Research Note

The effects of changes in cost allocations on the assessment of cost containment regulation in hospitals

Leslie Eldenburg a,*, Sanjay Kallapur b,1

a Department of Accounting, Eller Graduate School of Management, McClelland Hall 301, University of Arizona, P.O. Box 210108, Tucson, AZ 85721-0108, USA
b Krannert School of Management, Purdue University, West Lafayette, IN 47907, USA

Abstract

Empirical studies that examine the effects of regulation on cost containment frequently ignore the impact of changes in accounting practices. This results in a potential bias of research findings. For example, some studies found evidence of cost containment for inpatient services after a change in Medicare reimbursement in 1983. However, Eldenburg and Kallapur (1997, p. 33) found that more costs were allocated to outpatients and correspondingly less to inpatients after 1983, which could bias the cost comparisons. In this paper we examine changes in inpatient costs relative to outpatient costs, after controlling for allocations, to determine whether the magnitude of allocation changes was large enough to bias the findings of studies that ignored these accounting practices. As in previous health-care studies (noted in our paper), we found that inpatient full costs (i.e., direct cost plus allocated costs) decreased relative to outpatient full costs after 1983. However, when cost allocations were excluded, inpatient direct costs increased relative to outpatient direct costs, thus providing no evidence of cost-containment. When regulation provides incentives that have the potential to affect accounting practices and public policy researchers do not consider the implications of these accounting practices, analyses of the success of public regulation may reach improper conclusions. Accordingly, subsequent policy based on such research findings may be incorrectly motivated. © 2000 Elsevier Science Ltd. All rights reserved.
1. Introduction

Empirical studies examining the effects of regulation on cost containment that do not consider the impact of changes in accounting practices can potentially affect research findings. For example, in 1983 Medicare replaced the cost-based reimbursement system for hospital inpatient services with a flat-fee prospective payment system (PPS) to provide an incentive to control costs. Although other insurers continued to pay the amount billed by hospitals for patient services, Congress anticipated that hospitals would have incentives to contain overall inpatient costs because Medicare revenues are such a large part of hospital operations (nearly 40% in our sample) (see Guterman and Dobson, 1986, pp. 97–99, 104–107). The Prospective Payment Assessment Commission (ProPAC), set up by Congress to study and report on the success of this initiative, concluded that PPS initially did control costs (ProPAC, 1992, p. 25). The growth rate of inpatient costs dropped from 7.6% during the 1980–1983 period to 2.2% in the 1983–1987 period (ProPAC, 1992, p. 25). At the same time the growth rate of outpatient costs increased from 10.6% in the 1980–1983 period to 12.9% in the 1983–1987 period (ProPAC, 1992, p. 25, 1994, p. 27).

However, ProPAC’s (1992) study did not control for changes in cost reporting practices for inpatient and outpatient departments after PPS was introduced. Eldenburg and Kallapur (1997, p. 45) developed a ratio to reflect the relative overhead allocation rate for outpatients and found the allocation rate to be higher after 1983. They (1997, p. 50) concluded that managers responded to PPS by allocating more common costs to outpatient departments relative to inpatient departments after 1983. Total reimbursements would increase because Medicare inpatient reimbursement was fixed at prospective rates while outpatient payment remained cost-based (1997, p. 32). In this current paper we explore the implications of the Eldenburg and Kallapur (1997) findings by examining the impact of the changes in allocations on cost containment studies. If the reallocations were of sufficiently high magnitude, they would affect the conclusions of cost containment studies.

Because the reimbursement change is the most prominent cost-containment health policy initiative to date (Sloan et al., 1988, p. 192), we examine to what extent the lack of control for changes in cost allocations affects findings such as

---

2 PPS provides incentives to control costs by paying hospitals a fixed amount per patient-episode based on the patient’s diagnosis. Thus the flat-fee or prospective payment system shifts the financial risk for Medicare inpatient treatment to hospitals, i.e., hospitals lose if their costs are higher than the reimbursement and gain if their costs are lower, thereby giving them incentives for cost-control (Sheingold, 1986, p. 7).

3 In this current study, we use the same sample as Eldenburg and Kallapur (1997). However, we analyze costs (with and without cost allocations) to replicate prior health care cost containment studies. The 1997 paper used changes in ratios to provide evidence that cost allocations and patient mix had changed after 1983.
those in ProPAC (1994, p. 27). If researchers analyze the cost containment effects of PPS without considering associated incentives to change accounting practices, inpatient costs might appear to increase at a slower rate, and correspondingly, outpatient costs at a faster rate, giving the impression that the regulation succeeded. We avoid this problem by comparing relative changes in direct costs (full costs minus allocated costs) within inpatient and outpatient departments after the implementation of PPS. We compare these results with those using full costs, to determine whether allocation changes affected the previous studies.

Using data from Washington State hospitals, we found that full costs within inpatient departments decreased relative to outpatient departments after 1983. These findings are similar to those in the health care literature (e.g., ProPAC, 1992, 1994). However, when we excluded allocated costs, we found that the direct costs of inpatient departments increased, suggesting no cost containment on the part of hospitals. We also partitioned the sample into high and low cost hospitals to determine whether high-cost hospitals, whose incentives to control costs were greater, showed any evidence of cost control. We found that high-cost hospitals reduce their direct costs relative to low cost hospitals. Nevertheless, their inpatient department direct costs increased faster than their outpatient costs.

In addition to recognizing the impact of accounting practices on economic analysis and highlighting its importance, our study also complements previous research on inpatient cost containment by directly examining hospital costs. Although the regulation was aimed specifically at reducing the cost of hospital inpatient services, most of the previous studies (except the ProPAC, 1992, 1993 and 1994 studies) investigate either non-financial measures such as length of stay (Guterman and Dobson, 1986; Chesney, 1990) or the costs of Medicare/Medicaid programs to the government, rather than costs within hospitals (Russell and Manning, 1989).

Studies on length of stay indicate a decrease after 1983 (Guterman and Dobson, 1986, p. 103; Chesney, 1990, p. 376, for example). However, this evidence does not necessarily imply that hospitals incurred lower costs. A reduction in occupancy does not appear to affect monthly operating costs (Evans et al., 1997). These results are predictable because hospitals are characterized by high percentages of fixed costs (Noreen and Soderstrom, 1994, 1997). Studies on government costs of Medicare/Medicaid programs do not address the issue of whether hospitals’ efficiency increased – an important issue because savings to health care payors must ultimately come from increased efficiency. Moreover, results from these studies are conflicting: Coelen and Sullivan (1981, p. 1) found cost savings from PPS programs within certain states, while Sloan et al. (1988, p. 206) found no decrease in costs per adjusted admission.

The general approach used in these studies (Hadley and Swartz, 1989, for example) is to perform cross-sectional regressions of costs (total or per capita
or per adjusted admission or per patient day) on control variables and a
dummy variable equaling 1 for the PPS period. The coefficient on this dummy
variable represents the effect of PPS on costs. Commonly-used controls in-
clude: quantity (patient-days, outpatient visits, or adjusted patient-days),
hospital type (teaching or non-teaching), case-mix index, wage levels, and
hospital competition measured by the Herfindahl index of industry concen-
tration in the county where the hospital is located (Hadley and Swartz, 1989,
p. 40, for example). The main problem with this approach is that the effect on
costs of any variable affecting costs, but not included among the regressors, is
captured by the PPS dummy (a problem of correlated omitted variables). This
is especially likely with time-related factors (i.e., any factor that changed after
1983). For example, if input prices declined after 1983 for reasons unrelated to
the implementation of PPS, and the researcher uses a general price index to
control for changing price levels, then the resulting decrease in costs will be
unjustifiably attributed to PPS. Conversely, if input costs increased after 1983
the researcher may not find any cost savings even if PPS led to decreased re-
source use. We avoid this problem by comparing inpatient costs with con-
current outpatient costs. Any time-related factors omitted from the regression
will not affect the results as long as their effects on inpatient and outpatient
costs are similar. Thus our study complements previous research by using a
time-series approach, thereby using each hospital as its own control.

The remainder of this paper is organized as follows. Section 2 presents the
model used for empirical tests. The sample is described in Section 3. Section 4
contains the results. We conclude in Section 5.

2. Model development

2.1. Inpatient and outpatient classification

We investigate changes in inpatient department costs relative to outpatient
department costs after 1983. This methodology was used in the 1992, 1993 and
1994 ProPAC studies. If inpatient costs are contained as a result of PPS after
1983 they should rise at a slower rate than outpatient costs. Rather than es-
timate growth rates of inpatient and outpatient costs per unit volume (as
ProPAC did), we regressed costs on measures of volume. This allowed costs to
have both fixed and variable components. To investigate changes in inpatient
costs relative to changes in outpatient costs, we constructed dependent and
independent variables as ratios of inpatient costs to total costs and inpatient
volumes to total volumes respectively.

For costing purposes, hospitals are divided into revenue-generating de-
partments (inpatient and ancillary), and service departments, whose costs
are allocated to revenue generating departments (WSHC, 1992). Ancillary
departments (such as laboratory and physical therapy) treat both inpatients and outpatients (WSHC, 1992, p. 3). The charge (amount billed to patients) for each type of service is identical across patients, regardless of the insurer, the reimbursement system, or whether the service is for an inpatient or outpatient (CHARS, 1987, p. 3). Since reimbursement for Medicare outpatients is cost-based, Medicare calculates the hospital’s reimbursement amount as the charges multiplied by the ratio of department costs to department charges (CCH Medicare and Medicaid Guide, 1995, p. 2045). Therefore costs within departments are implicitly assigned to inpatients and outpatients based on charges, and cannot be manipulated. Thus the only way to allocate more service-department costs to Medicare outpatients is to allocate them to departments that serve a higher proportion of Medicare outpatients. Accordingly we use hospital departments as the unit of analysis.

We classified the departments into inpatient and outpatient according to the following scheme. For each of the sample years, we rank-ordered the departments in each hospital by the ratio of inpatient revenue to total revenue. Departments with ratios above the median were considered inpatient departments, and those with ratios below the median were considered outpatient departments. Departments that Medicare continued to reimburse on a cost basis (such as psychiatry) were considered outpatient, and those departments providing few services to Medicare patients (such as obstetrics and nursery) were considered inpatient.

2.2. Model specification

We estimated the following model:

\[ \text{INPCOST}_{it} = a_0 + a_1 \text{INPREV}_{it} + a_2 \text{DUMAF}_t + \epsilon_{it}, \]  

where INPCOST is the ratio of inpatient-department costs to total hospital costs (inpatient plus outpatient department costs), INPREV the ratio of inpatient department revenues to total revenues, and DUMAF is a variable equal to 0 for years through 1983, and 1 otherwise. \( i \) and \( t \) denote subscripts for hospital-department and year.

---

4 Hospitals have incentives to allocate more costs to departments with a high proportion of Medicare outpatient revenues because outpatient services continued to be reimbursed on a cost basis (Eldenburg and Kallapur, 1997, p. 32). However, because the percentage of Medicare inpatients and outpatients is not available at the department level, we used the ratio of inpatient to total revenues. Because we were able to replicate prior studies when we use full costs, our confidence in the classification scheme is increased.

5 Results are similar when we omit the psychiatry, obstetrics, and nursery departments.
We used pooled time series and cross-section data with one observation per hospital-department-year \(^6\) (hence subscripts \(i\) and \(t\) on all variables except DUMAF, which depends on time only). The dependent variable in each regression equation is the sum of the inpatient-department costs, deflated by the sum of hospital-wide costs. \(^7\) In addition to measuring inpatient costs relative to outpatient costs, this ratio also controls for inflation (assuming inpatient and outpatient costs are similarly affected).

There are two independent variables: inpatient revenues deflated by hospital-wide revenues and a dummy variable for the post-PPS period. The revenue ratio is included as a control for changes in relative inpatient and outpatient volumes, case complexity, and any changes in technology. Revenues reported in our data reflect total patient charges, i.e., amounts billed to the patient. As mentioned earlier, these charges reflect the use of services and do not differ by payor or reimbursement method. Thus the change in Medicare reimbursement methods does not affect the ability of reported revenues to proxy for volume. Moreover, revenues likely reflect volume changes, changes in case complexity, and changes in technology; all of which drive costs, because higher volume leads to higher charges, as do increased technology and case complexity. \(^8\) The other independent variable is DUMAF; its coefficient measures the change in the dependent variable (inpatient costs as a fraction of total costs) after 1983. That is, if inpatient costs increased at a slower rate than outpatient costs, then the ratio of inpatient departments’ costs to total cost will decrease after 1983 and the coefficient on DUMAF will be negative.

We first replicated health-care studies (ProPAC, 1992, 1994, for example) using full cost, i.e., direct cost plus allocated costs, as the cost measure. Next we controlled for changes in cost allocations by performing separate regressions using direct costs as our cost measure. Any differences in findings between the full cost and the direct cost measures reflect the effect of changes in cost

---

\(^6\) As an alternative approach, we regressed costs on volume measures for each department separately, allowing the coefficients to differ across departments. Our results remained unchanged.

\(^7\) Ideally one would measure resources used for treating inpatients and outpatients within each department separately, to determine whether resource use for inpatients is minimized. However, information on actual resource use for inpatients and outpatients is not available in our database. We do not believe that this significantly affects results because it is unlikely that within a given department there will be any differences in resource use between inpatients and outpatients. That is, if resources of a given department are economized for inpatients, then they likely are also economized for outpatients.

\(^8\) A typical measure of case complexity, the case-mix index, is not available until after 1985 and thus could not be used. An alternative measure of volume is the units of volume reported in the database for each department – for example the volume for operating rooms is minutes of surgery. We did not use this measure, however, because the regression estimates would reflect cost per unit of volume in each department, which are not comparable across departments because different departments use different units. Thus we would be unable to compute across department sums of costs for inpatient and outpatient departments, which are the measures of interest here.
allocations. Because Medicare continued to reimburse capital costs (depreciation) on a reasonable-cost basis after 1983, hospitals might not have the same incentives to control capital costs. We therefore distinguish between direct costs with and without depreciation.

3. Data

3.1. Sample

As noted by Eldenburg and Kallapur (1997, p. 38), in 1984 the Health Care Financing Administration began archiving national Medicare cost report data. Before 1985, the “data were not representative” (Eldenburg and Kallapur, 1997, p. 38). Since our study methodology requires data from periods prior to 1985, we utilized hospital data which has been collected by Washington State’s Commission Hospital Abstract Reporting System (CHARS) since 1975. These data include detailed information about direct and allocated costs at the department level. Although the data set is available beginning in 1975, information was not reported on a standardized basis until 1977 (see, Eldenburg and Kallapur, 1997, p. 38, for more detail).

We used the same sample as in Eldenburg and Kallapur (1997). Hence, we exclude Health Maintenance Organizations (HMOs) from the sample because they are paid on a capitation basis by Medicare and are therefore unaffected by any incentives to change cost allocations (Eldenburg and Kallapur, 1997, p. 38). We also excluded children’s hospitals because they do not treat Medicare patients (Eldenburg and Kallapur, 1997, p. 38). We also excluded substance abuse treatment centers and psychiatric hospitals because these services are more specialized and often not covered by Medicare (Eldenburg and Kallapur, 1997, p. 38). As in Eldenburg and Kallapur (1997, p. 38) hospitals had to have data for a minimum of 10 out of 15 years in the 1977–1991 test period. The resulting sample consists of 68 hospitals (Eldenburg and Kallapur, 1997, p. 38).

---

9 We did not have data on a large enough number of HMOs and children’s hospitals to be able to use them as controls (Eldenburg and Kallapur, 1997, p. 38).

10 Imposing the restriction that hospitals have data for 14 sample years resulted in a sample of 52 hospitals. The findings for the smaller sample are similar to the ones reported for the sample of 68 hospitals.
3.2. Descriptive statistics

Descriptive statistics for the sample are reported in Table 1 with the periods 1977–1983 and 1984–1991 reported separately. As noted in Eldenburg and Kallapur (1997, p. 39), “…the mean size statistics (such as revenues, beds, and patient-days) are greater than the medians indicating that there are a few large hospitals, and many small hospitals, which is a typical pattern in Western states.” Medicare revenues are an important component of total revenues (median 36.4% during 1977–1983, increasing to 39.5% during 1984–1991). Thus any change in Medicare reimbursement is likely to affect hospital incentives. Allocated costs are approximately 29% of revenues in both sub-periods.

The means and medians of the regression variables (INPCOST and INPREV) are similar, indicating that the variables are distributed symmetrically. Mean and median INPREV declined in the 1984–1991 period. The magnitude of the decline in INPCOST (cost = full cost) was similar. The magnitude of the decline in INPCOST (cost = direct cost, with or without depreciation), however, was much smaller. These differences reflect the effects of changes in cost allocations. To provide a more direct indication of changes in the proportion of costs allocated to inpatient departments (normalized by volume measured as revenues), in Fig. 1 we present the following ratio averaged across sample hospitals for years 1977–1991:

\[
\frac{\text{Costs allocated to inpatient departments}}{\text{Total allocated costs}} \div \frac{\text{Inpatient department revenues}}{\text{Total revenues}}.
\]

The fraction of costs allocated to inpatient departments, after controlling for volume changes, decreased over time. Although PPS was established in 1983, the change in allocations appears to begin in 1980; hospitals began planning for prospective payments several years before the system was established (Wallace, 1983, p. 23). Nevertheless, we used 1977–1983 and 1984–1994 as pre-PPS and post-PPS periods, in accordance with the effective date of PPS. This weakened our tests – when we eliminated years 1980–1982, the results were much stronger.

---

11 In Eldenburg and Kallapur (1997) the descriptive statistics are for the period 1977–1991. The present study reports statistics for the two separate time periods.
12 In this figure we examine allocations to inpatients and aggregate at the department level. In Eldenburg and Kallapur (1997), outpatient allocations are analyzed after further apportioning the department-level costs to inpatients and outpatients.
4. Results

In Table 2 we present the results of estimating Eq. (1) using different measures of cost. The results for full costs are similar to findings in the health care research literature (ProPAC, 1992, 1994 for example). The costs of inpatient departments appear to decrease relative to outpatient costs (DUMAF = −0.015, significant at the 0.001 level (two-tailed) using White heteroskedasticity-corrected $t$-statistics (White, 1980), and suggest cost containment. However, when we examine direct costs (with or without depreciation) which do not include allocated costs, the coefficient on DUMAF is positive and significant at the 0.001 (two-tailed) level. The magnitude of the coefficient is 0.012, i.e., 1.2% per year over the 1984–1991 period, for direct cost excluding depreciation, and slightly smaller (0.008) for direct costs including depreciation. Overall, these results provide no evidence of inpatient cost containment after PPS.

4.1. Sensitivity checks

A factor that potentially weakens the link between revenues and volume is that hospitals could increase charges after 1983 to secure higher reimbursement (from insurers who reimburse based on charges), thus compensating for any
decreases in Medicare revenues. We therefore checked the robustness of our findings using full-time equivalent employees (FTEs) as an alternative volume-and-complexity measure. This measure reflects volume and complexity from the inputs side: as volume and complexity increase, more FTEs are likely to be needed in the department. Using FTEs as a volume measure also controls for the effect that Washington’s rate-setting regulation might have on our findings. The regulation was in force from 1975–1989 and it specified that charges had to be within 105% of costs in each department (Eldenburg and Soderstrom, 1996, pp. 24–26). If costs were contained, hospitals might have decreased charges to be in conformance with the regulation. Thus any decrease in costs might be falsely attributed to decreasing volume as measured by charges, when, in fact, it is the result of cost containment. Results using FTEs were similar to those from our original model (not reported).

Eq. (1) imposes an equality constraint on the slope coefficients for the 1977–1983 and 1984–1991 periods, since DUMAF is not interacted with INPREV.

---

13 This is called cost-shifting (among payors) in the healthcare accounting literature (see, e.g., Eldenburg and Soderstrom, 1996, p. 28), and differs from the shift in cost allocations from inpatient to outpatient departments examined here.

14 The correlation (Pearson) between the revenue ratio and the FTE ratio is 0.80 ($p < 0.001$, two-tailed). We also include both revenues and FTEs as controls with similar results. It is possible that the rate regulation did not affect our findings because in practice hospitals were audited only if hospital-wide charges exceeded the limit.
To relax this constraint we estimated Eq. (1) for the 1977–1983 period and examined the residuals for the period after 1983. If inpatient costs were contained then predicted costs (the expected costs assuming no change in the cost function) would exceed actual costs and residuals would be negative. However, when we used full costs, the residuals for the 1984–1994 period were negative, indicating that costs were lower than predicted. When we used direct costs and direct costs plus depreciation, the residuals were positive, providing no evidence of cost control. Moreover, the magnitudes and significance levels of the average residuals were similar to those of the DUMAF coefficients for each cost measure. Thus the equality constraint did not appear to bias our results.

To check the statistical robustness of our findings we identified outliers using influence statistics (Belsley et al., 1980, p. 103). Deletion of these observations did not significantly alter the results. We also estimated the regression equation using the rank and normal score transformations of INPCOST and INPREV to determine whether any potential departures from normality affect the results. The results of both of these procedures were stronger than our reported results.

4.2. Potential explanations

Several factors could account for the lack of cost control. First, if Medicare revenues are a relatively small part of total hospital revenues, we might expect little cost control. However, descriptive statistics presented in Table 1 show that this is not the case – the median ratio of Medicare to total revenues is

---

Table 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>( a_0 )</th>
<th>( a_1 )</th>
<th>( a_2 )</th>
<th>( R^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPCOST (cost = full cost)</td>
<td>0.101***</td>
<td>0.895***</td>
<td>–0.015***</td>
<td>0.917</td>
</tr>
<tr>
<td></td>
<td>(11.22)</td>
<td>(65.70)</td>
<td>(–6.75)</td>
<td></td>
</tr>
<tr>
<td>INPCOST (cost = direct cost</td>
<td>0.006</td>
<td>0.973***</td>
<td>0.012***</td>
<td>0.897</td>
</tr>
<tr>
<td>without depreciation)</td>
<td>(0.69)</td>
<td>(78.86)</td>
<td>(4.44)</td>
<td></td>
</tr>
<tr>
<td>INPCOST (cost = direct cost</td>
<td>0.016**</td>
<td>0.951***</td>
<td>0.008***</td>
<td>0.903</td>
</tr>
<tr>
<td>with depreciation)</td>
<td>(1.91)</td>
<td>(75.43)</td>
<td>(3.34)</td>
<td></td>
</tr>
</tbody>
</table>

* \( p < 0.10 \), ** \( p < 0.05 \), *** \( p < 0.01 \) using two-tailed tests, where INPCOST: ratio of inpatient department costs to total hospital costs (inpatient plus outpatient department costs); INPREV: ratio of inpatient department revenues to total revenues; Full cost: inpatient department costs including allocated costs; Direct cost (without depreciation): direct inpatient department costs excluding depreciation; Direct cost (with depreciation): direct inpatient department costs including depreciation; DUMAF: a variable equal to 0 for years 1977 through 1983, and 1 otherwise.

\[ \text{INPCOST}_t = a_0 + a_1 \text{INPREV}_t + a_2 \text{DUMAF}_t + e_t, \] using different definitions of cost (number of observations = 757, overall significance level for each regression is \( p < 0.0001 \))
substantial at 36.4% prior to 1983, and increases to 39.5% after 1983. When we split the sample into two groups, one with percentage of Medicare revenues below the median and another with percentage of Medicare revenues above the median, we found virtually identical results for both groups. These results may reflect the substantial percentage of Medicare revenues for both groups. The quartiles of percentage of Medicare revenue are 29.4% and 42.9%. Second, if hospitals increased revenues by securing higher payments from non-Medicare patients, they may not have focused on cost control (ProPAC attributes it to this reason, ProPAC, 1993, p. 30). Third, Medicare phased in the PPS program by including a hospital-specific portion of payment (based on the hospital’s 1982 Medicare cost report) which was 50% of the payment in 1984 and decreased incrementally until 1987 when it was phased out. The gradual phase-in may have decreased incentives to reduce costs.16

Finally, hospitals with low costs might feel little need to reduce costs further. Hence we could expect greater cost containment by the subset of hospitals whose costs were initially high. To investigate this possibility, we partitioned the sample into high and low cost groups based on their costs in the 1977–1983 period. For each department we calculated a cost index as the ratio of per-unit hospital costs divided by that year’s average per-unit costs for identical departments across hospitals. We aggregated these departmental cost indexes into a hospital-wide index by averaging the departmental indexes weighted by departmental costs (to give greater weight to departments that are relatively larger).18 Hospitals with an overall index above the sample median were classified as high-cost hospitals, and the others were classified as low-cost.

To examine whether hospitals with higher costs show greater evidence of cost containment after 1983, we ran the following ordinary least-squares regression:

\[
\text{INPCOST}_t = a_0 + a_1 \text{HI}_i + a_2 \text{INPREV}_t + a_3 (\text{INPREV}_t \ast \text{HI}_i)
\]

\[
+ a_4 \text{DUMAF}_t + a_5 \text{DUMAF}_t \ast \text{HI}_i + e_{it},
\]  

(2)

16 However, because the hospital-specific payment portion was based on costs reported in the 1982 cost report, there were no reimbursement-related incentives to increase costs during the phase-in period.

17 Recall that units are reported for each department in the CHARS database, for example, minutes of surgery for operating rooms.

18 An example is presented below to clarify the calculation. Suppose each hospital has only two departments: A and B. Let the average per-unit costs (for all hospitals combined) be $750 and $3 for departments A and B respectively. Let a given hospital H have per-unit costs of $500 and $4 in departments A and B respectively. Then the departmental indexes for hospital H are 0.67 ($500/$750) and 1.33 ($4/$3) respectively. Let total revenues in departments A and B be $5,000 and $20,000 or $25,000 for hospital H. Then the cost index for hospital H is calculated as 0.67 \times (5,000/25,000) + 1.33 \times (20,000/25,000) = 1.198. Thus hospital H is costlier than the average hospital because its larger department (B) is costlier than average.
where INPCOST is the ratio of inpatient department costs to total hospital costs (inpatient plus outpatient department costs), INPREV is the ratio of inpatient department revenues to total revenues, HI is a dummy variable representing high cost hospitals, and DUMAF is a variable equal to 0 for years before 1983, and 1 otherwise.

The results, presented in Table 3, provide evidence that direct costs (excluding depreciation) of the high cost hospitals rose more slowly than direct costs of the low cost hospitals ($a_5$ is negative at $-0.013$). However, even the high-cost hospitals’ inpatient costs rose faster than outpatient costs ($a_4 + a_5 = 0.029 - 0.013 = +0.016$). An $F$-test, not reported in the table, indicated that this sum differs significantly from 0 ($p < 0.0001$). We therefore concluded that even high-cost hospitals with greater incentives to contain costs exhibited no control of their inpatient costs relative to outpatient costs.

5. Conclusions

This research investigated whether the prospective payment system (PPS) established by Medicare in 1983 led to cost containment for hospital inpatient services. We examined changes in direct and full costs for inpatient departments relative to outpatient departments after 1983. When we analyzed full costs (including cost allocations), it appeared as if inpatient costs had decreased relative to outpatient costs. These findings are similar to those in the health care research literature (ProPAC, 1992, 1994, p. 25; Hadley and Swartz, 1989, p. 45 for example). However, when we analyzed inpatient direct costs (excluding cost allocations), we found no decrease relative to outpatient direct costs after 1983, thus providing no evidence of cost containment. This evidence suggests that the changes in cost allocations identified in Eldenburg and Kallapur (1997, p. 46), are of sufficiently high magnitudes to affect findings of policy research such as the 1994 ProPAC study comparing inpatient to outpatient costs after 1983. Our findings in this present study have implications for research on the effectiveness of other regulatory policies as well. Researchers must consider whether the regulation provides incentives that also affect accounting methods. If such incentives are present, then empirical tests of the effectiveness of the regulation must control for any accounting changes. Otherwise sub-optimal policy may result from inferences based on such research findings.

Our present study complements previous research on cost containment in response to PPS (ProPAC, 1992, 1994; Hadley and Swartz (1989), for example). Our strategy of comparing inpatient costs with outpatient costs from the same hospital decreases the possibility of spurious inferences due to correlated omitted variables (i.e., any omitted variables affecting costs and changing in magnitude after 1983), a potential problem in the cross-sectional approach
Table 3
Descriptive statistics, coefficients, and White t-statistics for the ordinary least-squares regression: \( \text{INPCOST}_t = a_0 + a_1 \text{HI}_t + a_2 \text{INPREV}_t + a_3 (\text{INPREV}_t \times \text{HI}) + a_4 \text{DUMAF}_t + a_5 \text{DUMAF}_t \times \text{HI}_t + \epsilon_t \), using different definitions of cost

### Panel A: Descriptive statistics

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HI = 1</td>
<td>HI = 0</td>
<td>HI = 1</td>
<td>HI = 0</td>
</tr>
<tr>
<td></td>
<td>(n = 214)</td>
<td>(n = 189)</td>
<td>(n = 167)</td>
<td>(n = 136)</td>
</tr>
<tr>
<td>INPCOST (cost = full cost)</td>
<td>0.672</td>
<td>0.642</td>
<td>0.623</td>
<td>0.590</td>
</tr>
<tr>
<td>INPCOST (cost = direct cost without depreciation)</td>
<td>0.636</td>
<td>0.584</td>
<td>0.610</td>
<td>0.573</td>
</tr>
<tr>
<td>INPCOST (cost = direct cost with depreciation)</td>
<td>0.626</td>
<td>0.585</td>
<td>0.598</td>
<td>0.563</td>
</tr>
<tr>
<td>INPREV</td>
<td>0.645</td>
<td>0.607</td>
<td>0.606</td>
<td>0.547</td>
</tr>
</tbody>
</table>

### Panel B: Regression coefficients White t-statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>(a_0)</th>
<th>(a_1)</th>
<th>(a_2)</th>
<th>(a_3)</th>
<th>(a_4)</th>
<th>(a_5)</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPCOST (cost = full cost)</td>
<td>0.112***</td>
<td>-0.039***</td>
<td>0.876***</td>
<td>0.060***</td>
<td>-0.007**</td>
<td>-0.013***</td>
<td>0.920</td>
</tr>
<tr>
<td></td>
<td>(12.92)</td>
<td>(-2.91)</td>
<td>(63.34)</td>
<td>(2.84)</td>
<td>(-2.03)</td>
<td>(-2.78)</td>
<td></td>
</tr>
<tr>
<td>INPCOST (cost = direct cost without depreciation)</td>
<td>0.019*</td>
<td>-0.036**</td>
<td>0.946***</td>
<td>0.063**</td>
<td>0.029***</td>
<td>-0.013***</td>
<td>0.899</td>
</tr>
<tr>
<td></td>
<td>(1.83)</td>
<td>(-2.21)</td>
<td>(56.43)</td>
<td>(2.49)</td>
<td>(4.66)</td>
<td>(-2.35)</td>
<td></td>
</tr>
<tr>
<td>INPCOST (cost = direct cost with depreciation)</td>
<td>0.028***</td>
<td>-0.037**</td>
<td>0.928***</td>
<td>0.062***</td>
<td>0.016***</td>
<td>-0.014***</td>
<td>0.905</td>
</tr>
<tr>
<td></td>
<td>(2.85)</td>
<td>(-2.40)</td>
<td>(58.38)</td>
<td>(2.60)</td>
<td>(4.17)</td>
<td>(-2.63)</td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.10, **p < 0.05, ***p < 0.01 using two-tailed tests, where INPCOST: ratio of inpatient department costs of total hospital costs (inpatient plus outpatient department costs); INPREV: ratio of inpatient department revenues to total revenues; Full cost: inpatient department costs including allocated costs; Direct cost (without depreciation): direct inpatient department costs excluding depreciation; Direct cost (with depreciation): direct inpatient department costs including depreciation; HI: dummy variable equal to 1 for high cost hospitals, and 0 for others (see text for the classification method); DUMAF: variable equal to 0 for years 1977 through 1983, and 1 otherwise.
used in prior research. Although our results are based on data from Washington State hospitals, all hospitals serving Medicare patients have the same incentives to re-allocate costs; and this re-allocation, when not controlled for, could affect research results in other similar studies.

Acknowledgements

We thank Naomi Soderstrom, University of Colorado at Denver, for sharing these data. We also thank Steve Loeb and two anonymous reviewers for comments.

References

Hospital and hospital health care complex cost report worksheets and supplemental worksheets and electronic reporting specifications. Commerce Clearing House, Chicago, IL.