National Lessons in Financing of Health Care

Cost Convergence between Public and For-Profit Hospitals under Prospective Payment and High Competition in Taiwan

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Objective. To test the hypotheses that: (1) average adjusted costs per discharge are higher in high-competition relative to low-competition markets, and (2) increased competition is associated with cost convergence between public and for-profit (FP) hospitals for case payment diagnoses, but not for cost-plus reimbursed diagnoses.
Data Sources. Taiwan's National Health Insurance database; 325,851 inpatient claims for cesarean section, vaginal delivery, prostatectomy, and thyroidectomy (all case payment), and bronchial asthma and cholelithiasis (both cost-based payment).
Study Design. Retrospective population-based, cross-sectional study.
Data Analysis. Diagnosis-wise regression analyses were done to explore associations between cost per discharge and hospital ownership under high and low competition, adjusted for clinical severity and institutional characteristics.
Principal Findings. Adjusted costs per discharge are higher for all diagnoses in high-competition markets. For case payment diagnoses, the magnitudes of adjusted cost differences between public and FP hospitals are lower under high competition relative to low competition. This is not so for the cost-based diagnoses.
Conclusions. We find that the empirical evidence supports both our hypotheses.

Key words. Cost convergence, competition, hospital ownership, prospective payment

Studies of the effects of hospital competition on patient care costs in the United States have been confounded by market segmentation on insurance status, payers, and payment type, all operating at indeterminate levels within any given "market" (Robinson and Luft 1985, 1987; Melnick and Zwanziger 1988, Nguyen and Derrick 1994; Mukamel, Zwanziger, and Bamezai 2002). The literature suggests three fulcrums of hospital competition, contingent upon the prevailing combination of payment type, provider density, and rivalry among payers (Dranove and Satterthwaite 2001). Under high competition, cost-reimbursed hospitals compete on quality attributes for physicians, and physicians in turn compete for patients on price and patient perceptions of quality attributes. Prospective reimbursement of hospital services combined with incomplete price-regulation of physician services causes hospitals to engage in nonprice competition based on efficiency and quality to retain market share. Managed care causes payers to compete for purchasers on price and attractiveness of provider networks, while providers compete on price and quality. All three scenarios coexist and change dynamically in U.S. health care markets, confounding empirical verification of the conceptual models of competition, and confining the validity of findings to the United States (Sloan 2001). Uncompensated care for the uninsured further complicates research, and pending conclusive empirical studies, the controversy continues regarding the cost impacts of hospital competition.

BACKGROUND

This study examined the empirical validity of the postulated cost impacts of hospital competition in Taiwan, which offers a favorable research setting, relatively free from the methodological encumbrances of fragmented health care market settings driven by a dynamic mosaic of constantly shifting payers, payment types, purchasers, and insured client base. From a competition perspective, Taiwan's health system represents a level playing field for providers and patients due to universal coverage, a single payer, low copayments, freedom to choose any provider, and comprehensive benefits. Cost-based payment accounts for 90 percent of inpatient care, and prospective case payment for 10 percent (i.e., 50 high-volume or high-cost diagnoses that are pathologically and procedurally well-defined). Nearly 98 percent of all care is reimbursed under National Health Insurance (NHI) since its inception in 1995. Bed capacity is distributed evenly across ownership types, 35 percent in public

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hospitals, 35 percent not-for-profit (NFP), and 30 percent for-profit (FP). Quality is assured through accreditation processes and requiring the documentation-of-care items and discharge status. For medical resource planning purposes, Taiwan is divided into 17 medical area networks based on geographic contiguity of human settlements.

Hospital Competition in Taiwan

Implementation of NHI unwittingly unleashed competition among hospitals, due to a bed capacity expansion (of 10.1 percent during 1996–2001), induced by expectations of a health care bonanza. The professional euphoria hinged on anticipated volume expansions rather than unbridled pricing, because NHI payment rates averaged about half the prices formerly paid by consumers out of pocket. Low payments combined with increased system capacity cause hospitals to suffer acutely, any marginal loss due to unoccupied beds, causing intense competition for patients.

Despite low reimbursement rates, health care costs escalated dramatically, due to price-insensitive consumers, and provider freedom to provide any number of services. In response, the Bureau of NHI (BNHI) introduced case payment in a phased manner, beginning with three diagnoses in 1996, and extending it to 50 diagnoses by 1999. Case payment diagnoses are reimbursed at fixed rates regardless of clinical severity, supplemented by a cost-based increment for outliers (not exceeding 10–15 percent of cases). Similar to Medicare diagnostic related groups (DRGs), the standard rate is the average of weighted aggregate charge data across all hospitals. Care is reimbursed if at least 65 percent of BNHI-specified care items were provided and the specified discharge status was achieved. Readmission within two weeks is not covered. Despite apparent cost reductions, the region-wise response has been uneven (Lin, Yang et al. 2002; Lin, Chang et al. 2002).

For-profit hospital managements claim that under intensely competitive conditions, case payment squeezes hospital margins and threatens their survival. Public hospitals are heavily subsidized by the government, and NFPs receive tax exemptions, philanthropic donations, and county government subsidies (although the policy climate is now shifting to phase out subsidies). Patients, armed with full choices, seek care based on geographic convenience and quality perceptions. For survival, hospitals are forced to compete on quality and efficiency of service.

Research on hospital competition in Taiwan has generic academic and policy significance for the international community, due to the potential for relatively unfettered insights into competition–cost relationships. There are no uninsured, eliminating potential confounding by uncompensated care, and no competing payers and purchasers, eliminating confounding by variable contracting and price–quality tradeoffs. Full choice of providers, stable prices, and a relatively level playing field for providers further enhance the generalizability of findings to international settings.

Prospective Payment and Competition

Past U.S. studies of competition have mostly focused on global measures of performance such as average costs across all admissions, uncompensated care volumes, reserve beds, and hi-tech service offerings. While several studies are available on competition versus cost-based reimbursement, studies of prospective payment, notably, Medicare DRGs have yielded inconclusive results due to indeterminate cost-shifting to private payers or quality trade-offs that remain elusive to researchers (e.g., Hadley, Zuckerman, and Iezzoni 1996). Consistently, however, increasing hospital competition has been associated with higher costs and service intensity, reduced efficiency, and lower bed occupancy (Hadley and Swartz 1989; Nguyen and Derrick 1994; Rivers, Glover, and Munchus 2000).

Studies in the United States suggest that with increasing competition, hospitals respond more sharply to prospective payment system (PPS) pressures (Feder, Hadley, and Zuckerman 1987; Melnick and Zwanziger 1988; Hadley, Zuckerman, and Iezzoni 1996; Schlesinger et al. 1997) causing a medical arms race scenario (Robinson and Luft 1987; Mukamel, Zwanziger, and Bamezai 2002). According to Schlesinger et al. (1997), patient care costs will converge across public, FP, and NFP hospitals under increasing competition as FPs are forced to increase their quality and premium service expenditures and abandon efficiency strategies that would otherwise be the logical, profit-maximizing response to PPS. Dranove and Satterthwaite (2001) postulated that FPs may also respond to concurrent PPS and competitive pressures by skewing quality and service intensity in favor of low-cost (less sick) patients to selectively attract "financially attractive" patients, dumping high cost patients to public hospitals, or achieving poorer outcomes for sicker patients. Profit-maximizing behaviors of FP relative to public and NFP hospitals, per Menke's property rights theory (Menke 1997) are documented by Bellandi, Kirchheimer, and Saphir (2000) in the United States, and Lin, Xirasagar, and Tang (2004) in Taiwan. This study is designed to examine whether under PPS pressures, Taiwan's FP hospitals provide more intensive services in highly competitive markets.

Study Objectives and Hypotheses

This study compares the effects of competition on costs per discharge for case payment diagnoses with cost-based diagnoses in Taiwan. We test two hypotheses: (1) hospitals facing higher competition will have higher mean costs per discharge than under low competition; and (2) increased competition results in cost convergence between public and FP hospitals for case payment diagnoses, that is, cost differences between public and FP hospitals will be lower under high competition compared to low competition for case payment diagnoses, but not for cost-based diagnoses.

Material and Methods

From the NHI inpatient claims database, we selected all cases admitted in 2000 with DRG codes, 0371A cesarean section (CS; 90,322 cases), 0373A vaginal delivery (157,956 cases), 0337A prostatectomy (12,565 cases), and 0290A thyroidectomy without preadmission complications (9,068 cases), all case payment diagnoses, and ICD-574 gallstones with acute cholecystitis (25,633 cases), and ICD-493 bronchial asthma (30,307 cases), both cost-reimbursed diagnoses, for a total of 325,851 cases. We studied four case payment diagnoses to avoid spurious conclusions based on chance findings. The selected diagnoses were high-volume items, with stabilized hospital responses to this reimbursement method by 2000 (CS and vaginal delivery brought under case payment in 1996, prostatectomy in 1997, and thyroidectomy in 1998). Selection of the two cost-based diagnoses was based on high volumes, fairly homogeneous clinical severity from a disease pathology perspective, and widely distributed service across general hospitals in Taiwan.

The dependent variable is cost per discharge in New Taiwan dollars for each diagnosis (the aggregate monetary value of itemized costs of all services and disposables). Hospital competition is measured by the Herfindal-Hirschman Index (HHI), supplemented by additional variables to address its methodological deficiencies. HHI has been widely used (Goes and Zhan 1995), and equals $\sum s_i^2$ where s_i is each hospital's market share of adjusted admissions in a given health care market. We examine the effect of competition in two ways:

the oft-used method (e.g., Nguyen and Derrick 1994) of comparing high-competition (HHI ≤ 0.1) with low-competition markets (HHI>0.1), and comparing the two extreme quartiles of HHI (highest HHI quartile representing least competition, and vice-versa.)

The universe for HHI calculation is confined to hospitals. In Taiwan, proprietary obstetrics/gynecology (ob/gyn) clinics, with fewer than 10 beds compete with hospitals for delivery services. As noted by Schlesinger et al. (1997), the HHI ignores differences in competitive behavior across hospital types. Ob/gyn clinics may have different competitive strengths relative to hospitals. Number of clinic beds in the network is used to account for competition from this source in the vaginal delivery and CS regression analyses.

The HHI measure is also inaccurate to the extent that a section of patients travel outside their market area for care. Phipps and Robinson (1993) refined the HHI to represent a variable-radius market area, such that a specific percentage of a hospital's admissions (75 percent or 90 percent) come from the market area, a method used by many authors (e.g., Hadley, Zuckerman, and Iezzono 1996). Variable radius accounts for patient crossover across administratively defined market borders, but is impractical if many crossovers occur in many directions, especially likely in small countries such as Taiwan. Furthermore, women in Taiwan traditionally go to their parental home for delivery. Patients with more serious illness may also cross HHI area borders, to access care from hospitals reputed for better "quality of care" or medical outcomes. Crossovers are also likely due to FPs dumping sicker patients. With increasing crossover, all medical care networks could have large overlaps, making the variable-radius adjustment operationally inadequate for research purposes. To address these issues, we use another independent variable, net percentage of nonlocal patients that utilized services from a HHI network. If positive, it implies that the network gained patients over and above the locally resident population, if negative patients were lost to other networks. Percent crossover also accounts for the associated dynamics of "quality" and cost. Due to these adjustments, the HHI parameter estimates should be interpreted in conjunction with the estimates for percent crossover, and in case of delivery-related diagnoses, the estimate for clinic beds.

Hospital ownership is classified as public, FP and NFP. We control for age gender, clinical severity (number of secondary diagnoses, none, 1, 2, 3+ diagnoses), and discharge status (recovered, transferred to out-patient care, transferred to another hospital, died, and self-discharged against medical advice). Other institutional variables are hospital level—medical center (MC) with >500 beds, regional hospital (RH) $251\sim500$ beds, district hospital (DH)

$20 \sim 250$ beds, and ob/gyn clinic < 10 beds—and geographic location. Teaching status is excluded due to high collinearity with hospital level (all MCs and RHs are teaching hospitals, as well as some DHs). Most MCs and RHs are public or NFP. Cost data for all diagnoses were normally distributed. The majority of admissions were in high-competition markets (HHI < 0.1).

RESULTS

Table 1 shows that adjusted costs per discharge are significantly higher in high competition markets for all diagnoses, and significantly lower for FPs compared to public and NFP hospitals at high and low competition levels, after controlling for hospital level, geographic location, clinic beds, percent crossover patients, patient's age, gender, and comorbidities. Discharge status had to be excluded from analysis due to many zero values for "died" and "self-discharged."

The interaction term of competition with ownership was significant for all case payment diagnoses, but not for cost-based diagnoses, indicating that the ownership effect on costs varied with competition level for case payment diagnoses but not for cost-based diagnoses. (Table not presented.) This indicated the need for separate regressions for the highest- and lowest-competition quartiles to compare costs by competition level.

Table 2 shows the parameter estimates for each diagnosis in the highest and lowest competition quartiles. Geographic location had to be excluded due to its high collinearity with HHI operationalized into four quartiles. As expected, MCs and RHs (teaching hospitals) have higher costs than DHs (and clinics in delivery cases). Increasing comorbidity and male gender are also associated with higher costs. Parameter estimates across hospital levels and ownership between the highest- and lowest-competition quartiles are a mixed bag, due to collinearity between ownership and hospital level (most MCs and RHs are either public or NFPs), and the decomposition of competition effects across HHI, percent crossover between networks, and the ob/gyn clinic bed variables. Collinearity between hospital ownership and level causes cross allocation of the effect sizes on costs, which need to be unraveled to examine the consistency of their effects on costs across diagnoses. Similarly, the decomposition of competition effects across more than one variable causes cross allocation of effect sizes.

To clarify the competition effect, we present Table 3, a compilation of key estimates germane to the cost convergence hypotheses, including selected

Table 1: Adjusted Relationship between Competition Level, Ownership, and Costs per Discharge for Case Payment and Cost-Based Diagnoses

	Costs per Discharge					
Variable	*CS*	*VD*	*Prostat*	*Thyroid*	*Cholelithiasis*	*Asthma*
Competition level						
High (HHI < 0.1)						
Low (HHI $\geq$ 0.1) (no = 0)	– 873[c]	– 192[c]	– 1,184[c]	– 2,327[c]	– 4,151[c]	– 1,050[c]
Hospital ownership						
Public (no = 0)	1,513[c]	726[c]	1,149[b]	4,041[c]	5,319[c]	6,442[c]
NFP (no = 0)	367[c]	235[c]	1,137[c]	2,189[c]	5,073[c]	1,942[b]
FP						
Hospital level						
Medical center (no = 0)	2,317[c]	1,105[c]	72	4,580[c]	30,467[c]	17,253[c]
Regional hospital (no = 0)	1,420[c]	724[c]	871[a]	3,606[c]	19,685[c]	8,492[c]
District hospital						
Clinic (no = 0)	– 2,836[c]	– 762[c]				
Hospital location						
Northern						
Central (no = 0)	467[c]	– 494[c]	– 45	377	– 258	– 1,688[b]
Southern (no = 0)	371[c]	– 263[c]	1,229[c]	434	848	– 2,591[c]
Eastern (no = 0)	– 1,049[c]	– 124[b]	6,748[c]	7,580[c]	2,845	– 2,127
Patient's gender						
Male (no = 0)				420	1,652[a]	– 793
Female						
Patient's age	12[a]	15[c]	102[c]	12[a]	293[c]	258[c]
Clinic beds	0.21[a]	0.21[c]				
Percent crossover patients	– 270	– 278[c]	4,772[c]	– 6,152[c]	– 6,798	6,224[b]
Number of comorbidities						
0						
1 (no = 0)	317[c]	201[c]	1,852[c]	3,042[c]	940	– 21
2 (no = 0)	1,054[c]	705[c]	3,973[c]	5,696[c]	3,928[c]	1,313
3+(no = 0)	3,396[c]	2,176[c]	11,264[c]	10,015[c]	20,348[c]	14,260[c]
Constant	27,140	12,051[c]	29,050	24,640	3,992	– 2,953
N	90,322	157,956	12,565	9,068	25,633	30,307
R-square	0.1411	0.1754	0.0957	0.2081	0.0830	0.0848

HHI = Herfindal-Hirschman index; CS = cesarean section; VD = vaginal delivery; Prostat = Prostatectomy; Thyroid = Thyroidectomy.

net estimates combining known collinear variables. Public MC and public RH estimates for each competition level are calculated (sum of public and MC/RH estimates from Table 2), representing the adjusted cost differences between public MCs and FP DHs, and public RHs and FP DHs.

For all diagnoses, public hospitals have higher costs than FPs (Tables 2 and 3). Cost differences between public and FP hospitals in the highest and

Table 2. Adjusted Relationships between Competition Level* and Costs per Discharge, to Test for Cost Convergence between FPS and Public Hospitals under High Competition—Case Payment Diagnoses

	Costs per Discharge							
	CS		*VD*		*Prostatectomy*		*Thyroidectomy*	
Variable	*HC*	*LC*	*HC*	*LC*	*HC*	*LC*	*HC*	*LC*
Hospital ownership								
Public (no = 0)	1,443[c]	1,878[c]	409[c]	– 1,469[a]	1,023	162	2,479[c]	15,313[a]
NFP (no = 0)	806[c]		111[b]	– 2,614[c]	1,243[a]	217	776	7,759
FP								
Hospital level								
Medical center (no = 0)	2,366[c]	4,149[c]	1,477[c]	2,598[c]	716	5,325[c]	4,922[c]	11,519[c]
Regional hospital (no = 0)	1,641[c]	494[a]	779[c]	1,617[a]	1,377[c]	– 5,894[c]	4,002[c]	– 256
District hospital								
Clinic (no = 0)	– 2,292[c]	– 4,679[c]	– 534[c]	– 4,131[c]				
Percent crossover patients	3,244[c]	– 2,663[c]	781[c]	– 6,070[c]	8,012[c]	16,880[c]	3,612[b]	7,358[c]
Clinic beds	0.82[c]	2.2[c]	0.75[c]	0.88[c]				
Patient's gender								
Male (no = 0)							589	1,792
Female								
Patient's age	12[c]	– 3	12[c]	19[c]	111[c]	87	8	7
Number of comorbidities								
0								
1 (no = 0)	482[c]	– 632[c]	122[c]	– 1,298[c]	1,698[c]	3,992[c]	3,449[c]	5,469[c]
2 (no = 0)	1,260[c]	325	665[c]	– 584[c]	3,683[c]	7,749[c]	5,619[c]	6,342[b]
3+ (no = 0)	4,066[c]	1,301[c]	2,104[c]	792[c]	10,676[c]	16,635[c]	9,193[c]	7,033
Constant	27,732	15,412	10,931	14,345	28,035	33,917	25,595	20,061
N	57,315	5,554	94,328	10,787	8,015	1,031	6,093	380
R-square	0.164	0.380	0.155	0.310	0.077	0.232	0.114	0.423

[a] $p<0.05$;
[b] $p<0.01$;
[c] $p<0.001$;
*HC = highest competition quartile (lowest HHI quartile); LC = lowest competition quartile (highest HHI quartile).

lowest competition quartiles (Table 3) show cost convergence between public and FP hospitals under high competition relative to low competition, that is, reduction in the parameter estimates for public MCs and RHs from the least to the most competitive markets for all case payment diagnoses except for prostatectomy, once all relevant estimates are used (i.e., percent crossover, and for

Table 2 (*continued*): Adjusted relationship between competition level * and costs per discharge–cost-based diagnoses

	Costs per Discharge			
	Asthma		*Cholelithiasis*	
Variable	*HC*	*LC*	*HC*	*LC*
Hospital ownership				
Public (no = 0)	8,196[c]	10,621[c]	3,762[a]	9,063
NFP (no = 0)	4,643[c]	466	4,048[b]	17,135[b]
FP				
Hospital level				
Medical center (no = 0)	17,287[c]	16,027[c]	34,447[c]	30,436[c]
Regional hospital (no = 0)	9,532[c]	8,720[c]	23,484[c]	11,894[c]
District hospital				
Percent crossover patients	1,876	2,824[c]	–5,785	3,184
Patient's gender				
Male (no = 0)	– 313	265	1,340	1,166
Female				
Patient's age	318[c]	173	344[c]	440[c]
Number of comorbidities				
0				
1 (no = 0)	– 663	– 1,811	1,840	– 3,879
2 (no = 0)	433	– 1,532	5,115[c]	– 1,484
3+ (no = 0)	18,704[c]	4,429[b]	22,907[c]	9,592[b]
Constant	– 9,732	– 136	– 2,353	– 7,564
N	14,968	3,515	17,075	1,689
R-square	0.106	0.069	0.085	0.103

[a]$p < 0.05$;
[b]$p < 0.01$;
[c]$p < 0.001$;
*HC = highest competition quartile (lowest HHI quartile); LC = lowest competition quartile (highest HHI quartile).

deliveries, clinic beds). The apparent reversal of the pattern in the explicit parameter estimates across competition levels for vaginal delivery and CS at public RHs stands rectified once the estimates for clinic beds and percent crossover are accounted for. Each clinic bed, representing additional competition over and above HHI, is associated with NT$0.75 to 2.2 higher cost per delivery, which adds a substantial sum to the explicit competition estimate, considering that 34.8 percent of deliveries take place in clinics (Lin and Xirasagar 2004). The apparent anomaly of higher costs with each clinic bed in

Table 3: Selected Parameter Estimates Relevant to Testing Cost Convergence between Public and FP Hospitals for the Case Payment Diagnoses under High Competition

		Public			*Co-Morbidities*		
Diagnosis-Variable	*Comp. Level*	*MC***	*RH***	*Percent Crossover*	*1*	*2*	*3+*
Cesarean section (CS)*	HC	*3,809*	3,084	3,244	482	1,260	4,066
	LC	*6,027*	2,372	− 2,663	− 632	325	1,301
Vaginal delivery (VD)*	HC	1,886	1,188	781	122	665	2,104
	LC	1,129	− 148	− 6,070	− 1,298	− 584	792
Prostatectomy	HC	*1,739*	2,400	8,012	1,698	3,683	10,676
	LC	*5,487*	− 5,732	16,880	3,992	7,749	16,635
Thyroidectomy	HC	*7,401*	*6,481*	3,612	3,449	5,619	9,193
	LC	*26,832*	*15,057*	7,358	5,649	6,342	7,033
Bronchial asthma	HC	*25,843*	*17,728*	1,876	− 663	433	18,704
	LC	*26,648*	*19,341*	1,876	− 663	433	18,704
Cholelithiasis	HC	*38,209*	27,246	− 5,785	1,840	5,115	22,907
	LC	*39,499*	20,957	3,184	− 3,879	− 1,484	9,592

HC = highest competition quartile (lowest HHI quartile); LC = lowest competition quartile (highest HHI quartile).

*Estimates for clinic beds (applicable only to CS and vaginal delivery): CS: HC = 0.82; LC: 2.2; and VD: HC = 0.75; LC = 0.88.

**Sum of public and MC/RH estimates in Table 2. These estimates represent the differences between public MC/RH and FP district hospitals.

Italics indicate cost difference patterns that are explicitly consistent with the study hypothesis: High competition is associated with cost convergence for case payment (the first four diagnoses), but not so for cost-based items (the last two diagnoses).

low-competition areas relative to high-competition areas also stands rectified by the reversed direction of the estimate for percent crossover relative to other diagnoses. There is no evidence of cost convergence in respect of the cost-reimbursed diagnoses.

Percent crossover consistently shows positive parameter estimates (except deliveries) indicating that crossover into a network is associated with increasing costs, more so in low competition areas (Table 3), except cholelithiasis.

DISCUSSION

The empirical evidence supports both our hypotheses that: (1) highly competitive markets have significantly higher costs compared to low-competition markets, (consistent with U.S. studies, Robinson and Luft 1987; Hadley and Swartz 1989; Zwanziger and Melnick 1988; Rivers, Glover, and Munchus 2000), and (2) high competition is associated with cost convergence between public and FP hospitals relative to low competition for case payment diagnoses, but not for cost-based diagnoses. Our finding of lower mean costs per discharge in FP hospitals compared to public and NFPs is consistent with past studies (Silverman, Skinner, and Fisher 1999).

Past studies operationalized hospital performance in terms of overall costs, profitability, and service intensity, across all admissions adjusted for case mix (Sloan 2001). We have used a more specific measure, cost per discharge for each diagnosis. However, a major confounder for competition research in the otherwise level playing field in Taiwan (single payer, universal coverage, and full patient choice of hospitals) is that case payment is independent of clinical severity. This might induce FP hospitals to either dump patients to public hospitals, or reduce the quality of care for severely ill patients (Dranove and Satterthwaite 2001).

Nguyen and Derrick (1994) postulated the potential for confounding by patient crossover across HHI areas. Kessler and McClellan (2000) suggested that patient choices to travel farther for care may reflect their preference for "high-quality" care, causing market sizes and competitiveness to be confounded by quality differences. In our study, percent crossover is significantly and positively associated with costs, substantially so for prostatectomy, which is typically associated with adverse comorbidities and operative risk from a disease pathology perspective (older males, almost always with hypertension and often, other comorbidities, such as diabetes or kidney dysfunction germane to care intensity). Prostatectomy shows substantially higher cost for crossover patients, 20 percent to 41 percent of the mean cost, or NT$8,012 to 16,880 higher. Similar, though less substantial, crossover estimates are observed for thyroidectomy, another high-risk procedure. Our data support conjectures that crossing over patients are, on average, sicker or higher-risk patients seeking hospitals reputed for better "quality" or outcomes (Kessler and McClellan 2000), or they may be seriously ill patients dumped by FPs. Thus crossover patients may cost more, both due to clinical severity and the spending propensity of "quality-reputed" hospitals.

Clinical severity is a major research challenge, which appears to be robustly accounted for by age, gender, and number of comorbidities. For all diagnoses, we find that "3+ co-morbidities" are associated with much higher costs compared to "no comorbidity." Negative/low estimates for <3 comorbidities for some diagnoses are likely due to trivial secondary diagnoses irrelevant to care intensity, such as transient hypertension among delivery cases, and bronchitis/sinusitis with asthma.

Prostatectomy is the only case payment diagnosis that does not show cost convergence under high competition. This is probably due to substantially higher costs due to comorbidity (26–41 percent higher mean costs for 3+ comorbidity patients, or NT$10,676 to 16,635 higher), and crossover patients (20 percent to 41 percent or NT$8,012 to 16,880 higher). Our conjecture is that due to their high, severity-driven propensity to consume more medical resources, there is less slack for discretionary services to begin with, which is the segment of care responsible for cost convergence.

For the cost-based diagnoses, bronchial asthma and cholelithiasis cost differentials between public hospitals and FPs are similar in high- and low-competition areas (except for cholelithiasis in public RHs), which supports our hypothesis. The sharp cost convergence observed for case payment diagnoses under high competition is not evident for cost-based items. Under case payment, given the favorable demand conditions relative to supply in low-competition areas, FPs, motivated largely by the reimbursement constraint, may readily dump sicker patients to public hospitals, and provide more efficient care to the admitted patients to maximize profits. Public hospitals have higher costs, being less pressured due to the slack they enjoy from subsidies, lack of profit motivation, and taking care of sicker patients. These factors translate into the observed high differentials between public hospitals and FPs under case payment and low competition. When faced with high competition, FPs face two sources of pressure, reimbursement pressure and inadequate demand relative to capacity. For-profits are now pressured to fill up beds to get the associated marginal revenues, even if it requires excessive services to attract admissions. As their costs go up, they approach public hospitals, causing the observed cost convergence. Potential quality issues associated with lower costs in FPs under low competition appear to be a nonissue, given the BNHI's quality safeguards, and the empirically negligible incidence of mortality and self-discharge. For cost-based items, since there is no financial pressure, FPs provide services at the same (liberal) level under both high and low competition. Higher costs in public hospitals probably reflect the higher costs of service in a public sector setting.

Although only 4 out of 50 case payment items and two cost-based items were studied, these diagnoses were selected for their high volumes, potentially homogeneous severity from a disease pathology perspective, and widespread service provision at all levels of hospitals. Our data suggest that hospital competition may indeed be socially wasteful, an issue debated by McLaughlin

(1988), McManis (1990), and Kessler and McClellan (2000). From a policy perspective, however, the study limitations restrain its policy relevance. More research is needed to concurrently examine the role of other profit-maximizing behaviors by FPs, such as transfers to out-patient care under case payment pressures (Lin, Xirasagar, and Kao 2004), cost shifting to cost-based payment items (Zwanziger, Melnick, and Bamezai 2000; Lin, Xirasagar, and Tang 2004), and patient dumping. Moreover, hospitals have ample revenue buffers to offset case payment pressures, given that case payment accounted for only 10 percent of inpatient revenues in 2000, and inpatient revenues for only half of all hospital revenues. Being a cross-sectional study, this study is unable to conclusively establish causality, unlike longitudinal studies. Despite these limitations, a major insight for policymakers internationally, is that efficiency-oriented reimbursement could be blunted by high provider competition, given the information asymmetry that exists between providers and consumers in health care.

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