DiD and the Differential trends model.

I. Intended effects of BPT

In table 3 we present the results of our analysis of the intended effects of the tariff. These would be an increase in the day case proportion for cholecystectomy and a possible increase in the proportion of laparoscopic procedures. The day case models do not show evidence of differential trends, so we used the DiD model. The laparoscopic model does show evidence of a differential trend so we use the results that account for this. Our result suggests a 6.9 percentage point increase in the proportion of cholecystectomies performed as daycases in 2010/11. The laparoscopic proportion does not change significantly with the introduction of the new tariff, suggesting providers did not change how the procedure was performed.

II. Unintended effects of BPT

We consider three types of unintended effects: patient selection, quality and productivity effects. In table 4 we analyse the possibility that patient selection is made on the basis of age. Because we can reject the hypothesis of differential trends we comment on the results of the DiD models. The BPT increases the incentive for Trusts either to select patients who previously would have been deemed too high risk for a day case procedure or to select healthier and fitter patients. The change in behaviours might reveal itself as an increase or decrease in the mean age patients and changes in the proportion of patients over 70 years of age. However, our results suggest there has only been a negative weakly significant effect on the average age of treated patients, and no effect on the proportion over 70. We also find no significant change in the proportion of male patients.

Table 5 displays the results for the quality measures. Whilst we find evidence of differential trends in Model I, we do not find such significant evidence to hold for Models II-IV. Therefore we only comment on the differential trends results for model I and on the DiD model for models II-IV. We find no significant evidence of increased readmissions as a result of the tariff. However, we find that the proportion of patients with a length of stay greater than a day has decreased by three percent. We also find that the proportion of patients for whom a laparoscopic procedure reverted to an open procedure decreased by 0.5 percent. The death rate has not significantly changed. These results might suggest that BPT had no perverse effect on quality, but has actually improved quality.

Finally, Table 6 reports the results on the productivity effects. We find evidence of differential trend for waiting times but not for volume, the differential trend model will be discussed for the former and the DiD model of the latter. There is a statistically significant increase of 14 days in the average waiting time but no significant evidence of changes in volumes as a result of the tariff.

III. Gaming effects

In their attempts to comply with the BPT for cholecystectomy, providers may change their coding practice. In Table 7 we comment on the results for the proportion of procedures that were planned as a day case. We also provide results for the average number of comorbidities recorded for each patient. Results show the average number of comorbidities increased by 0.27; approximately 1 in every 4 patients will have an additional comorbidity. In the DID model there is an 11.6% increase in the proportion of procedures planned as day cases, which is considerably larger than the effect on the actual daycase proportion. The differential trends model shows a 6.4% increase but this is not statistically significant.

IV. Robustness checks

We conclude the empirical analysis by looking at whether the effect of the tariff has had a differential effect depending on the providers' quality of management and on the difference in outcomes in the year before and after the tariff. Providers have been split between the 141 trusts who had excellent or good financial management versus the 43 trusts who had fair or weak financial management. We only present the statistically significant results for either the DiD or the differential trends model depending on whether the trends assumption has been violated. All other outcomes variables are available from the authors on request.

Excellent/good providers show a significant increase in day case proportion, a reduction in the average age of patients and an increase in the male proportion. Comorbidities increased in excellent/good providers but the reversion rate to open procedures decreased. Readmissions rates reduced in fair/poor trusts. Waiting time increased amongst both groups of providers, more so in fair/poor trusts.

7. Conclusions

This paper provides evidence that the new BPT introduced in 2010 by the Department of Health has achieved its intended objective. An increase in the day case rate for cholecystectomy of 7% has been coupled with a reduction in length of stay and reversions to open surgery, while no adverse effects are found in death and readmission rates. However, patients had to wait longer for treatment and hospitals also changed their coding practice to increase their revenue. The increase in the planned daycases is larger than the increase in actual daycases; we will analysis the change in the daycase failure rate in future work. In terms of the financial management of the trusts, excellent and good trusts react differently when compared to fair and poor trusts.

8. Results tables

Table 3. Intended effect of BPT

Dep. Vars:	Model I: Day case		Model II: Laparoscopic	
	DID	*Diff. Trends*	*DID*	*Diff. Trends*
2008/09	0.018***	-	0.010 ***	-
	(4.54)		*(4.22)*	
2009/10	0.033***	-	0.021***	-
	(8.44)		*(9.73)*	
2010/11	0.056***	-	0.025***	-
	(12.62)		*(11.88)*	
Financial year		0.018***		0.008***
		(12.81)		*(12.82)*
Cholecystectomy	-0.161***	-0.178***	0.810***	0.784***
	(-21.53)	*(-9.33)*	*(142.38)*	*(53.29)*
DiD	0.069***	0.057**	0.022**	-0.005
	(4.12)	*(2.28)*	*(2.37)*	*(-0.37)*
Financial year*chole		0.008		0.013**
		(0.91)		*(2.11)*
Constant	0.333***	0.316***	0.044***	0.038***
	(108.65)	*(83.96)*	*(30.00)*	*(23.58)*
R^2	0.79	0.79	0.98	0.98
Observations	1,461	1,461	1461	1461

Note: Models account for trust fixed effect and weight by volume, t statistics in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4. Patient selection effects

Dep. Vars:	Model I: Age		Model II: Male		Model III: Age>70	
	DID	*Diff. Trends*	*DID*	*Diff. Trends*	*DID*	*Diff. Trends*
2008/09	0.133	-	-0.002	-	0.001	-
	(1.49)		*(-1.12)*		*(0.50)*	
2009/10	0.332***	-	-0.003*	-	0.003*	-
	(3.70)		*(-1.74)*		*(1.85)*	
2010/11	0.581***	-	-0.008***	-	0.004**	-
	(5.75)		*(-4.55)*		*(2.21)*	
Financial year	-	0.204***	-	-0.002***	-	0.001**
		(6.34)		*(-4.79)*		*(2.38)*
Cholecystectomy	-0.985***	0.599*	-0.200***	-0.208***	-0.095***	-0.097***
	(-7.77)	*(-1.86)*	*(-78.68)*	*(-30.91)*	*(-41.52)*	*(-17.01)*
DiD	-0.482*	-0.086	0.005	-0.004	-0.0002	-0.002
	(1.85)	*(0.22)*	*(1.08)*	*(-0.57)*	*(-0.06)*	*(-0.33)*
Financial year*chole	-	-0.192	-	0.004	-	0.001
		(-1.28)		*(1.41)*		*(0.39)*
Constant	51.846***	51.598***	0.453***	0.457***	0.239***	0.238***
	(714.15)	*(584.38)*	*(358.93)*	*(291.12)*	*(201.04)*	*(160.86)*
R^2	0.95	0.95	0.93	0.93	0.91	0.91
Observations	1,461	1,461	1,461	1,461	1,461	1,461

Note: Models account for trust fixed effect and weight by volume, t statistics in parentheses. Reference year 2007/08. *** *p < 0.01,* ** *p < 0.05,* * *p < 0.1.*

Table 5. Quality effects

Dep. Vars:	Model I: Readmissions		Model II: Length of Stay		Model III: Reversion to open		Model IV: Deaths	
	DID	*Diff. Trends*	*DID*	*Diff. Trends*	*DID*	*Diff. Trends*	*DID*	*Diff. Trends*
2008/09	0.003***	-	-0.027***	-	0.00004	-	-0.00004	-
	(5.32)		*(-7.52)*		*(0.12)*		*(-0.57)*	
2009/10	0.004***	-	-0.043***	-	0.0001	-	-0.0001*	-
	(7.11)		*(-11.83)*		*(0.38)*		*(-1.82)*	
2010/11	0.002***	-	-0.068***	-	0.0003	-	-0.0003***	-
	(2.93)		*(-16.72)*		*(1.16)*		*(-3.81)*	
Financial year	-	0.001***	-	-0.021***	-	0.0002**	-	-0.0001***
		(2.63)		*(-17.01)*		*(2.06)*		*(-3.62)*
Cholecystectomy	0.017***	0.012***	-0.013**	0.009	0.034***	0.036***	0.0004***	0.001**
	(19.17)	*(5.01)*	*(2.08)*	*(0.53)*	*(33.48)*	*(12.70)*	*(3.01)*	*(2.02)*
DiD	0.004**	-0.003	-0.026**	-0.007	-0.005***	-0.003	0.0001	0.0003
	(2.56)	*(-0.96)*	*(-2.52)*	*(-0.40)*	*(-3.18)*	*(-1.13)*	*(0.29)*	*(0.92)*
Financial year*chole	-	0.003**	-	-0.010	-	-0.001	-	-0.0001
		(2.53)		*(-1.38)*		*(-0.86)*		*(-1.04)*
Constant	0.049***	0.050***	0.334***	0.353***	0.001***	0.001***	0.001***	0.001***
	(111.28)	*(87.63)*	*(112.69)*	*(102.73)*	*(3.61)*	*(2.64)*	*(18.87)*	*(16.81)*
R^2	0.71	0.70	0.81	0.81	0.72	0.72	0.54	0.54
Observations	1,460	1,460	1,460	1,460	1,461	1,461	1,461	1,461

Note: Models account for trust fixed effect and weight by volume, t statistics in parentheses. Reference year 2007/08. *** *p < 0.01,* ** *p < 0.05,* * *p < 0.1.*

Table 6. Productivity effects

Dep. Vars:	Model I: Waiting Times		Model II: Volume	
	DID	*Diff. Trends*	*DID*	*Diff. Trends*
2008/09	-10.288***	-	84.300*	-
	(12.95)		*(1.92)*	
2009/10	-8.863***	-	155.027***	-
	(-9.61)		*(3.48)*	
2010/11	-8.692***	-	141.731**	-
	(7.93)		*(2.47)*	
Financial year	-	-2.206***	-	70.223***
		(-6.11)		*(3.65)*
Cholecystectomy	20.500***	30.771***	-1785.171***	-1659.752***
	(21.71)	*(11.03)*	*(-45.75)*	*(-19.02)*
DiD	1.499	14.014***	-57.422	-30.681
	(0.71)	*(4.80)*	*(-0.75)*	*(-0.36)*
Financial year*chole	-	-5.287***	-	-52.807
		(-4.35)		*(-1.39)*
Constant	51.644***	50.106***	1881.722***	1801.574***
	(74.74)	*(52.89)*	*(55.80)*	*(35.58)*
R^2	0.67	0.65	0.79	0.79
Observations	1,447	1,447	1,461	1,461

*Note: Models I-II account for trust fixed effect, Model I weighted by volume, t statistics in parentheses. Reference year 2007/08. Median waiting times.. *** p < 0.01, ** p < 0.05, * p < 0.1.*

Table 7. Gaming effects

Dep. Vars:	Model I: Comorbidities		Model II: Planned day cases	
	DID	*Diff. Trends*	*DID*	*Diff. Trends*
2008/09	0.097***	-	0.023***	-
	(3.99)		*(3.78)*	
2009/10	0.309	-	0.046***	-
	*(13.00)****		*(7.54)*	
2010/11	0.758***	-	0.071***	-
	(23.39)		*(11.07)*	
Financial year	-	0.250***	-	0.022***
		(22.98)		*(11.21)*
Cholecystectomy	-0.171***	-0.027	-0.063***	-0.125***
	(-8.33)	*(-0.50)*	*(-5.10)*	*(-3.78)*
DiD	-0.027	0.267***	0.118***	0.064
	(0.56)	*(4.28)*	*(4.66)*	*(1.62)*
Financial year*chole	-	-0.086***	-	0.030*
		(-3.48)		*(1.92)*
Constant	1.421***	1.084***	0.421***	0.401***
	(67.62)	*(37.55)*	*(89.75)*	*(73.85)*
R^2	0.89	0.87	0.66	0.66
Observations	1,461	1,461	1,460	1,460

*Note: Models account for trust fixed effect and weight by volume, t statistics in parentheses. Reference year 2007/08. *** p < 0.01, ** p < 0.05, * p < 0.1.*

Table 8. Robustness checks

Dep. Vars:	Model I: Daycase	Model II: Age	Model III: Male	Model IV: Comorbidities	Model V: reversions to open	Model VI: readmissions	Model VII: Waiting time	Model VIII: waiting time
	DID for excellent/good trusts	*DID for good/excellent trusts*	*DID for good/excellent trusts*	*Diff. Trends for good/excellent trusts*	*DID for good/excellent trusts*	*Diff. Trends for fair/poor trusts*	*Diff. Trends for good/excellent trusts*	*Diff. Trends for fair/poor trusts*
2008/09	0.018***	0.166*	-0.002		-0.0001			
	(4.16)	*(1.66)*	*(-1.09)*		*(-0.20)*			
2009/10	0.036***	0.391***	-0.003		-0.0001			
	(8.59)	*(3.91)*	*(-1.63)*		*(-0.24)*			
2010/11	0.059***	0.687***	-0.010		0.0002			
	(12.25)	*(6.11)*	*(-5.11)*		*(0.62)*			
Financial year				0.242***		0.001*	-2.052***	-2.956***
				(19.18)		*(1.68)*	*(-5.01)*	*(-3.82)*
Cholecystectomy	-0.149***	-1.141***	-0.201***	-0.031	0.035***	0.008*	28.584***	40.426***
	(-19.49)	*(-8.26)*	*(-71.42)*	*(-0.49)*	*(30.92)*	*(1.86)*	*(9.46)*	*(6.11)*
DiD	0.080***	-0.600**	0.010*	0.289***	-0.005***	-0.012**	12.566***	21.969***
	(4.81)	*(-2.20)*	*(1.87)*	*(3.88)*	*(-2.68)*	*(-2.03)*	*(4.05)*	*(3.33)*
Financial year*chole				-0.090***		0.05**	-4.055***	-8.968***
				(-3.09)		*(2.56)*	*(-3.12)*	*(-3.02)*
Constant	0.318***	51.931***	0.457***	1.155***	0.001***	0.048***	49.214***	54.858***
	(96.38)	*(640.46)*	*(320.79)*	*(34.99)*	*(3.68)*	*(40.78)*	*(48.31)*	*(23.08)*
R^2	0.81	0.96	0.94	0.87	0.73	0.70	0.63	0.69
Observations	1,059	1,059	1,059	1,059	1.059	286	1055	278

Note: Models account for trust fixed effect and weight by volume, t statistics in parentheses. Reference year 2007/08. *** *p < 0.01,* ** *p < 0.05,* * *p < 0.1.*

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