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Costs per discharge and hospital ownership under prospective payment and cost-based reimbursement systems in Taiwan

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This study in Taiwan examined the relationships between health care costs and hospital ownership under two financing systems with diametrically opposite incentives, case-payment (a form of prospective payment) and cost-based reimbursement. The universal sample of patients treated in 2000, for three standard care groups under each payment method, was included. The case payment diagnoses were uncomplicated cases of caesarean section, femoral/inguinal hernia operation and thyroidectomy, and the cost-based reimbursement diagnoses were uncomplicated cases of benign breast neoplasm, pneumococcal pneumonia and traumatic finger amputation. Costs per discharge were significantly lower in for-profit hospitals (by 2.8 to 5.7%) compared with public and not-for-profit hospitals for case payment diagnoses, which is consistent with the literature on US hospitals. For the cost-based reimbursement diagnoses, for-profits had 11.5 to 21.8% higher costs per discharge. The opposite direction of associations under the two payment systems validates the assumptions of the property rights theory in Taiwan's health care sector. Three plausible explanations for the study findings are suggested: (1) greater productive efficiency in private hospitals under case payment, (2) cost shifting from case payment diagnoses to cost-reimbursed diagnoses, and (3) patient dumping. Longitudinal studies using detailed hospital-level information with patient tracking facility are needed to clarify these issues.

Key words: case payment, hospital ownership, cost per discharge, financing

Introduction

The prospective payment system (PPS) provides hospitals with financial incentives to minimize costs in order to maximize profits. Research in the United States (Ozcan and Luke 1993; Rezaee 1993; Friedman and Shortell 1988; Hirth et al. 2000) and in many other countries (Linna 2000, in Finland; Helmig and Lapsley 2001, in Germany; Kwon 2003, in Korea) has established the cost-containing effect of PPS and fixed price systems on patient care costs. In the United States, several authors have explored the association between ownership of health care facilities and cost containment/medical productivity under PPS pressures, particularly in terms of enhanced efficiency of health services in for-profit (FP) hospitals (Robinson et al. 1988; Rayburn et al. 1992; Rezaee 1993; Zwanziger et al. 1994; Garritson 1999). Rosko (2001) reported higher efficiency of FP hospitals under conditions of increased health maintenance organization penetration, an extreme form of prospective payment pressure. Anders (1993) concluded that nonprofit hospitals had more administrative delays resulting in higher costs. Helmig and Lapsley (2001) documented the cost reduction effect of prospective payment in Germany's hospitals, Gruca and Nath (2001) in Canada's hospitals, and Hamilton (1994) in Canada's hospices. In Taiwan, Shih et al. (1996) and Lo et al. (1996) reported that private hospitals are more efficient compared with public hospitals, although these studies were conducted before the initiation of the case payment system in Taiwan. There is no documentation on hospital efficiency under prospective payment in Taiwan, which now covers 50 high volume/high cost conditions.

Taiwan has a national health insurance system with the government as the single payer for all health care provided to its 20 million citizens. In 1995, the Bureau of National Health Insurance (BNHI) introduced a prospective payment system, called the case payment system for selected diagnostic groups. Diagnoses were selected based on relative homogeneity of clinical severity (so that uniform reimbursement rates could be applied without disputes about clinical severity), high volume of the procedure throughout Taiwan, and the big-ticket (high cost) items. Under case payment, hospitals are reimbursed based on a weighted index driven by the average of aggregate charges across all hospitals. This is in sharp contrast to the cost-plus reimbursement driven by actual historic individual hospital costs. For the case payment diagnoses, hospitals that incur costs way beyond the average not only lose money, but also become liable to close scrutiny of the BNHI. Thus, case payment provides hospitals, especially the FP hospitals, with strong incentives to curtail costs to protect their profits.

Studies sponsored by Taiwan's Department of Health (DOH 2000) have shown that case payment has resulted in decreased hospital expenditures for covered diagnoses, through decreased lengths of stay (LOS) and a shift from inpatient to ambulatory care. This study seeks to explore variations in cost-reduction across different forms of hospital ownership. Under the assumptions of the property rights theory, propounded by Furubotn and Pejovich (1972), not-for-profit (NFP) and public institutions lack the incentive to fulfill the objectives set out by their principals, and therefore, FP hospitals tend to outperform the NFP and public

institutions, in terms of profitability and efficiency. Since private ownership allows managers and owners to benefit from the profits, there is an incentive to maximize profits. In public and NFP institutions, the benefits of efficiency and increased profits accrue to the public or community that owns the institution, and therefore managers have no incentive to exert unduly to maximize efficiency and profits. Under these assumptions, we hypothesized that case payment is likely to induce FP hospitals to lower their costs per discharge compared to NFP and public hospitals in order to maximize profits. In comparison, we hypothesized that cost-based reimbursement diagnoses would show similar costs, on average, at the three types of hospitals. The availability of national standardized data on costs per discharge, hospital-wise, presents an opportunity to test this hypothesis.

This study used nation-wide data on costs per discharge for six diagnostic groups, three diagnoses reimbursed under the case payment system and three items reimbursed under the cost-based reimbursement system, to investigate the association between hospital ownership and costs per discharge under case payment, and compare it to cost-based reimbursement.

Similarities and differences between PPS in Taiwan and the US

The earliest and most widely adopted prospective payment concept is the diagnosis-related group (DRG) developed in the late 1960s. DRGs have been adopted for all hospital-based treatment of elderly citizens of the United States under Medicare since 1995. Under this system, all illnesses and symptoms are grouped into approximately 500 DRGs to capture every hospital admission into one or other DRG. Hospitals are paid a fixed amount per patient based on the diagnosis, procedure, age, sex, co-morbidity and complication factors, regardless of the actual cost of resources used (Wyszewianski 1987). Therefore, DRG payment induced early discharge of patients to minimize costs, and also better hospital management to enhance service efficiency (Coulam and Gaumer 1991). Following Medicare's adoption of DRGs, many, if not most, private insurers in the US have adopted varied forms of prospective payment, ranging from discounted fee-for-service to capitated payments under health maintenance organizations. It should be noted that given the variety of insurers and payment methods covering different segments of the population, cost reductions or efficiencies demonstrated under one payment system (such as inpatient Medicare expenditure) may be misleading, since hospitals can engage in cost shifting to other payers covering other segments of the population.

Compared with the US health care system, Taiwan's case payment, similar to DRG payment, is restricted to 50 relatively uncomplicated diagnoses, while outpatient care for these diagnoses and all care for the remaining diagnoses are covered by cost-plus reimbursement. To ensure quality of care, minimal requirements of care and standardized procedures are mandated by the BNHI. To obtain full reimbursement, hospitals must ensure provision of at least 65% of the minimal service requirements for each case, and that health status at discharge meets specified BNHI standards. Certain optional items on a need basis are also specified, although these do not qualify for extra charges. Hospitals are not reimbursed for unscheduled readmissions for the same disease within 14 days. These policies were intended to preempt the 'quicker and sicker' syndrome (premature discharge followed by readmission of a sicker patient), that characterized the early years of DRGs in the United States. The notable features in Taiwan that are distinct from the US are a single-payer system covering all citizens, DRG application for 50 selected diagnoses, and uniform reimbursement policies for each diagnosis across the country, either case payment or cost-based reimbursement, without fragmentation across age or insurer groups. Thus, profit maximization in Taiwan could potentially take the form of improved production efficiency, cost shifting to cost-based reimbursement diagnoses (in contrast to cost shifting *across payers* in the US), shifting patients to care units that are beyond the purview of case payment constraints (such as transfer to outpatient care), or patient dumping of complicated cases to public hospitals.

Financing of hospitals in Taiwan

To evaluate institutional profit maximization behaviours, it is essential to understand the sources of financing for the different ownership categories. Public hospitals are under the control of the DOH and local governments, may be affiliated with the public medical schools, or could be under the Veterans' Administration. Public hospitals are financed by 60% of hospital budgets from the government (primarily to take care of salaries), NHI reimbursement, and out-of-pocket payments by customers. Being subsidized and managed by government, managerial decisions often involve a prolonged bureaucratic process, which is generally believed to slow down public hospitals' response to changes in the external environment. Moreover, the government routinely provides a generous annual budget that usually covers salary costs, which provides a generous cushion against payment constraints imposed by NHI. Therefore, reimbursement changes do not call for a response with the same urgency as a FP or NFP hospital.

NFP hospitals are affiliated with non-profit religious organizations, private medical schools, and other not-profit organizations. They are exempt from property and other taxes, and their operating expenses are mainly covered by third-party reimbursement, out-of-pocket payment by customers, donations and endowments received from philanthropists.

By law, FP hospitals can be owned only by individual physicians, and not by corporations or partnerships. These hospitals are exclusively financed by third-party reimbursement and out-of-pocket payments by customers. Being owned by individual physicians, operational decision-making in these hospitals incorporates the dual perspectives of financial business sense along with clinical expertise. Of the three types of hospitals, the FP hospitals are not encumbered by bureaucratic process or decision-making by lay managers, and thus expected to be the most profitable and adaptable in response to changes in financial conditions introduced by the BNHI.

Data and methodology

Data source

This study used the *National Health Insurance Research Database* (NHIRD) for 2000, published by Taiwan's National Health Research Institute (TNHRI). This database covers all inpatient and outpatient medical benefit claims for Taiwan's population of over 20 million.

Study sample

The study sample included patients admitted to hospitals between January and December 2000, for a caesarean section, femoral/inguinal hernia operation, thyroidectomy, benign breast neoplasm, pneumococcal pneumonia, and uncomplicated traumatic amputation of fingers other than the thumb or index finger. To ensure comparable clinical severity, and therefore comparability of costs per discharge across hospitals, under all six diagnoses, patients were selected for the study only if they had no complications or co-morbidities. The former three diagnoses were case payment diagnoses, and the latter three formed the comparison group, being paid for by cost-based reimbursement.

Criteria for selection of diagnoses for the study

In Taiwan, all 50 case payment diagnoses are surgical or procedure-oriented conditions. Out of these, the three items for the study were selected based on the criteria of high volume, comparability in terms of share of revenue across hospital ownership categories,[1] brought under case payment early on, most widely performed across all categories of hospitals throughout Taiwan, and items with the least percentage of exclusions on account of co-existing morbidities. The latter two criteria were used to circumvent selection bias. Although the caesarean delivery group had a high proportion of cases with secondary diagnoses and therefore exclusions (75%), it was selected because it was the first item placed under case payment in 1996, is a very high volume item (given the prevailing caesarean delivery rate of 32%), and we expected institutional responses to case payment for this item to be stabilized by 2000. The remaining two diagnoses had the lowest percentage of cases with co-existing morbidity that had to be excluded (25% and 30% respectively).

The three cost-based diagnoses were selected based on the same criteria as case payment diagnoses. Since many cost-based diagnoses are medical cases (not surgical/procedure-driven), we chose to include one medical item. We selected a very high volume medical condition, pneumococcal pneumonia, although 85% of cases had to be excluded on account of co-morbidities. Most conditions treated in departments of internal medicine were associated with more than 85% co-morbidity rate. The remaining two selected conditions, benign breast neoplasm and traumatic finger amputation (other than thumb and index finger) were selected based on the criteria outlined, and had 21% and 35% exclusions on account of co-morbidities. We used three distinct diagnoses in each reimbursement type in order to avoid the pitfall of a chance finding, and to ensure better generalization of our study findings across the case payment system itself.

Another major exclusion criterion was caesarean delivery in a private clinic (with less than 10 beds). This was done to ensure uniformity of institutional setting, essentially a hospital setting, which has vastly different dynamics compared with private clinics run by a solo practitioner.

Study objective

The study objective was to compare the association between hospital ownership and cost per discharge among case payment diagnoses with that of the cost-based reimbursement diagnoses. This methodology represents a concurrent comparison of the cost containment response of hospitals differentiated by ownership to the case payment system versus cost-based reimbursement system.

Identification of patient records for the study

The patients in the case payment group were identified from the NHIRD by DRG codes, 0371A (caesarean section), 0163A (femoral/inguinal hernia operation) and 0290A (uncomplicated thyroidectomy without complications or comorbidities). The study patients in the comparison group of three diagnoses were identified by ICD-9-CM codes, benign breast neoplasm (ICD – 217), pneumococcal pneumonia (ICD – 481) and traumatic amputation of the finger (ICD – 886.0), all three groups without any co-morbidity. After excluding patients with secondary diagnoses and caesarean patients delivered at clinics, a total of 36 652 cases were included in the study, 14 452 caesarean deliveries, 15 468 hernia operations, 5349 thyroidectomies, 1366 benign breast neoplasms, 492 pneumococcal pneumonia and 1528 traumatic finger amputations.

Statistical analysis

Statistical analysis was conducted using the SPSS statistical package (SPSS 10.0 for Windows, 1997). To explore the relationship between costs per discharge and hospital ownership for each case payment diagnosis, one-way analysis of variance (ANOVA) and multiple regression analysis were used. Separate analyses were done for each of the six diagnoses. Multiple regression analysis was used to control for the effects of other institutional and patient level variables.

Key variables of interest

The key independent variable of interest was hospital ownership, and the key dependent variable of interest was cost per discharge for each of the six diagnoses. Hospital ownership was recorded as one of three types: public, NFP and FP hospital. Cost per discharge was represented by the monetary value of medical care claimed by the hospital. Claims submitted to the NHI have to show the itemized costs of services/disposables provided. Cost per discharge represents the aggregate of these itemized costs billed to NHI.

Control variables

Besides ownership, several factors could influence the cost of care. The control variables used in the study were patient-level variables of age and gender, and the institutional variables of geographic location and hospital level. Geographic location was operationalized as north, central, south and east. Hospital size is likely to influence costs per discharge, as suggested by Zuckerman et al. (1994) and Hadley et al. (1996). Since data on hospital-wise bed capacity is not available in each patient record, we used hospital level as a proxy for the effect of hospital size on costs. In the database, hospitals are classified as medical centres (500 plus beds), regional hospitals (250–500 beds) and district hospitals (20–250 beds). Hospital teaching status was not included because of collinearity issues: all regional hospitals and medical centres are teaching hospitals. A significance level of 0.05 for the regression coefficients was selected to determine the significance of predictors in the models.

Results

Descriptive statistics and unadjusted cost comparisons

Tables 1 and 2 summarize the demographic characteristics of sampled patients, and other descriptive statistics for each diagnostic group. The mean ages were 30 ± 5 years, 43 ± 25 years, and 41 ± 14 years (mean ± standard deviation) for caesarean delivery, hernia operation, and thyroidectomy case groups, respectively, with mean costs per patient of NT$27 975 ± 2415, NT$16 962 ± 2707 and NT$28 799 ± 5730 (average exchange rate in 2000: US$1 = NT$33.5). Mean LOS were 5 days (SD = 1), 2 days (SD = 1) and 3 days (SD = 1), respectively.

For the three cost-based reimbursement diagnoses, the mean ages and standard deviations were 35 ± 13 years, 19 ± 23 years and 35 ± 15 years for benign breast neoplasm, pneumococcal pneumonia, and traumatic finger amputation, respectively, with mean costs per patient of NT$17 322 ± 6231, NT$15 058 ± 7226 and NT$39 525 ± 27 055. Mean LOS were 2 ± 1 days, 6 ± 3 days and 6 ± 4 days, respectively. The univariate statistics show considerably higher standard deviations for the cost-based reimbursement diagnoses compared with the case payment groups. Tables 1 and 2 also show that the majority of the caesarean cases (63.5%) were treated at FP hospitals, and the majority of pneumonia (69.1%) and traumatic finger amputation cases (57.4%) were treated at NFP hospitals.

Preparatory to ANOVA and regression analysis, the distribution of the dependent variables, cost per discharge for each diagnosis, was checked for normality. For all six diagnoses, cost per discharge showed normal distributions (plots not presented). Analysis of variance (ANOVA) was done to examine the crude unadjusted relationship between hospital ownership and cost per discharge in each diagnostic group (Table 3). The analysis shows a significant association between hospital ownership and cost for every case payment diagnostic group, and for benign breast neoplasm among the cost-based reimbursement diagnoses, with FP hospitals having the lowest mean costs per discharge compared with public and NFP hospitals ($p < 0.001$ for all four diagnoses).

Adjusted cost comparisons based on multiple regression analyses

Multiple regression analyses reveal significant, consistent associations between hospital ownership and costs for the case payment diagnoses, and the cost reimbursement diagnoses, after adjusting for hospital location, hospital level, patient age and gender, as shown in Tables 4 and 5. The analyses show that adjusted costs per discharge were *consistently lower at FP hospitals* compared with public and NFP hospitals *for the case payment diagnostic groups* (caesarean delivery, hernia, and thyroidectomy; all $p < 0.001$). In contrast, *for the cost-based reimbursement diagnoses, FP hospitals had significantly higher* costs per discharge than public hospitals ($p < 0.001$ for benign breast neoplasms, $p < 0.01$ for pneumonia, and $p < 0.001$ for traumatic finger amputations), and significantly higher than NFP hospitals for pneumococcal pneumonia and traumatic finger amputations.

Magnitude of effects – case payment vs. cost-based reimbursement

Apart from statistical significance, the magnitude of differences is also important. Given mean costs per discharge for the caesarean section group of NT$29 069, and the parameter estimate in Table 4 of 793 for NFP hospitals (the larger of the two parameter estimates), FP hospitals showed, on average, about 2.7% lower costs than NFP hospitals, after controlling for hospital level (a proxy for bed capacity), geographic location and patient demographic variables. For hernia operations, FP hospitals had 5.2% lower costs than NFP hospitals, and for thyroidectomy, they had 5.7% lower costs than public hospitals.

The magnitude of cost differences for the cost-based reimbursement diagnoses is much greater, and in the opposite direction. Given mean costs per discharge for benign breast neoplasms of NT$18 202, and the parameter estimate of –2632 for public hospitals, FP hospitals showed, on average, 14.5% higher costs than the public hospitals. For pneumococcal pneumonia cases, FP hospitals had 11.5% higher costs than NFP hospitals. For traumatic finger amputations, they had 21.8% higher costs than NFP hospitals.

As expected, the larger hospitals, medical centres and regional hospitals (which are also teaching hospitals) have higher costs per discharge for all six diagnoses, and within the teaching hospitals, the medical centres (with higher bed capacity) have higher costs than the regional hospitals, as shown by the parameter estimates in Tables 4 and 5.

Discussion and policy implications

The findings of this study are intriguing, especially since it is a concurrent comparison of cost variations across ownership types, under case payment and cost-based reimbursement

Table 1. Descriptive statistics of the three case payment diagnoses

DRG classification (DRG code)	Caesarean delivery (0371A) n = 14 452				Hernia operation (0163A) n = 15 468				Thyroidectomy (0290A) n = 5349			
	Min.	Max.	Mean	S.D.	Min.	Max.	Mean	S.D.	Min.	Max.	Mean	S.D.
Cost per discharge (NT$)	20 015	42 549	27 975	2415	9014	45 124	16 962	2707	15 487	57 964	28 799	5730
Age (years)	14	46	30	5	1	90	43	25	10	84	41	14
LOS (day)	1	12	5	1	1	12	2	1	1	10	3	1
Gender												
Male		13 280 (85.9%)				830 (15.5%)						
Female		2 188 (14.1%)				4 519 (84.5%)						
Hospital ownership												
Public		3 443 (23.8%)				3 900 (25.2%)				945 (17.7%)		
NFP		1 833 (12.7%)				6 410 (41.4%)				2 768 (51.7%)		
FP		9 176 (63.5%)				5 158 (33.3%)				1 636 (30.6%)		
Hospital location												
Northern		4 658 (32.2%)				6 785 (43.9%)				2 306 (43.1%)		
Central		4 672 (32.3%)				4 137 (26.7%)				1 790 (33.5%)		
Southern		5 090 (35.2%)				4 081 (26.4%)				1 173 (21.9%)		
Eastern		32 (0.2%)				465 (3.0%)				80 (1.5%)		
Hospital level												
Medical centre		1 648 (11.4%)				4 554 (29.4%)				2 305 (43.1%)		
Regional hospital		2 229 (15.4%)				5 719 (37.0%)				1 574 (29.4%)		
District hospital		10 575 (73.2%)				5 195 (33.6%)				1 470 (27.5%)		
Teaching status												
Yes		5 725 (39.6%)				11 715 (75.7%)				4 141 (77.4%)		
No		8 727 (60.4%)				3 753 (24.3%)				1 208 (22.6%)		

Note: The average exchange rate in 2000 was US$1.00 = NT$ 33.50.
NFP = not-for-profit; FP = for-profit.

Table 2. Descriptive statistics of the three cost-based reimbursement diagnoses

ICD-9-CM classification (code)	Benign breast neoplasm (ICD – 217) n = 1366				Pneumococcal pneumonia (ICD – 481) n = 492				Traumatic finger amputation (ICD – 886.0) n = 1528			
	Min.	Max.	Mean	S.D.	Min.	Max.	Mean	S.D.	Min.	Max.	Mean	S.D.
Cost per discharge (NT$)	2 224	67 975	17 322	6 231	2 354	73 749	15 058	7 226	1 205	281 067	39 525	27 055
Age (years)	0	84	35	13	0	88	19	23	1	88	35	15
LOS (day)	1	12	2	1	1	16	6	3	1	33	6	4
Gender												
Male										251 (51.0%)		1
161 (76.0%)												
Female										241 (49.0%)		
367 (24.0%)												
Hospital ownership												
Public		572 (41.9%)				91 (18.5%)				159 (10.4%)		
NFP		619 (45.3%)				340 (69.1%)				877 (57.4%)		
FP		175 (12.8%)				61 (12.4%)				492 (32.2%)		
Hospital location												
Northern		580 (42.5%)				297 (60.4%)				648 (42.2%)		
Central		187 (13.7%)				109 (22.2%)				372 (24.3%)		
Southern		572 (41.9%)				73 (14.8%)				465 (30.4%)		
Eastern		27 (2.0%)				13 (2.6%)				43 (2.8%)		
Hospital level												
Medical centre		744 (54.4%)				156 (31.7%)				618 (40.4%)		
Regional hospital		428 (31.3%)				266 (54.1)				645 (42.2%)		
District hospital		194 (14.2%)				70 (14.2)				265 (17.3%)		

Table 3. Analysis of costs per discharge in each diagnostic group by hospital ownership

Diagnosis by hospital ownership	Costs per discharge (NT$)					
	n	Mean	S.D.	Min.	Max.	t(F)-test
Caesarean section (0371A)						954.57[a]
Public	3 443	29 293	2 064	21 090	42 549	
NFP	1 833	28 964	2 708	20 733	40 401	
FP	9 176	27 440	2 323	20 015	39 886	
Total	14 452	27 975	2 415	20 015	42 549	
Femoral/inguinal hernia operation (0163A)						898.49[a]
Public	3 900	17 717	2 555	11 043	45 124	
NFP	6 410	17 491	2 278	12 037	38 486	
FP	5 158	15 733	2 882	9 014	40 568	
Total	15 468	16 962	2 707	9 014	45 124	
Thyroidectomy without complications (0290A)						537.49[a]
Public	945	30 872	5 779	20 231	57 964	
NFP	2 768	30 139	5 248	19 069	52 039	
FP	1 636	25 334	4 610	15 487	50 496	
Total	5 349	28 799	5 730	15 487	57 964	
Benign breast neoplasm (217)						87.49[a]
Public	572	15 544	6 315	2 224	67 975	
NFP	619	19 622	5 420	2 275	54 465	
FP	175	14 997	5 895	2 487	32 503	
Total	1 366	17 322	6 231	2 224	67 975	
Pneumococcal pneumonia (481)						0.79
Public	91	16 095	8 643	4 221	44 476	
NFP	340	14 889	8 245	2 354	57 228	
FP	61	14 443	13 252	3 616	73 749	
Total	492	15 058	7 226	2 354	73 749	
Traumatic amputation of finger (886.0)						0.52
Public	159	38 523	31 212	1 205	245 667	
NFP	877	40 358	39 541	1 475	281 067	
FP	492	38 365	20 708	1 687	193 863	
Total	1 528	39 525	27 055	1 205	281 067	

[a] $p < 0.001$; NFP = not-for-profit; FP = for-profit.

schemes, with a single national payer system. The finding of consistent directions of relationship between cost and ownership among the two sets of diagnoses substantiates the assumptions of the property rights theory in Taiwan's hospital scenario. FP hospitals had lower costs per discharge than public and NFP hospitals for the case payment diagnoses, suggesting that they may be enhancing the efficiency of production and controlling costs better. The opposite direction of association was observed among the cost-based reimbursement group, with FPs having substantially higher costs than public hospitals, and higher costs than NFPs for two diagnoses. At first glance, it appears anomalous that NFPs had the highest costs for one of the cost-based reimbursement items. But our findings stand vindicated in the light of the property rights theory, given the physician compensation mechanism in NFP hospitals. Most NFPs compensate their physicians in proportion to the volume-driven revenues generated by each physician. Thus, although NFP hospital managements have no incentive to maximize profits, physicians have an incentive (allied with the assumptions of the property rights theory) to minimize costs for case payment items and maximize costs for the cost-based reimbursement items.

Our findings also raise more complex questions on the effects of prospective payment systems. The magnitude of cost reduction in the FP sector among the case payment diagnoses (ranging between 2.7 to 5.7%) is far outstripped by the magnitude of higher costs among their cost-based reimbursement cases (higher by 11.5 to 21.8%). Within the limitations of a cross-sectional study, it could be argued that the prospective payment system has caused considerable convergence of costs across ownership types, with the oldest case payment diagnosis (caesarean delivery) showing the highest convergence in costs (varying within a 2.7% range), followed by the remaining two diagnoses showing a 5.2 and 5.7% range of variation, respectively. This may represent the durational effect of PPS on cost control across all types of hospitals. Caesarean delivery was the earliest to be brought under case payment (in 1996), compared with hernia (1997) and thyroidectomy (1999).

It should be cautioned, however, that a cross-sectional study spanning only three case payment diagnoses may not be adequate for unequivocal conclusions about a durational effect. To validate this potential explanation, longitudinal data analysis, traversing the year of introduction of case payment in each category, will be needed. If validated, it suggests that case payment does stimulate significantly greater efficiency and productivity in FP hospitals in the short

Table 4. Results of multiple regression analyses – case payment diagnoses

Variable	Costs per discharge								
	Caesarean delivery (0371A)			Hernia operation (0163A)			Thyroidectomy (0290A)		
	B	S.E.	t-test	B	S.E.	t-test	B	S.E.	t-test
Independent variable									
Hospital ownership									
Public hospital (no = 0)	491	73	6.67[c]	867	65	14.27[c]	1692	290	5.83[c]
NFP hospital (no = 0)	793	67	11.93[c]	894	63	17.94[c]	772	263	2.93[c]
FP hospital (ref. group)									
Hospital location									
Central (no = 0)	–600	51	–11.72[c]	–1 121	53	–21.16 [c]	–1 778	187	–9.53[c]
Southern (no = 0)	199	52	3.85[c]	367	50	7.42[c]	–655	180	–3.64[c]
Eastern (no = 0)	2 726	403	6.77[c]	399	120	3.32[b]	3 065	569	5.39[c]
Northern (ref. group)									
Hospital level									
Regional hospital (no = 0)	–711	76	–9.34[c]	68	51	1.32	–949	172	–5.52[c]
District hospital (no = 0)	–1 794	80	–22.34[c]	–670	65	–10.23[c]	–4 187	267	–15.70[c]
Medical centre (ref. group)									
Gender									
Male		–34	59	–5.82	232	290	1.22		
Female (ref. group)									
Age	10	4	2.41[a]	–8	1	–10.40[c]	9	5	1.74
Constant	29 069	158	183.99[c]	17 082	91	187.87[c]	29 823	351	85.08[c]
N	14 452		15 468		5 349				

[a]p < 0.05; [b]p < 0.01; [c]p < 0.001; S.E. = standard error; NFP = not-for-profit; FP = for-profit.

Table 5. Results of multiple regression analyses – cost-based reimbursement diagnoses

Variable	Costs per discharge								
	Benign breast neoplasm (217)			Pneumococcal pneumonia (481) (886.0)			Traumatic finger amputation		
	B	S.E.	t-test	B	S.E.	t-test	B	S.E.	t-test
Independent variable									
Hospital ownership									
Public hospital (no = 0)	–2 632	569	–4.62[c]	–880	1 623	–2.58[b]	–12 156	3 553	–3.42[c]
NFP hospital (no = 0)	1 204	599	2.01	–2 062	1 366	–2.53[b]	–14 792	2 857	–5.18[c]
FP hospital (ref. group)									
Hospital location									
Central (no = 0)	–1 874	548	–3.42[b]	–49	1 150	–0.43	2 131	2 606	0.82
Southern (no = 0)	–1 876	478	–3.92[c]	–2 240	1 214	–1.85	–8 987	2 188	–4.11[c]
Eastern (no = 0)	482	497	0.97	–1 601	2 505	–0.64	–7 129	5 516	–1.29
Northern (ref. group)									
Hospital level									
Regional hospital (no = 0)	–3 819	359	–10.63[c]	–3 153	1 052	–3.00[c]	–19 785	2 319	–8.53[c]
District hospital (no = 0)	–3 844	539	–7.32[c]	–6 635	1 486	–4.47[c]	–42 940	3 253	–13.20[c]
Medical centre (ref. group)									
Gender									
Male		789	800	0.99	5 329	2 090	2.55[a]		
Female (ref. group)									
Age	52	12	4.40[c]	69	18	3.81[c]	–128	60	–2.13[a]
Constant	18 202	743	24.48[c]	17 984	1 799	9.99[c]	67 941	4 271	15.91[c]
N	1 366	492	1 528						

[a]p < 0.05; [b]p < 0.01; [c]p < 0.001; S.E. = standard error; NFP = not-for-profit; FP = for-profit.

run, and only gradually do the public and NFP hospitals approach the efficiency gains made in the FP sector under prospective payment. This pattern is also supported by the strategic decision-making style, characteristic of the three types of hospitals. The bureaucratic decision-making style in public hospitals, and to a lesser extent in NFPs, could explain the lag in cost contraction relative to FPs owned by solo physician-entrepreneurs. Besides entrepreneurial and proactive decision-making styles facilitated by a single owner, particularly a clinician, the direct stake in profits held by the physician-entrepreneur also explains their rapid cost reduction response to financial pressures, compared to NFPs and public hospitals.

One possible mechanism by which FPs may be improving their production efficiency is the use of clinical pathways or evidence-based medicine. Clinical pathways are practices that are likely to result in favourable clinical outcomes for a particular diagnosis using prospectively defined resources to minimize costs and LOS, while maintaining or improving quality of care under PPS (Lagoe and Aspling 1997). Wang et al. (2001) and Wu et al. (2000) have demonstrated the association between use of clinical pathways and lower patient care costs in Taiwan. It is possible that FPs are achieving lower costs partly due to greater initiative to implement clinical pathways, relative to public and NFP hospitals.

However, the concurrent finding of disproportionately greater costs in FP hospitals relative to public hospitals for cost-based reimbursement items complicates the discussion. Is this a manifestation of cost shifting, assuming that the cost phenomena in the case payment and cost reimbursement systems are linked? Under this scenario, FP hospitals need not be more efficient producers of health care services. When pressured by financial restraints such as PPS, they will seek alternative sources of revenue to ensure their targeted rate of return on investment (Hadley et al. 1996). Under a uniform reimbursement mechanism across all diagnoses, there is no incentive to discriminate between diagnostic categories in cost allocation, but under varied payment mechanisms, there is an incentive to allocate closer to the norms for fixed reimbursement categories, and make up the difference on other diagnostic groups. If such is the case, then hospital cost data (which is really charge data) is not a suitable variable to evaluate efficiency of production. Rather, efficiency differences have to be evaluated by direct measurements of production efficiency. The scope of this study does not permit verification of efficient production or cost shifting behaviour by FP hospitals.

The lower costs of public hospitals under cost-based reimbursement perhaps reflect the lack of provider incentive to perform more services than medically required, because these physicians are mostly salaried, supplemented by a general bonus regardless of revenue volumes generated by each provider. Another caveat about public hospitals is that they may not be as cost-conscious as their FP counterparts about factoring in their fixed capital costs (including costs of raising capital and depreciation) into their itemized billing for services. Capital and depreciation costs are real costs, but are often hidden from cost computations, since they are often hidden subsidies financed by tax dollars in case of public hospitals. It is difficult to assess to what extent the differences in costs per discharge between public and FP hospitals are attributable to this factor.

Another explanation for the extreme findings between case payment and cost reimbursement could be that the current case payment diagnoses also had similar patterns (of higher costs than public and NFP hospitals) prior to being brought under case payment. If such is the case, and it can be demonstrated that current costs for cost-based diagnoses are similar to historic costs, then one could infer that genuine cost control and profit squeezing of private hospital margins may be taking place under PPS. Longitudinal studies are needed to clarify this issue.

A third explanation for lower FP hospital costs under case payment is that it may actually be concealing other greater costs to the community. One example of such costs could be that FP hospitals discharge patients prematurely, causing higher readmission rates at other government or NFP hospitals (patient dumping). FPs may be using this route to deal with the BNHI rule of no-pay for readmissions within 2 weeks. (Currently, BNHI does not track patients across hospitals.) Under this scenario, the overall health care costs for case payment diagnoses may actually be higher, but remain undetected, since these patients would qualify as multiple cases in different hospitals. Research from the US suggests the potential for this mechanism. Silverman et al. (1999) reported that total per capita Medicare spending was considerably higher in areas served exclusively by FP hospitals compared with those served by NFPs. Moreover, once the major NFP providers converted to FP status or vice versa, Medicare spending patterns followed the trend indicated above.

Another area of concern relates to FP hospitals and caesarean deliveries (63.5% taking place at FP hospitals). Given the worldwide controversy surrounding elective procedures like caesarean, it is difficult to determine the appropriateness of caesareans in FP hospitals. To the extent that caesareans are inappropriately performed, FPs may actually be increasing the costs of obstetric services to the community, given that caesarean deliveries are reimbursed at approximately twice the rate of vaginal delivery. No empirical research is documented on patient shifting, patient dumping or appropriateness of elective procedures under case payment in Taiwan. Unless NHIRD releases provider-specific and patient-specific information that allows patient tracking across care sites, these dimensions of lower costs per discharge in FP hospitals cannot be explored.

In conclusion, lower costs per discharge in FP hospitals compared with public and NFPs for case payment diagnoses, and higher costs per discharge for cost-based reimbursement diagnoses have major implications for further research and policy interventions. As the single payer for all health services, Taiwan's government has a lot at stake in enhancing the productive efficiency of the health care system.

Potential hospital inefficiencies in the United States are estimated at about 13.6% (Zuckerman et al. 1994). With Taiwan's annual health care budget of NT$525 billion in 2000, as much as NT$75 billion could be at stake. The case payment system appears to hold much promise if implemented effectively. The findings of our limited cross-sectional study suggest the need for longitudinal research studies with patient tracking information to assess cost shifting, patient dumping and productive efficiency under case payment. Efficiency studies should ensure to account for the budget supplements provided by governments to public hospitals, tax benefits enjoyed by the NFPs, and capital and depreciation costs (usually subsidized by governments in case of public hospitals, representing hidden public subsidies). Pending such research, we recommend that the Bureau of NHI should also keep track of variations in historic costs of cost-based reimbursement diagnoses.

Limitations of the study

There were several limitations to this study. Information on hospital size and bed occupancy, manpower and other resource utilization, competitiveness of local markets, etc., which influence the efficiency of hospital operations (Hadley et al. 1996), is withheld by the NHIRD. Secondly, the cross sectional study design does not permit clear conclusions on cost shifting and other potential dysfunctional institutional responses relative to productive efficiencies, as described earlier. It should be noted, however, that the cross-sectional study design, a liability on some dimensions, is an asset in others. Being a concurrent comparison of two types of reimbursement systems, the observed variations in costs across diagnostic categories are concurrent in real-time, and cannot be imputed to possible variations in input costs, technological change or other durational effects.

Endnotes

[1]According to information from the Taipei Branch of the Bureau of the National Health Insurance, the costs of DRG 0163A (femoral/inguinal hernia operation) account for 0.3% (NT$47 064 055 out of 16 379 565 327), 0.4% (NT$66 202 448 out of 14 782 201 644), and 0.3% (NT$9 240 257 out of 2 737 628 065) of total inpatient cost reimbursements to public hospitals, not-for-profit hospitals and for-profit hospitals, respectively. The costs of DRG 0290A (thyroidectomy without complications or co-morbidities) accounted for 0.2, 0.2 and 0.2% of total inpatient revenues of public hospitals, not-for-profit hospitals and for-profit hospitals, respectively. The costs of DRG 0371A (caesarean section) account for 1.0, 2.0 and 2.6% of total inpatient revenues of public hospitals, not-for-profit hospitals and for-profit hospitals, respectively. The costs of ICD 217 (benign neoplasm of breast) account for 0.03, 0.03 and 0.02% of total inpatient revenues in public hospitals, not-for-profit hospitals and for-profit hospitals, respectively. The costs of ICD 481 (pneumococcal pneumonia) account for 0.05, 0.06 and 0.07% of total inpatient costs in public hospitals, not-for-profit hospitals and for-profit hospitals, respectively. The costs on ICD 8860 (traumatic amputation of other fingers without complication) account for 0.09, 0.1 and 0.04% of total inpatient costs in public hospitals, not-for-profit hospitals and for-profit hospitals, respectively.

The above figures show that in terms of share of hospital inpatient revenue, within each selected diagnosis, the percentages of total revenue are quite comparable across ownership types.

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