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EFFECTS OF COMPETITION UNDER PROSPECTIVE PAYMENT ON HOSPITAL COSTS AMONG HIGH AND LOW COST ADMISSIONS: EVIDENCE FROM CALIFORNIA, 1983 - 1993

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ABSTRACT

Competition and prospective payment systems have been widely used to attempt to control health care costs. Though much of the increase in medical costs over the past half-century has been concentrated among a few high-cost users of health care,prospective payment systems may provide incentives to selectively reduce expenditures on high-cost users relative to low-cost users and this pressure may be increased by competition. We use data on hospital charges and cost-to-charge ratios from California in 1983 and 1993 to examine the effects of competition on costs for high and low cost admissions before and after the establishment of the Medicare Prospective Payment System (PPS). Comparing persons above and below age 65 before and after the establishment of PPS, we find that competition is associated with increased costs before PPS in both age groups, but decreased costs afterwards, especially among those above age 65 with the highest costs. We conclude that the combination of competition and prospective payment systems may result in incentives to selectively reduce spending among the most expensive patients. This raises important issues relevant to the use Of competition and prospective payment to control costs and implies at minimum the need to carefully monitor outcomes for the sickest patients under prospective payment systems in competitive environments.

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INTRODUCTION

After a half-century of extraordinary growth in health care expenditures in the United States, there is now evidence that health care spending growth is slowing. Why this is occurring and how long it may last is not known, but a substantial literature suggests that two key elements of the efforts to contain costs may have played a role: the use of prospective payment systems (Russell and Manning, 1989) and the encouragement of competition among providers (Melnick and Zwanziger, 1988). Indeed, the combination of these two approaches seems to be particularly important, since competition in the absence of prospective payment systems has been suggested to increase costs (Robinson and Luft, 1985), and prospective payment in the absence of competition provides no financial incentive to provide quality care.

While most theoretical discussions of the effects of prospective payment hinge on the incentives to provide lower levels of care under fixed reimbursement and do not discuss the differential incentives to provide care to different types of patients,[1] a few theoretical examinations of prospective payment have also incorporated the differential incentives for spending on profitable or unprofitable patients (e.g. Allen and Gertler, 1991; Ellis, 1998). Meanwhile, a number of empirical studies have examined the differential effects of prospective payment systems on low and high-cost patients. For example, Ellis and McGuire (1996) show how prospective payment for mental health services under Medicaid in New Hampshire resulted in reduced expenditures selectively among the sickest patients. In the context of the Medicare Prospective Payment, Newhouse (1989) finds that, while patients in unprofitable DRGs were not more likely than other patients to be transferred under PPS, they are more likely to be found in "hospitals of last resort", suggesting that there is patient

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[1] For standard textbook discussion, see Peter Zweifel and Friedrich Breyer, Health Economics, Oxford Press, New York, 1997; Charles Phelps, Health Economics 2nd Ed., Addison Wesley, Reading MA, 1997.

selection according to profitability. Similarly, Meltzer and Chung (2000) show that hospital spending for the elderly in California under Medicare PPS was selectively reduced among the most expensive patients. Indeed, these reductions occurred despite an overall pattern among the young and among the elderly prior to the implementation of Medicare PPS for cost growth to be greatest among the most expensive patients, as reflected in the increasing concentration of health care expenditures over this century (Cutler and Meara, 1998). Moreover, Meltzer and Chung show that this same pattern of selective cost reduction for the most expensive patients is present within the 12 largest Diagnosis Related Groups (DRGs), the categories by which Medicare reimburses hospitals under PPS.

That prospective payment systems may lead to a redistribution of resources from sick and costly persons within a payment category to healthier and more profitable ones cuts in many ways against a fundamental idea behind prospective payment systems in that the profitable patients are supposed to subsidize the costs of the unprofitable ones. Nevertheless, competitive pressures could lead to such an outcome as hospitals that attempt to support the care of unprofitable patients with revenue from profitable patients find the profitable patients wooed away by other hospitals that have chosen to invest resources in amenities that may appeal to patients and their doctors, but that are not necessarily related to better outcomes for the most severely ill.

In this paper, we use California data on patient charges and hospital cost-to-charge ratios from 1983 and 1993 to explore the effects of competition under prospective payment on hospital costs for low- and high-cost admissions for the 12 largest Diagnosis Related Groups. Since the Medicare Prospective Payment System (PPS) was implemented nationwide almost simultaneously, we have to identify the effects of PPS mainly through comparison of the effects of competition before and after the implementation of PPS. However, to attempt to separate out the effects of PPS from temporal changes in the effects of competition, we also contrast the effects of competition on costs for admissions for persons older than 65 with the effects of competition on costs for persons younger than 65. Complicating this analysis is the fact that this period was also a time of important change in the organization and financing of health care for those below age 65 in California. In particular, the development of a selective provider contracting program and per-diem reimbursement system by California Medicaid program (Medi-Cal), and the increasing use of managed care arrangements were important suppressing hospital cost growth among the young in California over this period.

Although we cannot prove that the patterns we observe are due to Medicare PPS, we find clear evidence that increased competition was associated with increased costs among the elderly before the implementation of PPS, but decreased costs afterwards, with the reductions in costs clearly much greater among high-cost admissions than among low-cost admissions. This is consistent with the idea that the incentives created by Medicare PPS may have selectively reduced expenditures on the high-cost elderly.

We begin in Section I with a short overview of the most important cost-containment efforts prevailing in California during this period: the Medicare Prospective Payment System (PPS), the California Medicaid selective provider contracting program, and the expansion of managed care. The description of PPS provides the institutional context for the effects of PPS we aim to investigate, while the discussion of the changes in reimbursement strategies among the young provides some insight into the use of the temporal changes in the effects of competition on costs for the young as a comparison. In Section II, we develop the theoretical motivation for our analyses using a model of provider response to fixed-rate, prospective reimbursement in which quality can be varied for patients who differ in their underlying severity of illness and, hence, profitability. In Section III we describe our data, and in Section IV we present the results of our analyses of the effects of competition on cost. Section V concludes and examines the implications of our work for the design of reimbursement strategies, for quality assessment, and for outcomes research.

Section I – Background on Cost-Containment in California, 1983 – 1993

Between 1983 and 1993, diverse cost-containment strategies were undertaken in California which led to a widespread transition to prospective payment systems as well as intensified hospital market competition.[2] Here, we briefly discuss major cost containment strategies that were implemented over this period: the Medicare Prospective Payment System (PPS), selective provider contracting between California's Medicaid program (Medi-Cal) and health care providers, and the expansion of managed care arrangements.

Medicare PPS

Prospective payment systems certainly existed prior to the establishment of the Medicare Prospective Payment System beginning in 1983. Nevertheless, the scale and influence of Medicare made the shift from retrospective reimbursement on the basis of reasonable costs to PPS a change of fundamental importance for hospitals. With the establishment of PPS, reimbursement for almost all hospitalizations under Medicare came to be made on the basis of prospectively fixed rates according to diagnosis-related groups

[2] For a good summary of the cost-containment in California during the 1980s, see Langa, 1992.

(DRGs). Each hospitalization is assigned a DRG based on principal diagnosis or the performance of a very limited number of particularly costly procedures, such as coronary artery bypass graft surgery. Each DRG is assigned a fixed weight that reflects its relative cost of treatment with respect to a base rate. Because hospitals are paid a fixed amount per DRG based on the DRG weight, the classification system was designed to create groups of patients as homogeneous as possible with respect to resource consumption. To this end, DRGs were also stratified with respect to age and the presence of complicating conditions. After a phase-in period over the course of four years during which reimbursement reflected a mix of national, regional, and facility-specific rates (Smith and Fottler, 1985), hospitals were reimbursed for each case according to the national average cost of treating a base case (with adjustments to reflect location and local wages) multiplied by the DRG weight (Davis et al., 1990). Thus, reimbursement under PPS was fully prospective from the onset, but the persistence of differences in reimbursement rates based on historical costs meant that the competitive aspects of the effects of PPS increased progressively over its phase-in.

Medi-Cal Selective Provider Contracting

The same year that Medicare PPS was implemented, California enacted legislation authorizing the state Medicaid program, Medi-Cal, to negotiate contracts with health service providers for the care of Medi-Cal beneficiaries. This was done with the intent to promote price competition in the Medicaid market. Under this legislation, eligible, short-term, acute-care general hospitals were offered the opportunity to negotiate service provision contracts with Medi-Cal on the basis of fixed per-diem rates (Johns, 1985). Failure to secure a contract meant that hospitals would not be reimbursed for care given to Medi-Cal patients except in cases of emergency (Langa, 1992). Though the per-diem reimbursement established under this legislation did not result in a fully prospective payment system for Medi-Cal patients, the resulting declines in Medi-Cal reimbursement also intensified the competitive pressures on California hospitals during this period.

Expansion of Managed Care

During the 1980s, managed care spread rapidly throughout the U.S., but particularly in California. By 1988, California ranked first in the nation in terms of its HMO enrollment rate, with roughly 28.5 percent of the state population (7.68 million individuals) belonging to an HMO. This was more than double the national enrollment rate in 1987, when only 12.1 percent of the U.S. population was enrolled in an HMO (Davis et al., 1990), and even well above the national rate of 19.7 percent in 1994 (I.O.M., 1997). Likewise, the number of Preferred Provider Organizations (PPOs) in California grew 94 percent from 34 PPOs in 1984 to 72 in 1988 (Johns, 1989).

Some managed care payers adopted prospective payment systems for hospital care similar to Medicare Prospective Payment. However, the majority adopted other approaches to cost control such as selective contracting, per diem reimbursement, and utilization review that did not necessarily provide any particular incentive to decrease expenditures for high cost users relative to low cost users (Gold et al., 1995)[3]. Nevertheless, many aspects of managed care served to further intensify competition in California during these years.

Indeed, the empirical evidence available suggests that Medicare PPS, Medi-Cal selective contracting and managed care arrangements all contributed to curbing cost growth. From 1967 to 1984, Medicare hospital care expenditures had been growing at an average annual rate of 16.5 percent: in the seven years immediately following PPS growth fell to 7.3 percent (Davis and Burner, 1995). Based on projections of Medicare expenditures, Russell and Manning (1989) estimated savings of 12 to 18 billion dollars for 1990 under PPS. Medi-Cal selective contracting in California also appears to have been largely successful in raising the level of competition in hospital markets while simultaneously suppressing cost growth (Johns, 1989; Robinson and Phibbs, 1989; Melnick et al., 1992). Additionally, the growth of managed care organizations also contributed to lower cost growth, both by delivering health care at lower costs due to lower service intensity (Manning et al., 1984) and by increasing competition in hospital markets (Melnick and Zwanziger, 1995).

Thus, between 1983 and 1993, hospitals in California became increasingly subject to prospective payment systems as a result of Medicare PPS, and increased competition due to the effects of Medi-Cal selective contracting and the growth of managed care. It is in this context that economic theories of provider behavior under prospective reimbursement suggest incentives to decrease expenditures on high cost patients while increasing expenditures on low-cost patients, as we explore below.

Section II - Economic Theories of Provider Behavior under Fixed-Rate Prospective Payment Systems

Many cost-containment strategies rely on supply-side cost-sharing to achieve cost-containment objectives. Whereas retrospective reimbursement systems largely insulate providers from increases in costs, providers under prospective payment system are paid a fixed rate per unit of output defined in advance.

[3] A detailed overview managed care forms can be found in Gold et al., 1995.

If the patient population is taken as given, such payment schemes that hold providers financially responsible for the marginal costs of treatment can create incentives to reduce provision of unnecessary services to patients. This is reflected by the common view of managed care as reducing services. What is less appreciated, however, is that when providers have to compete for patients, prospective payment systems also create a new distinction among patients: namely, one between profitable and unprofitable patients depending on their expected costs relative to the level of prospective reimbursement (Newhouse, 1989). Thus, when profit-maximizing hospitals under fixed-rate prospective reimbursement face a patient population of variable illness within a reimbursement category, they may have incentives to provide excessive levels of care for the less-ill, and/or to choose and advertise quality of care or amenities that differentially attract these profitable patients while avoiding unprofitable ones (Hornbrook and Rafferty, 1982; Ellis and McGuire, 1986; Dranove, 1987; Luft and Miller, 1988; Newhouse, 1989; Hodgkin and McGuire, 1994; Ellis, 1998).[4] When intensified competition decreases overall profit levels and increases the price-responsiveness of patient volume, such strategies may become matters of institutional survival. Thus, as Ellis (1998) has shown, incentives to engage in patient selection and discrimination in quality provision are exacerbated under increased competition, a condition that has been realized in many U.S. hospital markets in recent years with greater market penetration by managed care organizations (Ellis, 1998; Dranove and White, 1994).

The empirical implication of these theories is that, where providers are subject to fixed-rate prospective payment systems, declines in hospital cost growth will be concentrated

[4] This may in practice be implemented by increasing spending on infrastructural elements that may be most important to health patients (such as a pleasant cafeteria or waiting area), and decreasing spending on infrastrucure that is most important to the sickest patients (such as expensive imaging machines, or intensity of

at the top of the spending distribution. In other words, high-cost (unprofitable patients) will experience greater reductions in resource consumption relative to low-cost (profitable) patients. Furthermore, these effects will be magnified under competition.

To illustrate this, we develop the following model of choice of quality of care for patients with differing severity of illness (s) given a prospective payment rate (P). Specifically, we model the choice of quality of care for patient of severity s (q_s) at cost $c(q_s)$. To capture the variation in costs of patients who differ in severity of illness, we allow the cost of providing basic care to also depend on severity (c(s)). Thus the total cost of caring for a patient of severity s is $c(s) + c(q_s)$, where the first component is non-discretionary and the second is subject to choice depending on the desire to provide additional quality. Thus we model the profit from caring for a patient of severity s ($\pi(s)$) under prospective payment as:

$$\pi(s) = P - c(s) - c(q_s) \quad (1)$$

where:

P = prospective payment rate

c(s) = basic cost of caring for patient of severity s ($c_s > 0$, $c_{ss} > 0$)

q_s = quality of care provided to patient of severity s

$c(q_s)$ = cost of added quality of care to patients of severity s ($c(0)=0$, $c_q > 0$, $c_{qq} > 0$)

To go from this patient level-profit to the profit of caring for the class of patients of severity s, we allow the demand for care by patients of severity s when quality is q_s to be $D(q_s,s)) = D(q_s)$ ($D_q > 0$, $D_{qq} < 0$). Thus the hospital chooses chooses q(s) to maximize profit:

$$\underset{q_s}{Max}\ \Pi(q_s) = D(q_s)\left[P - c(s) - c(q_s)\right] \qquad (2)$$

ICU care). It might also be implemented by reducing pressure on physicians to rapidly discharge relatively

Taking the first order condition with respect to q_s, profit maximization results in the condition that hospitals set the marginal revenue from additional quality equal to the marginal cost:

$$D'(q_s)\left[P-c(s)-c(q_s)\right]-D(q_s)\,c'(q_s)=0 \quad (3)$$

which implies:

$$\frac{\left[P-c(s)-c(q_s)\right]}{c(q_s)}=\frac{1}{\frac{D'(q_s)q}{D(q_s)}}\frac{c'(q_s)q_s}{c(q_s)}=\frac{\varepsilon_{c,q_s}}{\varepsilon_{D,q_s}} \qquad (4)$$

Totally differentiating, and checking the second order conditions demonstrates:

$$\frac{dq_s}{ds}=\frac{D''(q_s)\left[P-c(s)-c(q_s)\right]-2D'(q_s)\,c'(q_s)-D(q_s)\,c''(q_s)}{D'(q_s)c'(s)}<0 \quad (5)$$

as long as $P\text{-}c(s) \geq 0$, and $q_s = 0$ otherwise. Thus discretionary quality falls with severity for all profitable patients, and is set to zero for all unprofitable patients.

Comparison to retrospective reimbursement

Since one of the empirical comparisons we will make is between prospective reimbursement and retrospective reimbursement, it is useful to contrast this result with what would be expected under a retrospective reimbursement system. In particular, instead of a fixed price P, independent of severity and quality, a retrospective reimbursement system may in general depend on both (e.g. $P(s,q_s)$). Under some circumstances, this makes the comparison between prospective and retrospective reimbursement easy, in others it is more difficult. To illustrate this, assume $P(s,q_s)$ takes the general form $P(s,q_s)= P_0 + P_s\, c(s) + P_q\, c(q_s)$, where P_0, P_s, and P_q are the rates at which hospital are reimbursed for, respectively the

healthy patients.

basic admission (as in prospective payment), expenditures on severity-related costs, and expenditures on discretionary dimensions of quality (e.g. amenities). In general, the latter two categories may be hard to distinguish among in practice, but the distinction is worth making to reflect the idea that there may be some expenditures that might not be fully covered under a retrospective reimbursement system, but nevertheless desired by hospitals in order to attract patients.[5] For our purposes, the most straightforward case is when reimbursement provides a fixed amount of profit per admission by providing a lump sum profit (K) per admission and exactly reimburses severity-related costs while not covering quality-related costs. In that case, P_0=K>0, p_s=1 and p_q=0, so Equation 4 becomes $[K-c(q_s)]/c(q_s)= \frac{\varepsilon_{c,q_s}}{\varepsilon_{D,q_s}}$ and quality is independent of s. In this case, the shift to prospective payment would be expected to decrease spending for more expensive patients relative to less expensive ones.

Perhaps even more relevant is the case in which retrospective reimbursement provides no fixed profit per admission but instead offers a markup over costs for severity-related costs, e.g. P_0=0, P_s>1, and P_q=0. In this case, equation 4 becomes $[P_s c(s)- c(s)-c(q_s)]/c(q_s)= \frac{\varepsilon_{c,q_s}}{\varepsilon_{D,q_s}}$, and $\frac{dq_s}{ds}>0$. Thus, with P_s>1, hospitals make more profit on more expensive patients and therefore will spend more on quality for the more expensive patients. Again, the switch to prospective payment will lead to a reduction in spending among the sicker patients.

Finally, it is also worth considering a system in which no fixed profit per admission is given but all costs related to both severity and quality are reimbursed retrospectively with a markup. Some might consider this most like the retrospective reimbursement system as it

[5] The classic example of this is are the free car seats sometimes offered to expectant parents in order to attract

applied prior to prospective payment. In this case, $P_0=0$, $P_s = P_q>1$ and equation 4 becomes

$$[P_s c(s) + P_q c(q_s) - c(s) - c(q_s)]/c(q_s) = [(P_s - 1)\,(c(s)+c(q_s))]/c(q_s) = \frac{\varepsilon_{c,q_s}}{\varepsilon_{D,q_s}}, \text{ and again } \frac{dq_s}{ds} > 0 .$$

This is would seem to suggest again that quality would rise with severity. It is misleading, however, because with full retrospective reimbursements for amenities, the hospital has no incentive to limit expenditures on amenities so the second order conditions actually imply that the optimal quality is infinite for all patients. Thus, there must be some other constraint on the reimbursement of discretionary care, which seems most likely to be a combination of the possibility of doing harm to the patient (and associated risk of liability), and whatever limits are placed by the payer. Whichever is the case, it is not possible how to predict prospective payment will affect discretionary expenditures on low- and high-cost patients.

Summarizing, except in the case where discretionary expenditures are not limited by economic incentives, there appears to be a fairly broad set of assumptions under which prospective payment would be expected to selectively reduce expenditures for the most expensive patients relative to retrospective reimbursement.

Effects of Competition

Equation 4 implies that that the ratio of profit to cost for quality falls with increasing elasticity of demand with respect to quality so that, accordingly, quality rises with increasing elasticity of demand with respect to quality. Since the out-of-pocket cost of a hospitalization to a Medicare patient is independent of the hospital they choose, it seems likely that competitive pressures will make this elasticity be quite large, though such competitive forces will surely be limited by geographic factors in areas where there are few hospitals so that

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them to deliver their child at a particular hospital.

patient options are limited because of high search and transportation costs and where changes in quality are more likely to be coordinated (Stigler 1968; Bain 1951; Tirole 1988; White 1972).[6] Rearranging Equation 4 to solve for $c(q_s)$ yields:

$$c(q_s) = \frac{\varepsilon_{D,q_s}}{[\varepsilon_{c,q_s} + \varepsilon_{D,q_s}]}[P - c(s)] \quad (6)$$

Since quality is set to a minimum for unprofitable patients, this applies where patients are profitable so the numerator is positive, and quality for profitable patients rises with the degree of competition. As above, quality falls with increasing severity, and here the rate at which expenditures on quality fall with increasing severity is seen to rise with increasing elasticity of demand with respect to quality (e.g. competition) so that the positive effect of competition on costs is reduced for more costly patients. Thus, an increasingly competitive environment under prospective payment has the effect of raising quality most for the least costly patients. Since competition under prospective payment may also increase efficiency, this may not result in an absolute increase in costs, but should at least lessen cost decreases for the least expensive patients relative to the most costly patients, for whom the clear incentive is to reduce expenditures if possible because they are not profitable. Indeed, in the limit, as the elasticity of demand with respect to quality approaches infinity, expenditures on quality fall dollar-for-dollar with increasing severity of illness as all profits are competed away at each level of severity.

[6] Note however, that the relationship between competition and quality in general may be much more complex than this in settings where both price and quantity may be varied because it will also depend on the complementarity between quantity and quality (Spence, 1975; Saving, 1982). Another alternative view is reflected in Satterthwaite (1979), in which an increasing number of sellers in a market effectively raises search costs by decreasing the value of information held by any individual about a particular seller.

Section III - DATA AND METHODS

Data Description

Cost and Financial Data

We use the 1983 and 1993 hospital discharge and financial data released for public use by the California Office of Statewide Health Planning and Development (OSHPD). The financial data is described in detail below. The discharge data cover all inpatient discharges from every licensed, non-federal hospital in California, as well as discharges from some specialized facilities such as psychiatric hospitals, rehabilitation, and nursing facilities. Data elements available for each patient abstract in the public use files include: facility identifiers, patient's age, zip code of patient's residence, expected source of payment, total charges incurred during the hospitalization episode, and patient's Diagnosis Related Group classification (DRG). Additional data for calculating per capita spending and utilization rates come from the U.S. Bureau of the Census Intercensal Population Estimates by Age, Sex, and Race (U.S. Dept. of Commerce, Bureau of the Census, 1993, 1998).

We limit our analysis to all California State residents (identified by zip code) discharged from acute-care facilities for which data on total hospital charges are available. Certain institutions, many of which are managed care facilities such as Kaiser hospitals, do not report total charges on their discharge abstracts because they are exempt from standard OSHPD accounting procedures. As a convention, patients discharged from these hospitals have zero charges recorded in their abstracts, although true costs were non-zero. Since total hospital charges for these patients can not be ascertained, they are excluded from our analyses.[7]

To calculate costs, we begin with charge data that we convert to 1993 constant dollars using the general Consumer Price Index and then to costs using an annual institution-specific ratios of costs to charges (RCCs). These RCCs are calculated using the OSHPD Financial Disclosure Data, which reports facility-level data on total operating expenses, gross patient revenue, and other non-operating revenue. Because other non-operating revenue consists of revenue from hospital enterprises such as the outpatient pharmacy and gift-shop, we follow the approach recommended by OSHPD (1993) in calculating the facility-specific RCC as:

RCC = (Total Operating Expenses-Other Non-operating Revenue)/Gross Patient Revenue.

Although RCCs are commonly used to estimate costs based on charges, the fact that OSHPD data does not permit disaggregation of inpatient charges into its component departments and services so that institution-level RCCs must be used, is an important limitation since they cannot reflect discrepancies between costs and charges that arise because of internal cross-subsidization across departments and services within a facility. Nevertheless, facility-level RCCs can adjust for certain discrepancies between costs and charges, such as if a facility treats a large proportion of charity cases (Finkler, 1982), and have been found to perform somewhat better than charges as proxies for costs (Newhouse, Cretin and Witsberger, 1989; Schwartz, Young and Siegrist, 1995). While this suggests some justification for analyzing RCC-adjusted charges rather than raw charges, the most compelling reason during the period we study is the growing inflation of rates charges to full paying customers and concomitant use of rebates for managed contracts, so that charge growth based on charges

[7] Discharges from managed care facilities exempted from standard accounting requirements were identified in the data by a zero recorded in data field for total charges, although actual charges were non-zero. In total, this

will overstate real cost increases (Dranove et al., 1991). The advantage of using cost-to-charge ratios in this case is that increases in gross patient charges that are offset by increases in rebates result in a decrease in the cost-to charge ratio a calculated above, so that estimates of costs based on patient-level charges and RCCs are not inappropriately inflated by the use of rebates.

In addition to the effects of discrepancies between costs and charges on aggregate charge growth, it is also important to consider the possibility that such discrepancies could have effects on costs across the spending distribution if they do not apply uniformly across it. Indeed, it is possible that the discrepancy between costs and charges could vary across the spending distribution. For example, if the mark-up on low cost services and departments exceeds the mark-up on high-cost services and departments, then the actual distribution of costs across patients will be more concentrated than suggested by the distribution of charges. Though it is not clear that it is the case, it is possible that such mark-ups might change over time – for example if competition is particularly intense in high-cost services so that cost containment differentially reduces charges in these area. If so, it is possible that an analysis of hospital charges may overstate costs at the bottom of the distribution in later years, and understate costs at the top of the cost distribution.

Although this would lead to patterns in hospital costs similar to those we find, we do not believe that internal cross-subsidization drives our results because we study a period in which all payers were tightening their reimbursement policies, thereby imposing a constraint on the extent to which hospitals could shift costs to other payers and departments. Indirect support for this comes from Dranove and White (1998), who studied the responses of hospitals in California to Medicaid fee reductions between 1983 and 1992 and found

involves omitting 8.8% of discharges.

significant reductions in levels of services provided to all patients, and Medicaid patients in particular, but no evidence of cost-shifting. The ideal data to test this would allow us to assess whether rebates were more likely for sicker patients within a hospital, but the available data do not permit this disaggregated analysis because rebates are not made on a patient level basis. However, as an alternative check, we examined whether hospitals in the OSHPD data that care for sicker patients as measured by either greater average age, length of stay or in-hospital mortality were likely to give greater rebates to payers as a percent of net revenue. Our results suggest no evidence of any significant relationship or change in relationship over time between rebates and age or length of stay, but do suggest a positive relationship between rebates and mortality in the first six years we study that is eliminated by the end of the period. While this latter result could suggest an artificial inflation of costs for the sickest patients initially that is later eliminated, the effect is not large.

Thus, while there are possible reasons to be concerned that changes in the relationship between costs and charges across patients that differ in severity of illness could influence our results, we cannot find evidence of any changes in such relationships.

Limitations of Cost and Financial Data

Several data and analytic limitations should be recognized at the outset. First, the 1983-1993 period was one during which hospital accounting and reimbursement systems were in flux. Hospitals are instructed by OSHPD to report the total charges incurred during a patient's hospitalization according to the facility's full-established rates prior to any prepayment deductions. At a minimum, hospitals are to include all charges associated with daily hospital services, ancillary services, and patient care services in calculations of total inpatient charges per discharge. Physician fees are omitted. Due to the volume of discharges processed, OSHPD does not conduct comprehensive accounting checks; hence the reliability of reported data on charges is not known. Nevertheless, the OSHPD charge data has been widely used by a variety of researchers (for example: Dranove and White, 1998; Melnick and Zwanziger, 1995; Langa and Sussman, 1993; Langa, 1992; Stafford, 1990; Robinson and Phibbs, 1989).

Another issue relates to our lack of data concerning charges associated with outpatient care and forms of post-discharge care. Since the introduction of PPS and managed care, many have speculated that any decline in hospital spending may be offset by growth in other sectors such as ambulatory and long-term care. Since we are unable to account for cost-shifting across sites of delivery, our finding that growth in hospital charges fell among high-cost admissions does not imply that the total cost of treatment among high-cost admissions also fell, since these patients may be heavy consumers of post-discharge health care resources. However, we found no tendency for differential cost reduction among high cost admissions with increasing competition in diagnoses with high or increasing levels of discharge to skilled nursing facilities. Moreover, even if such a pattern were found, it could be understood as providing insight into a mechanism by which quality discrimination was accomplished.

A final point concerns the period over which we have data to analyze. The earliest data we have date back to 1983, the year in which Medicare's DRG-based Prospective Payment System was implemented, and legislation authorizing selective contracting between Medi-Cal (California's Medicaid Program) and service providers took effect. Also, throughout the 1983-1993 period studied, HMOs and a variety of other managed care organizations emerged and proliferated. Because we do not have comparable data that antedate these major changes and because important changes were happening in the reimbursement strategies for younger persons at the same time, it is important to be cautious in drawing a causal connection between these specific policies and observed trends in charge growth. On the other hand, because Medicare PPS, Medi-Cal, and managed care all rely on different approaches to achieve cost containment, we can borrow insights from the theoretical models of provider responses to alternative reimbursement systems described above in interpreting our findings.

Despite these limitations, the OSHPD data offer an opportunity to study growth in hospital charges over ten consecutive years. Particularly advantageous are the availability of data through the early 1990s and across patients above and below age 65, enabling us to extend research examining the long-term effects of widespread movement towards fixed-rate prospective payment by contrasting the pattern of cost growth of older persons affected directly by prospective payment with that of younger persons.

Measures of Competition

A large literature exists attempting to identify the appropriate measures of markets and competition within health care. Key debates in this literature include how one defines a market (e.g. by county, distance, patient flows, or economic measures such as cross-price elasticities), whether one is interested in competition at the hospital level, medical service level, or patient level, and what mathematical measure of concentration is used (e.g. Herfindahl Index, entropy measure, etc.).[8] Although these approaches may differ in their

[8] There is a large literature on defining hospital markets for the purpose of measuring competition. Traditional measures have included market definitions based on geopolitical boundaries such as counties or metropolitan statistical areas (e.g. Joskow (1980)), distance (Robinson and Luft (1985)), or patient flows (e.g. Melnick and

theoretical appeal both in general and in individual applications, expediency has often been a prime criteria by which measures of competition are selected, and by far the most common approach chosen has been to calculate Herfindahl indexes for total admissions at the county level.[9] In the analyses reported here, we follow this same approach. Several studies have examined the robustness of the effects of competition to the measure chosen and some have found that their results depend on the definition of competition chosen (e.g. Dranove, Shanley, and Simon, 1992.; Sohn, 1996; Kessler and McClellan, 1999). As a result, we also plan in future work to attempt to repeat our analyses with alternative measures of competition.

Analytic Plan

To analyze the effects of competition across the distribution of health care expenditures, we include measures of competition in quantile regressions of cost for patients above and below age 65 before the implementation of PPS in 1983, and in 1993. Our basic hypothesis is that competition under PPS will exert a downward pressure on costs among the most expensive elderly patients in 1993 relative to its effects among the less expensive elderly in 1993, relative to the expensive elderly in 1983, and relative to its effects among the young. To pick the most appropriate comparison group among the young, we focus on persons age 55-64, though our results are not substantially different when we include persons age 5-64. Since our theory does not specify a specific measure of concentration and since we have no reason to suspect a linear relationship between any particular measure of concentration and

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Zwanziger (1988)). These measures have all been criticized for varying reasons, including the (ir)relevance of geopolitical boundaries or distance with respect to competition, and the endogeneity of patient flows. While some newer approaches have tried to address these concerns (e.g. Kessler and McClellan, 1999), such approaches are substantially more difficult to implement, and their merits have not yet been demonstrated. While a comparison of multiple measures of competition would be of value, we therefore defer it for future work.

costs, we define a set of indicator variables to categorize counties as competitiveness based on the Herfindahl Index (Less Competitive (HI>0.2), Moderately Competitive (0.2>HI>0.1), Competitive (0.1>HI>0.05), Very Competitive (HI<0.05). We also control for payer (Medicare, Medi-Cal, Other non-private, and private), and a variety of market-level and hospital characteristics. The market level characteristics are: log physicians per capita, log HMO enrollment rate, log county population, and log average per capita income. Hospital level characteristics are ownership status (for-profit vs. not for-profit), teaching status (teaching hospital vs. non-teaching hospital), number of licensed beds, and total number of annual discharges. In our basic specification we do not control for patient characteristics such as age and comorbidity because PPS does not base much if any of reimbursement on those factors. As a result, selectively caring for patients who are younger or have less comorbidity may be a mechanism by which hospitals respond to PPS and limit costs, so that controlling for those variables could mask the effect we aim to identify. In alternative specifications, we also include patient age and the number of secondary diagnoses, and find little change in our overall results.

We limit our analyses to 12 highest-volume DRGs, which we define as those with at least 10,000 discharges over the age of 4 in 1983 and 1994 combined. An important concern in this analysis relates to the incentives under Medicare PPS for hospitals to engage in 'DRG creep', i.e. progressively up-code patients into DRGs with a higher reimbursement rate for a given condition (Carter, Newhouse, and Relles, 1990). As a result, changes in charges within each stratified DRG might reflect trends in coding and classification rather than changes in service provision. To address this concern, we aggregated DRGs for the same procedure

[9] See also Stigler (1968) and Cowling and Waterson (1976) for theoretical rationale for the use of the Herfindahl index.

and/or condition that are stratified for severity in calculating utilization rates and growth in charges.[10]

Adjustments for changes in discharge rates

In order to know how to interpret changes in the effects of competition at different points in the spending distribution over time and also to generate meaningful estimates of cost growth over time at different points in the spending distribution, it is important to consider the dramatic decline in admission rates in California over this period, since a given position in the spending distribution may reflect a different degree of severity in different years. The California data show that per capita hospital discharge rates declined steadily from 112 discharges per 1,000 total population in 1983 to 69 discharges per 1,000 total population by 1994. The decline in California's discharge rates is consistent with national utilization trends, which began slowing in the 1970s but declined even further since the 1980s. Much of the decline has been attributed to more widespread use of utilization control mechanisms by Medicare, state Medicaid programs, managed care and other third party payers. These controls include peer-review organizations, physician gatekeepers, and pre-certification requirements employed by Medicare and other third party payers. In California especially, declining rates of discharges may also reflect the expansion of HMO enrollment and the shift of many services to outpatient settings.

Assuming stable population morbidity from year to year, a falling admission rate implies that in each successive year, a smaller proportion of episodes of illness result in

[10] Another possibility would be to analyze the effects of competition on cost growth within ICD-9 codes. However, we elected not to do this because the incentives created by Medicare PPS that may differentially affect high and low cost patients refer to high and low cost patients within DRG groups rather than within ICD-9 codes.

hospitalization. If one were to rank all admissions in order of increasing severity of illness, it would be reasonable to assume that, given the nature of utilization control measures, the distribution would tend to be truncated from the left, leaving the least severely ill episode denied hospital admission. Hence, not only does the proportion of the population experiencing hospitalization shrink over time, but the average severity level of the hospitalized population would be expected to increase as well because there are fewer 'healthy' admissions to dilute the spending distribution.

Figure 2 illustrates how shifts in utilization rates can complicate intertemporal comparisons of expenditures at specific locations within the population spending distribution. The X-axis plots the percent of population ranked in order of increasing severity of illness. The Y-axis plots the frequency or number of individuals at each severity level. The curves in Figures 2a and 2b depict the distribution of illness in a given population at two time points, (Year 0 and Year 1), which we assume to be stable. H_0 and H_1 represent the discharge rates in Year 0 and Year 1, respectively. In this hypothetical population, the top 50% of the population ranked in terms of morbidity were hospitalized in Year 0. In Year 1, the admission rate fell to 40%.

Suppose we wish to compare effects on median hospital charges between Year 0 and Year 1. In Year 0, the median discharge (M_0) was the patient at the 75th percentile of the disease distribution. In Year 1, the median discharge (M_1) was at the 80th percentile of the disease distribution. Because of the falling discharge rate between Year 1 and Year 2, these two discharges are not directly comparable. This is seen in Figure 2 by the dotted line that traces M_0 down to the disease distribution in Year 1, and by the dotted line that traces M_1 above to the disease distribution in Year 0. Thus, the median discharge in Year 0 was less ill than the median discharge in Year 1. Without taking into account falling discharge rates, a simple comparison between the median hospitalizations in Year 0 and Year 1 will compare patients that differ in their severity of illness.

To address this concern due to falling admission rates, we also performed all our analyses based on adjusted percentiles in which we aim to compare persons with comparable levels of severity of illness. Therefore, we examine growth rates or the effects of competition at adjusted percentiles wherever discharge rates fell between two time points according to the formula:

$$P_0 = [(H_0 - (H_1*(1-P_1))/H_0]*100$$

where P_0 is the adjusted percentile in the earlier time period (Y_0), P_0 is the percentile in the later time period (Y_1), and H_0 and H_1 are the discharge rates in the two corresponding years. For example, to compare costs at the median of the spending distribution of the hypothetical population, we should compare the median discharge in Year 1 to the discharge at the 60^{th} percentile of discharges in Year 0 (60=[(50–(40*(1.5)))/60]*100. We use this approach directly to calculate growth rates at different percentiles in the spending distribution. To analyze the effects of competition, we implement this adjustment by performing our regression analyses using the same number of observations drawn from the top of the distribution of the 1983 data as we have in the 1993 data.

Our method of adjustment exploits the fact that discharges fell over time, and that utilization control mechanisms typically raised the threshold of illness severity for hospital admission. This raises several potential problems. One is that in DRGs in which discharge rates rise over time, it is not clear whether expanded services were extended to the less severely ill, or if improvements in technology and medical management enabled treatment of a greater number of the severely ill who would otherwise have remained untreated. Thus, in analyzing spending growth for the few DRGs where admission rates rose, we use all the observations from 1983 and analyze only unadjusted percentiles.

Probably more important is the possibility that reductions in admission did not come uniformly from the left tail of the distribution during this period. In an extreme example, suppose that, although we assumed the reduction of 43 admissions per 1,000 population between 1983 and 1993 came from the right of the distribution (the 'healthy' side), the reductions actually came entirely from the right side of the distribution. This might happen, for example, if the 43 fewer admissions in 1993 were terminally ill individuals who had been shifted into hospices but who would have died in hospitals at high cost in 1983. The top of the 1993 distribution would then be expected to have a lower average severity of illness level compared to the top of the 1983 distribution – the opposite of our assumption. This implies that an unadjusted comparison would understate growth, and that our adjustment procedure would further exacerbate this. Fortunately, for the diagnoses that we examine, we believe that most of the reductions in are due to the movement of less-severely ill patients to the outpatient setting. This is supported by the observation that the greatest declines in admission rates in our sample were among admissions for Esophageal and Gastrointestinal Disorders, which likely results from a movement towards treatment if the least severely ill patients to an ambulatory setting. It is also supported by additional analyses we performed that showed that the degree of comorbidity of patients in the DRGs we studied increased over our sample period.[11] Nevertheless, we also examined the robustness of our findings under the assumption

[11] Specifically, we calculated the Charlson co-morbidity index based on secondary diagnoses for the index admission, and found that the distribution of scores shifted upwards in all our DRGs (Charlson et al. (1987); Deyo and Romano (1993), and Romano et al. (1993)).

that the reduction in admissions is distributed evenly across the spending distribution by examining growth rates at the unadjusted percentiles.

Section IV – RESULTS

Distribution of RCC-adjusted Charges by DRG: 1983 and 1993

Tables 1 and 2 show the number of cases and distribution of costs in 1983 and 1993 for the 12 DRGs we examine. As Figure 1 shows clearly, the distribution of costs in every DRG is highly skewed to the right, with about two-thirds of all admissions having costs below the mean (Tables 1-2). This lays out the basic incentives implicit in PPS – that the majority of patients are profitable, while a minority are unprofitable but potentially responsible for large losses.

Growth of RCC-adjusted Charges by DRG: 1983 and 1993

Table 3 shows the growth of costs from 1983 to 1993 at unadjusted and adjusted percentiles for persons older than age 65. Although there are a few exceptions, the vast majority of the unadjusted and adjusted growth rates clearly show falling growth rates with increasing position in the spending distribution, as predicted by the theoretical predictions of the effects of prospective payment.

Table 4 repeats these analyses for persons age 55-64. While the pattern is not as strong in several diagnoses as for those persons above age 65, there is still a clear trend for falling growth rates with increasing position in the spending distribution. This is not as predicted by the theoretical model. We discuss possible reasons for this below.

Effects of Competition on Hospital Expenditures: 1983 and 1993

To limit the number of tables, we present the results of the competition analyses in full only for acute myocardial infarction (AMI), and only the coefficients on the competition variables for the remaining DRGs. Table 5 reports the quantile regressions for admissions for AMI for persons above age 65 in 1983 and 1993, while Table 6 reports regressions for AMI admissions for persons ages 55-64. Table 7 reports the coefficients on the competition variables from the quantile regressions for all 12 DRGs we examine for 1983 and 1993 for persons above age 65 and for persons ages 55-64. We begin with the panel on the left examining admissions for persons above age 65. Examining first the results for 1983, we see in every case that costs rise with increasing competition, and particularly for the most expensive admissions. This is consistent with the "medical arms race" literature, which suggests that under the retrospective reimbursement system in place at the beginning of the period we study, a more competitive hospital market will raise costs as hospitals compete to attract doctors and their patients by offering added services (Robinson and Luft, 1985). In contrast, in 1993, increasing competitiveness is associated with decreased costs in all 12 diagnoses. This consistent with prior findings such as those of Melnick and Zwanziger (1988), who found that costs fell by more than 11% for hospitals in the most competitive markets in California during this period, while actually rising in the least competitive markets. Not addressed in their findings, however, is the strong pattern we observe for the reductions in expenditures with increasing competition to increase progressively along the spending distribution, as predicted by the incentives of PPS to selectively reduce expenditures among the most expensive patients. For example, for AMI admissions among the elderly the highest level of competition is associated with \$8,338 lower costs at the 95th percentile, but only \$1,454 lower costs at the 25th percentile.

The right hand panel of Table 7 repeats the above analyses for persons age 55-64. In general, we still find strong positive effects of competition on costs in 1983, but in 1993 we find much smaller negative effects of competition on costs that are statistically significant for only 4 of the 12 DRGs. Several DRGs also show a statistically insignificant trend towards lower costs with competition, raising the question whether some of the difference may be due to reduced sample size. However, increasing the sample analyzed to include all persons below age 65 or adding additional years of data (e.g. 1992), did not meaningfully alter these results. This suggests that whatever forces led to changes in the distribution of hospital expenditures in these diagnoses among the elderly between 1983 and 1993 may have also affected those below age 65, though the effects do not appear to have been as powerful.

Adjustments for Changes in Discharge Rates

To address the concern that percentiles in one year may not be comparable to percentiles in another year due to changes in severity of illness, especially due to declines in admission rates due to the shift of inpatient services to the outpatient setting, we also examined quantile regressions for DRGs in which admission rates fell from 1983 to 1993 that limited the number of observation in 1983 to the number in 1993, so as to compare "comparable" patients assuming no change in the underlying distribution of disease. These were not substantively different than the regressions reported in Tables 5 and 6.

SUMMARY AND CONCLUSION

Summary

Using annual patient discharge data from all non-federal, acute-care hospitals in the State of California from 1983 and 1993, we examined growth in hospital costs and the effects of competition on costs at various points in the spending distribution for persons above and below age 65 for the 12 largest diagnosis-related groups. Our analyses of cost growth show cost growth falling with increasing position in the spending distribution in every DRG we studied, as predicted by the effects of Medicare PPS. However, a very similar pattern is also evident among admissions of patients age 55-64. Our analyses of the effects of competition show a strong trend for increasing competition to increase expenditures in all ages groups in 1983, with increasing effects at higher locations in the spending distribution. Our analyses for those above age 65 in 1993 show the opposite pattern, however, with increasing competition associated with decreased costs, and the effects far larger among the most expensive patients. Moreover, this pattern is not as pronounced among those below age 65, suggesting that spending on persons above age 65 during this period may have been subject to some forces different than those affecting spending on persons below age 65.

These findings are broadly consistent with the model of provider behavior under alternative reimbursement schemes that we present. This predicts a tendency for hospitals to 'skimp' on unprofitable patients and to 'milk' profitable patients under fixed-rate prospective reimbursement. Although a number of studies have documented lower resource utilization associated with fixed-rate reimbursement systems, fewer have considered the possibility that such reductions might differentially affect profitable and unprofitable classes of patients, and none have demonstrated these patterns of increasing cost reductions among high-cost patients for Medicare PPS, or shown that these reductions increase with increasing competition.

Limitations

Certainly the establishment of PPS and the associated incentives to selectively decrease costs among the most costly patients is a plausible explanation for the patterns we observe among the elderly, but several other possible explanations are worth considering. One is that there were changes in particular medical technologies or the underlying severity of illness among the elderly over this period that somehow selectively reduced expenditures for the high-cost elderly relative to the low cost-elderly. Concerning in this regard is the fact that we see a fairly similar pattern of growth rates among those age 55-64. It is not clear why this is the case, but it seems highly plausible that practice patterns are likely to be similar for older and younger patients, so that the incentives implicit in PPS end up affecting practice patterns for patients below age 65 as well. Moreover, if the changes in spending we observe are explained by some specific change in underlying severity of illness or medical technology, it is not clear why such changes should occur over such a broad range of diagnoses or be associated with increased competition. Also, in additional analyses we also stratified the elderly according to age and controlled for measurable aspects of underlying comorbidity using the number of secondary diagnoses, and found no changes in our results.

Another possibility is that our results may reflect changes in coding practices under Medicare, often referred to as "DRG creep". We have tried to address this concern in our analysis by combining related DRGs with and without complications, but it is possible that this does not capture all the changes that could have occurred. Indeed, one particular concern is that the development of the tracheostomy DRG in 1991 for patients requiring mechanical ventilation may have drawn some expensive patients out of the upper part of the distribution of costs of some of our DRGs. While this is important to consider, the fraction of all admissions in that DRG is only 0.1% to 0.2%, which seems too modest to explain the broad changes we see across the spending distribution for such a broad range of diagnoses. Also, some of the pattern we identify is clearly present by 1991, when the tracheostomy DRG was just being introduced. Moreover, it is somewhat surprising that such recoding would be present only in the most competitive markets, though certainly that would also be of interest if it were the case. It should also be noted that, to the extent that some of our diagnoses may be more highly reimbursed than other closely related diagnoses, they may also be the recipients of up-coding, in which case one would expect expenditures at the lower end of the distribution to decline as healthier patients are added to the distribution.

Finally, it should also be noted that our findings that cost reductions are largest for the most expensive patients might also be interpreted as simply reflecting that it is easier to save large amounts of money where more money is being spent. We are sympathetic to this concern, but note that we find a similar pattern of reductions in both our more and less expensive DRGs, and that it is not always the case that it is easier to decrease spending where more money is being spent. For example, in analyzing data from a natural experiment comparing the cost of hospital care provided by doctors who specialize in inpatient care to care by doctors who spend only a small fraction of their time taking care of inpatients, we found no evidence that cost savings differed across the distribution of costs (Meltzer et al., 2000).

Conclusions

With an understanding of the limitations of our analysis, it appears that increasing competition in the context of prospective payment is associated with selective reductions of expenditures for the most expensive patients. Whether this is desirable is impossible to determine without an analysis of the effects on outcomes. Nevertheless, our results suggest several clear lines for such analysis.

First, the possibility that costs are selectively reduced for the most costly patients suggests that outcomes may also be selectively affected. And while more than few studies have examined the effects of prospective payment on outcomes (e.g. Rodgers et al. (1990) and accompanying articles; Cutler, 1995), none has stratified outcomes according to patient cost. Our results suggest that such analyses might be very useful, since it is possible that adverse effects among the most costly patients might be masked by their inclusion along with less costly patients, whose outcomes may even improve if increased resources allocated to attracting them to a particular hospital have some positive (albeit small) effect on outcomes. The same conclusion applies for attempts to measure the effects of competition on outcomes (e.g. Kessler and McClellan, 1999)

Additionally, our results have important implications for measuring the quality of care under prospective payment systems, and especially in competitive environments, since they suggest that high cost patients may be at particular risk in such contexts. Thus, it is important that quality measures reflect the concerns of that potentially vulnerable group. Even when a single measure of quality is used, our findings may have implications for how to measure quality of care. For example, our findings may provide a justification to prefer outcomes measures to process measures, since process measures can suggest quality is high over the whole population when the quality of care for certain parts of the population are actually poor, while outcomes are often favorable for less severely ill (less costly) patients in any case, so expending greater resources on them is unlikely to improve outcomes. It is worth noting that this basic conclusion remains regardless of whether one believes that cost reductions were largest among the most costly patients due to selective incentives within prospective payment or whether one simply believes that cost reductions are largest for the most costly patients simply because, as it has been said, "that's where the money is". A related issue is whether the effects of competition on costs should be interpreted as reducing quality or rather improving efficiency. Resolution of this question will only be possible with data that permits a comprehensive assessment of outcomes.

It should also be noted that the combination of prospective payment and competition studied here is not unique to Medicare PPS, but in fact is the basic idea behind the increasing use of capitated managed care arrangements and competition to control costs, including perhaps most prominently Medicare managed care. Indeed, such "managed competition" arrangements present similar incentives to expend resources to attract less costly participants while avoiding more costly ones. It is not difficult to imagine these incentives resulting in substantial investments in wellness programs and preventive services, amenities that improve access for working persons, reductions in copayments, etc. that would attract relatively healthy participants. Even casual observation of the offerings of health maintenance organizations leaves little question that many of these offerings are indeed occurring, but whether such expenditures are an efficient use of health care resources and how they may impact the care received by the most severely ill are important questions for future work. This is especially true given evidence that quality of care in HMOs may be worst for patients who are chronically ill (Miller and Luft, 1997), and that HMOs may limit expenditures for severely ill persons in intensive care (Rapoport, et al., 1992; Cher and Lenert, 1997).

Finally, it should be noted that there a variety of approaches that could be tried to improve upon existing prospective payment systems. These include improved risk adjusters and use of "blended" payment systems that include both prospective and retrospective components to lessen the incentives for patient selection or the provision of too much or too little care. Indeed, the Medicare Prospective Payment System has always tied reimbursement to the amount of care provided to some extent and thus never been fully prospective (McClellan, 1997). Moreover, proposals have been seriously considered to expand this retrospective aspect of Medicare PPS as well as to improve risk adjusters by developing a DRG system that allows a finer classification of admissions (Newhouse, Buntin, and Chapman, 1997). Our work provides support for the value of continued examination of both these approaches.

REFERENCES

Allen, Robin and Paul Gertler (1991). "Regulation and the Provision of Quality to Heterogeneous Consumers: The Case of Prospective Pricing of Medical Services" Journal of Regulatorybbb Economics 3:361-375.

Bain J. 1951. "Relationship of Profit Rate to Industry Concentration: American Manufacturing, 1936-1940. Quarterly Journal of Economics 65: 293-324.

Berk, Marc L., Alan C. Monheit, and Michael M. Hagan. (1988). "How the U.S. spent its Health Care Dollar: 1929-1980." Health Affairs.

Carter, Grace M., Joseph P. Newhouse, and Daniel A. Relles. (1990). "How much Change in the Case Mix Index is DRG Creep?" Journal of Health Economics 9: 411-428.

Charlson ME, Pompei P, Ales KL, McKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. Journal of Chronic Disease 1987; 40: 373-383.

Cher, Daniel J, and Leslie Lenert. (1997). "Method of Medicare Reimbursement and the Rate of Potentially Ineffective Care of Critically Ill Patients" JAMA 278 (12): 1001-7.

Cutler, David. (1995). "The Incidence of Adverse Medical Outcomes Under Prospective Payment." Econometrica. 63(1):29-50.

Cutler, David and Ellen Meara. (1997). "The Medical Cost of the Young and Old: A Forty-Year Perspective." Paper presented at the Conference on the Economics of Aging. National Bureau of Economic Research, April 25, 1997.

Davis, Karen et al. Health Care Cost Containment. Baltimore: Johns Hopkins University Press, 1990.

Davis, Margaret and Sally T. Burner. (1995). "Three Decades of Medicare: What the Numbers Tell us." Health Affairs. 14(4):231-243.

Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-CM administrative databases. Journal of Clinical Epidemiology 1993; 46: 613-629.

Dranove, David (1987). "Rate-setting by Diagnosis-Related Groups and Hospital Specialization" RAND Journal of Economics 18(3): 417-427.

Dranove, David, Mark Shanley, and Carol Simon. (1992). "Is Hospital Competition Wasteful?" RAND Journal of Economics 23(2): 247-262.

Dranove, D., M. Shanley, and W. White. (1991). "How fast are Hospital Prices Really Rising?" Medical Care. 29(8): 690-696.

Dranove, David and William D. White. (1998). "Medicaid-Dependent Hospitals and Their Patients: How Have They Fared?" Health Services Research. 32(2):163-185.

Dranove, David and William D. White. (1994). "Recent Theory and Evidence on Competition in Hospital Markets." J of Economics and Management Strategy. 3(1):169-209.

Ellis, Randall P. (1998). "Creaming, Skimping, and Dumping: Provider Competition on the Intensive and Extensive Margins." J of Health Economics. 17:537-555.

Ellis, Randall P. and Thomas G. McGuire. (1986). "Provider Behavior Under Prospective Reimbursement." J of Health Economics. 5:129-151.

Finkler, S. A. (1982). "The Distinction between Cost and Charges." Annals of Internal Medicine. 96(1): 102-109.

Gold, Marsha et al. (1995). "Behind the Curve: A Critical Assessment of How Little is Known About Arrangements between Managed Care Plans and Physicians." Medical Care Research and Review. 52(3):304-41.

Guterman, Stuart, Jack Ashby, and Timothy Greene. (1996). "Hospital Cost Growth Down." Health Affairs. 15(3):134-139.

Hodgkin, Dominic and Thomas G. McGuire. (1994). "Payment Levels and Hospital Response to Prospective Payment." J of Health Economics. 13:1-29.

Hornbrook, Mark and John Rafferty. (1982). "The Economics of Hospital Reimbursement." Advances in Health Economics and Health Services Research. 3:79-115.

Institute of Medicine. Managing Managed Care: Quality Improvement in Behavioral Health. Washington, D.C.: National Academy Press, 1997.

Johns, Lucy. (1985). "Selective Contracting in California." Health Affairs. 4(3):32-48.

Johns, Lucy. (1989). "Selective Contracting in California: An Update." Inquiry. 26:345-353.

Joskow, Paul (1980). "The Effects of Competition and Regulation on Hospital Bed Supply and the Reservation Quality of the Hospital" Bell Journal of Economics v11, n2 (Autumn): 421-47

Keeler, Emmett B. et al. (1990). "Changes in Sickness at Admission Following the Introduction of the Prospective Payment System." JAMA. 264(15):1962-1968.

Kessler, Daniel P and Mark B. McClellan (1999). "Is Hospital Competition Socially Wasteful?" NBER Working Paper 7266. NBER, Cambridge, MA.

Langa, Kenneth M. (1992). Medicaid Cost-Containment in the 1980's: Did it Encourage Interpayer Differences in Hospital Care? Unpublished Dissertation. University of Chicago.

Langa , Kenneth and Elliot J. Sussman. (1993). "The Effect of Cost-Containment Policies on Rates of Coronary Revascularization in California." The New England Journal of Medicine. 329(24): 1784-1789.

Langa, Kenneth M. (1992). Medicaid Cost-Containment in the 1980's: Did it Encourage Interpayer Differences in Hospital Care? Unpublished Dissertation. University of Chicago.

Lave, Judith et al. (1988). "The Early Effects of Medicare's Prospective Payment System on Psychiatry." Inquiry. 25:354-363.

Levit, Katherine R., Helen C. Lazenby, and Lekha Sivarajan. (1996). "Health Care Spending in 1994: Slowest in Decades." Health Affairs. 15(2):130-145.

LoGerfo, James P. (1990). "The Prospective Payment System and Quality: No Skeletons in the Closet." JAMA. 264(15):1995-1996.

Luft, Harold S. and Robert H. Miller (1988). "Patient Selection in a Competitive Health Care Environment" Health Affairs 7(3): 97-119.

Manning, W.G. et al. (1984). "A Controlled Trial of the Effect of a Prepaid Group Practice on Use of Services." New England Journal of Medicine. 310(23):1305-1310.

McClellan, Mark. (1997) "Hospital Reimbursement Incentives: An Empirical Analysis." Journal of Economics and Management Strategy 6(1): 91-128.

Melnick, Glenn et al. (1992). "The Effects of Market Structure and Bargaining Position on Hospital Prices." Journal of Health Economics. 11:217-233.

Melnick, Glenn and Jack Zwanziger, (1988). "Hospital Behavior Under Competition and Cost-Containment Policies." JAMA. 260(18):2669-75.

Melnick, Glenn and Jack Zwanziger. (1995). "State Health Care Expenditures Under Competition and Regulation, 1980 through 1991." American Journal of Public Health. 85(10):1391-1396.

Meltzer, David and Jeanette Chung. (2000). "Cost Growth among High- and Low-Cost Hospital Admissions under Cost-Containment: Evidence from California, 1983-1994." Unpublished manuscript.

Meltzer, David, et al. (2000) "Effects of Medical Specialization on Costs and Outcomes on a General Medicine Service: Results of a Randomized Trial of Hospitalists." Unpublished manuscript.

Miller, Robert H. and Harold S. Luft. (1997). "Does Managed Care Lead to Better or Worse Quality of Care?" Health Affairs. 16(5): 7-25.

Morrisey, Michael A., Frank A. Sloan and Joseph Valvona (1988). "Medicare Prospective Payment and Posthospital Transfers to Subacute Care" Medical Care 26(7): 685-98.

Munoz, Eric et al. (1989). "Hospital Costs, Resource Characteristics, and the Dynamics of Death for Hospitalized Patients in Cardiology Diagnosis-Related Groups." Heart and Lung. 18(2):164-171.

Munoz, Eric et al. (1988). "Diagnosis Related Groups, Resource Utilization, Age, and Outcome for Hospitalized Nephrology Patients." American Journal of Kidney Diseases. 11(6):481-488.

Newhouse, Joseph P. (1989). "Do Unprofitable Patients Face Access Problems?" Health Care Financing Review. 11(2):33-42.

Newhouse, Jospeh P., Melinda Beeuwkes Buntin, and John D. Chapman (1997). "Risk Adjustment and Medicare: Taking a Closer Look." Health Affairs 16(5): 26-43.

OSHPD (Office of State-wide Health and Planning and Development. (1993) Accounting and Reporting Manual for California Hospitals. Second Edition. Sacramento, CA: OSHPD.

Rapoport, John, Stephen Gehlbach, Stanley Lemeshow, and Daniel Teres. (1992). "Resource Utilization Among Intensive Care Patients: Managed Care vs. Traditional Insurance," Archives of Internal Medicine 152: 2207-12.

Robinson, James and Harold Luft (1985). "The Impact of Hospital Market Structure on Patient Volume, Average Length of Stay, and the Cost of Care." Journal of Health Economics 4: 333-356.

Robinson, James C. and Ciaran S. Phibbs. (1989). "An Evaluation of Medicaid Selective Contracting in California." Journal of Health Economics. 8:437-455.

Rodgers, William H., David Draper, Katherine L. Kahn, Emmett B. Keeler, Lisa V. Rubenstein, Jacqueline Kosecoff, Robert H. Brook. (1990) "Quality of Care Before and After Implementation of the DRG-Based Prospective Payment System: A Summary of Effects" JAMA 264(15): 1989-94.

Romano PS, Roos LL, Jollis JG. Adapting a clinical comorbidity index for use with ICD-CM administrative data: differing perspectives. Journal of Clinical Epidemiology 1993; 46: 1075-1079.

Russell, Louise B. and Carrie Lynn Manning. (1989). "The Effect of Prospective Payment on Medicare Expenditures." New England Journal of Medicine. 320(7):439-444.

Satterthwaite (1979). "Consumer Information, Equilibrium Industry Price, and the Number of Sellers" Bell Journal of Economics 10 (2): 483-502.

Saving, Thomas R. (1982). "Market Organization and Product Quality" Southern Economic Journal 48 (4): 855-867.

Schwartz, Michael, David W. Young and Richard Siegrist. (1995). "The Ratio of Costs to Charges: How Good a Basis for Estimating Costs?" Inquiry 32:476-481.

Smith, Howard and Myron D. Fottler. Prospective Payment: Managing for Operational Effectiveness. Rockville, MD: Aspen Systems Corporation, 1985.

Sohn, Min-Woong. (1996). From Regional to Local Markets: Network Study of Competition in California Hospital Markets. Ph.D. Dissertation, Department of Sociology, University of Chicago.

Spence, A. Michael (1975). "Monopoly, Quality, and Regulation". Bell Journal of Economics 6: 417-429.

Stafford, Randall S. (1990). "Cesarean Section Use and Source of Payment: An Analysis of California Hospital Discharge Abstracts." American Journal of Public Health. 80(3):313-315.

Stigler, George J. (1968). The Organization of Industry University of Chicago Press, Chicago, 1968.

Tirole, Jean (1988). The Theory of Industrial Organization, MIT Press, Cambridge, MA.

U.S. Dept. of Commerce, Bureau of the Census. REVISED ESTIMATES OF THE POUPLATION OF COUNTIES BY AGE, SEX, and RACE [UNITED STATES]: 1980-1989 [Computer File]. Washington, DC: U.S. Dept. of Commerce, Bureau of the Census [producer], 1992. Ann Arbor, MI: Inter-University Consortium for Political and Social Research [distributor], 1993.

U.S. Dept. of Commerce, Bureau of the Census. ESTIMATES OF THE POUPLATION OF COUNTIES BY AGE, SEX, RACE, and HISPANIC ORIGIN [UNITED STATES]: 90-1996 [Computer File]. Washington, DC: U.S. Dept. of Commerce, Bureau of the Census [producer], 1998. Ann Arbor, MI: Inter-University Consortium for Political and Social Research [distributor], 1998.

White, Lawrence J. (1972). "Quality Variation when Prices are Regulated" Bell Journal of Economics and Management Science 3: 425-436.

Zook, Christopher J. and Francis D. Moore. (1980). "High-Cost Users of Medical Care." New England Journal of Medicine 302(18):996-1002.

Figures 1a-1l. The Distribution of RCC-Adjusted Hospital Charges within the 12 Largest DRGs in 1993: Age 65+ (Vertical bars indicate mean RCC-adjusted charge in each DRG)

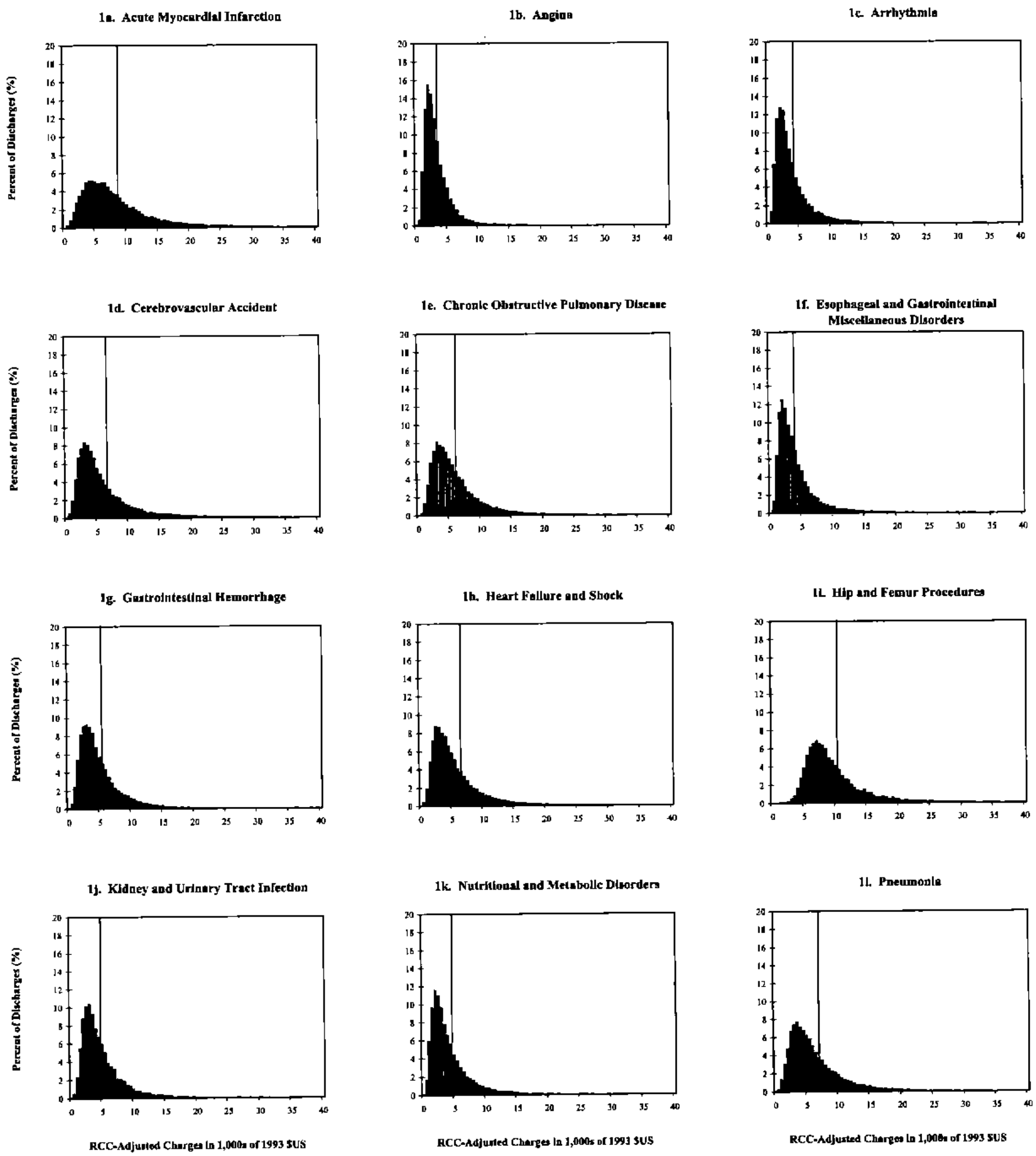

FIGURE 2. Intertemporal Comparisons of Percentile Locations in the Spending Distribution Adjusting for Changes in Hospital Utilization Rates

Figure 2a. Discharge Distribution in Year 0

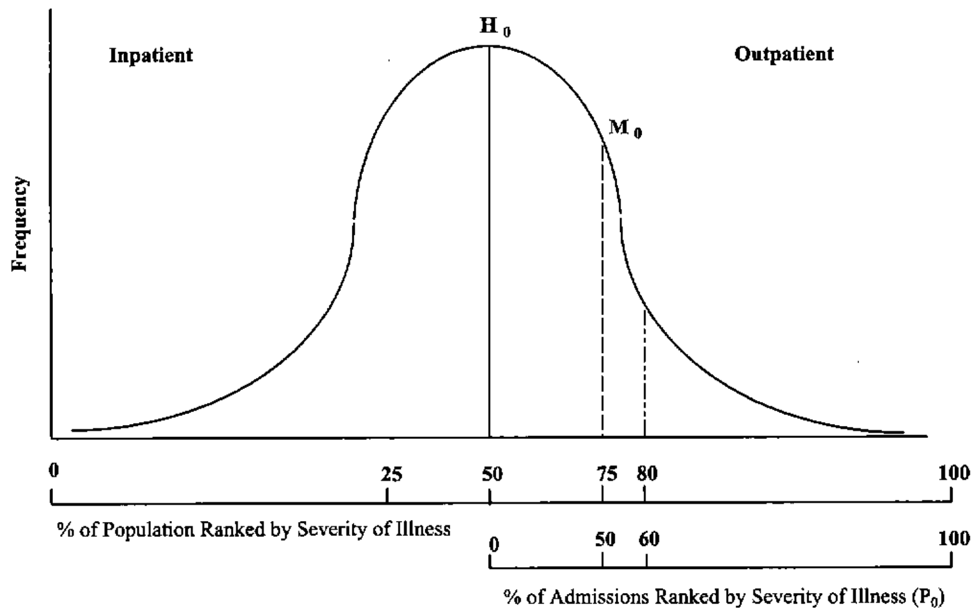

Figure 2b. Discharge Distribution in Year 1

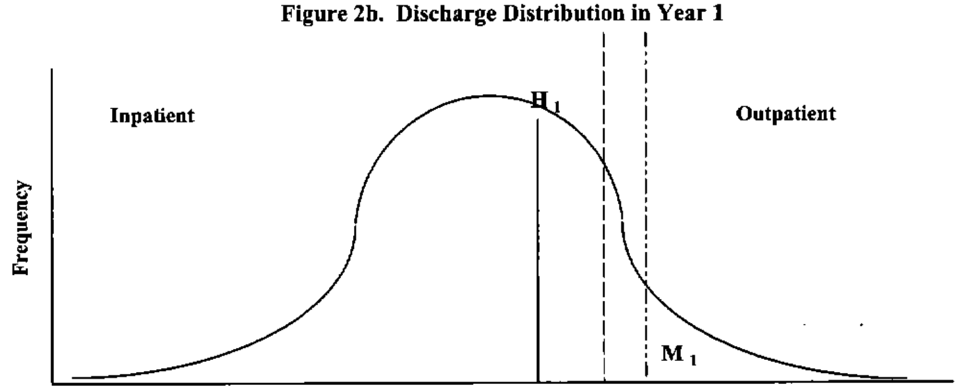

Table 1. The Distribution of RCC-Adjusted Charges by DRG in 1983 and 1993: Age 65+

Table 1a. 1983 Unadjusted Distribution

1983	N	Mean	Std. Dev.	*Unadjusted Percentiles* 25th	50th	75th	90th	95th
Acute Myocardial Infarction	24,093	9,068	(9,095)	4,264	6,916	10,769	16,771	22,693
Angina	18,790	3,926	(3,253)	2,187	3,181	4,685	6,909	8,755
Arrhythmia	18,522	4,490	(5,469)	1,986	3,200	5,271	8,503	11,751
Cerebrovascular Accident	26,833	8,928	(11,808)	2,966	5,406	10,281	19,263	27,876
Chronic Obstructive Pulmonary Disease	18,900	7,678	(11,167)	2,919	4,880	8,458	14,870	22,121
Esophageal and Gastrointestinal Misc. Disorders	27,802	3,586	(3,988)	1,613	2,544	4,118	6,822	9,380
Gastrointestinal Hemorrhage	10,769	5,149	(6,511)	2,241	3,543	5,810	9,728	13,665
Heart Failure and Shock	29,849	6,720	(8,307)	2,773	4,588	7,654	13,139	18,755
Hip and Femur Procedures	12,296	11,872	(9,695)	7,039	9,477	13,349	20,042	26,198
Kidney and Urinary Tract Infection	9,560	5,642	(6,095)	2,430	3,974	6,660	10,981	14,968
Nutritional and Metabolic Disorders	11,345	4,923	(6,678)	1,941	3,181	5,586	9,912	14,416
Pneumonia	25,375	8,207	(11,311)	3,167	5,290	9,355	16,174	22,984

Table 1b. 1983 Adjusted Distribution

1983	N	Mean	Std. Dev.	*Unadjusted Percentiles* 25th	50th	75th	90th	95th
Acute Myocardial Infarction	22,368	9,651	(9,184)	4,837	7,344	11,188	17,352	23,610
Angina	18,790	3,926	(3,253)	2,187	3,181	4,685	6,909	8,755
Arrhythmia	18,522	4,490	(5,469)	1,986	3,200	5,271	8,503	11,751
Cerebrovascular Accident	26,833	8,928	(11,808)	2,966	5,406	10,281	19,263	27,876
Chronic Obstructive Pulmonary Disease	18,900	7,678	(11,167)	2,919	4,880	8,458	14,870	22,121
Esophageal and Gastrointestinal Misc. Disorders	17,169	4,950	(4,558)	2,709	3,617	5,422	8,545	11,710
Gastrointestinal Hemorrhage	10,769	5,149	(6,511)	2,241	3,543	5,810	9,728	13,665
Heart Failure and Shock	29,849	6,720	(8,307)	2,773	4,588	7,654	13,139	18,755
Hip and Femur Procedures	12,296	11,872	(9,695)	7,039	9,477	13,349	20,042	26,198
Kidney and Urinary Tract Infection	9,560	5,642	(6,095)	2,430	3,974	6,660	10,981	14,968
Nutritional and Metabolic Disorders	11,345	4,923	(6,678)	1,941	3,181	5,586	9,912	14,416
Pneumonia	25,375	8,207	(11,311)	3,167	5,290	9,355	16,174	22,984

Table 1c. 1993 Unadjusted Distribution

1993	N	Mean	Std. Dev.	*Unadjusted Percentiles* 25th	50th	75th	90th	95th
Acute Myocardial Infarction	22,368	8,855	(7,446)	4,415	6,947	10,795	16,494	21,672
Angina	23,182	3,388	(2,655)	1,932	2,774	4,075	5,853	7,452
Arrhythmia	20,470	4,151	(4,486)	1,955	2,996	4,769	7,719	10,623
Cerebrovascular Accident	32,227	6,585	(7,131)	2,975	4,620	7,612	12,624	17,735
Chronic Obstructive Pulmonary Disease	24,572	6,243	(5,744)	3,184	4,853	7,467	11,413	15,027
Esophageal and Gastrointestinal Misc. Disorders	17,169	4,157	(4,283)	1,982	3,096	4,899	7,710	10,538
Gastrointestinal Hemorrhage	22,264	5,438	(5,065)	2,713	4,118	6,414	10,055	13,387
Heart Failure and Shock	52,857	6,015	(6,723)	2,861	4,440	7,087	11,248	15,287
Hip and Femur Procedures	13.790	10,176	(7,342)	6,522	8,446	11,453	16,186	21,012
Kidney and Urinary Tract Infection	15,258	5,147	(4,716)	2,649	3,954	6,137	9,331	12,456
Nutritional and Metabolic Disorders	20,248	4,587	(4,912)	2,081	3,282	5,396	8,810	12,159
Pneumonia	36,783	6,537	(10,075)	3,357	5,136	7,964	12,015	15,538

Table 1d. 1993 Adjusted Distribution

1993	N	Mean	Std. Dev.	*Unadjusted Percentiles* 25th	50th	75th	90th	95th
Acute Myocardial Infarction	22.368	8,855	(7,446)	4,415	6,947	10,795	16,494	21,672
Angina	23,182	3,388	(2,655)	1,932	2,774	4,075	5,853	7,452
Arrhythmia	20,470	4,151	(4,486)	1,955	2,996	4,769	7,719	10,623
Cerebrovascular Accident	32,227	6,585	(7,131)	2,975	4,620	7,612	12,624	17,735
Chronic Obstructive Pulmonary Disease	24,572	6,243	(5,744)	3,184	4,853	7,467	11,413	15,027
Esophageal and Gastrointestinal Misc. Disorders	17,169	4,157	(4,283)	1,982	3,096	4,899	7,710	10,538
Gastrointestinal Hemorrhage	22,264	5,438	(5,065)	2,713	4,118	6,414	10,055	13,387
Heart Failure and Shock	52.857	6,015	(6,723)	2,861	4.440	7,087	11,248	15,287
Hip and Femur Procedures	13,790	10,176	(7,342)	6,522	8,446	11,453	16,186	21,012
Kidney and Urinary Tract Infection	15,258	5,147	(4,716)	2.649	3,954	6,137	9,331	12,456
Nutritional and Metabolic Disorders	20,248	4,587	(4,912)	2,081	3,282	5,396	8,810	12,159
Pneumonia	36,783	6,537	(10,075)	3,357	5,136	7,964	12,015	15,538

Table 2. The Distribution of RCC-Adjusted Charges by DRG in 1983 and 1993: Age 55 - 64

Table 2a. 1983 Unadjusted Distribution

				Unadjusted Percentiles				
1983	**N**	**Mean**	**Std. Dev.**	**25th**	**50th**	**75th**	**90th**	**95th**
Acute Myocardial Infarction	10,340	8,203	(7,668)	4,036	6,538	9,883	14,577	19,435
Angina	8,505	3,441	(2,604)	1,978	2,860	4,131	5,941	7,583
Arrhythmia	5,760	3,816	(4,453)	1,696	2,702	4,368	6,890	9,984
Cerebrovascular Accident	5,012	9,844	(13,760)	2,891	5,405	10,975	22,116	33,398
Chronic Obstructive Pulmonary Disease	6,538	7,664	(12,205)	2,837	4,677	7,924	14,590	22,530
Esophageal and Gastrointestinal Misc. Disorders	10,634	3,144	(3,443)	1,490	2,318	3,681	5,792	7,763
Gastrointestinal Hemorrhage	3,525	4,693	(6,063)	2,028	3,273	5,174	8,854	12,482
Heart Failure and Shock	5,756	6,519	(8,544)	2,735	4,393	7,385	12,467	17,664
Hip and Femur Procedures	1,635	12,537	(12,728)	6,382	9,083	13,967	22,227	32,370
Kidney and Urinary Tract Infection	2,062	4,530	(4,292)	2,066	3,238	(5,552)	8,853	11,804
Nutritional and Metabolic Disorders	2,370	4,687	(7,201)	1,705	2,870	4,967	8,753	13,524
Pneumonia	5,402	7,230	(10,658)	2,714	4,508	7,864	13,792	21,123

Table 2b. 1983 Adjusted Distribution

				Unadjusted Percentiles				
1983	**N**	**Mean**	**Std. Dev.**	**25th**	**50th**	**75th**	**90th**	**95th**
Acute Myocardial Infarction	6,004	11,543	(8,568)	7,207	9,143	12,654	18,343	24,625
Angina	7,066	3,883	(2,644)	2,410	3,205	4,469	6,385	8,030
Arrhythmia	3,988	4,939	(4,947)	2,615	3,571	5,315	8,214	12,085
Cerebrovascular Accident	4,921	10,015	(13,829)	3,015	11,207	22,423	33,618	69,655
Chronic Obstructive Pulmonary Disease	6,269	7,951	(12,383)	3,058	4,873	8,130	14,873	23,048
Esophageal and Gastrointestinal Misc. Disorders	5,360	4,793	(4,218)	2,878	3,668	5,191	7,741	9,925
Gastrointestinal Hemorrhage	3,525	4,693	(6,063)	2,028	3,273	5,374	8,854	12,482
Heart Failure and Shock	5,756	6,519	(8,544)	2,735	4,393	7,385	12,467	17,664
Hip and Femur Procedures	1,074	16,304	(14,295)	9,155	12,057	17,133	28,122	40,432
Kidney and Urinary Tract Infection	2,062	4,530	(4,292)	2,066	3,238	5,552	8,853	11,804
Nutritional and Metabolic Disorders	2,370	4,687	(7,201)	1,705	2,870	4,967	8,753	13,524
Pneumonia	5,402	7,230	(10,658)	2,714	4,508	7,864	13,792	21,123

Table 2c. 1993 Unadjusted Distribution

				Unadjusted Percentiles				
1993	**N**	**Mean**	**Std. Dev.**	**25th**	**50th**	**75th**	**90th**	**95th**
Acute Myocardial Infarction	6,004	8,702	(7,378)	4,529	7,116	10,600	15,326	19,809
Angina	7,066	3,336	(2,625)	1,874	2,700	3,980	5,819	7,422
Arrhythmia	3,988	3,916	(4,372)	1,782	2,762	4,475	7,316	10,281
Cerebrovascular Accident	4,921	7,505	(8,618)	3,113	4,915	8,508	14,645	21,951
Chronic Obstructive Pulmonary Disease	6,269	6,191	(5,621)	3,193	4,769	7,318	11,359	15,193
Esophageal and Gastrointestinal Misc. Disorders	5,360	3,916	(4,179)	1,816	2,854	4,570	7,260	9,866
Gastrointestinal Hemorrhage	4,425	5,401	(5,581)	2,642	3,962	6,160	9,662	14,108
Heart Failure and Shock	8,152	6,564	(7,810)	2,953	4,615	7,317	12,384	17,572
Hip and Femur Procedures	1,074	12,010	(11,015)	6,307	8,925	13,807	21,119	28,568
Kidney and Urinary Tract Infection	2,370	5,188	(5,202)	2,503	3,916	6,002	9,613	12,632
Nutritional and Metabolic Disorders	3,626	4,660	(5,475)	1,874	3,176	5,484	9,348	13,165
Pneumonia	5,859	6,397	(5,427)	3,220	4,948	7,616	12,003	15,875

Table 2d. 1993 Adjusted Distribution

				Unadjusted Percentiles				
1993	**N**	**Mean**	**Std. Dev.**	**25th**	**50th**	**75th**	**90th**	**95th**
Acute Myocardial Infarction	6,004	8,702	(7,378)	4,529	7,116	10,600	15,326	19,809
Angina	7,066	3,336	(2,625)	1,874	2,700	3,980	5,819	7,422
Arrhythmia	3,988	3,916	(4,372)	1,782	2,762	4,475	7,316	10,281
Cerebrovascular Accident	4,921	7,505	(8,618)	3,113	4,915	8,508	14,645	21,951
Chronic Obstructive Pulmonary Disease	6,269	6,191	(5,621)	3,193	4,769	7,318	11,359	15,193
Esophageal and Gastrointestinal Misc. Disorders	5,360	3,916	(4,179)	1,816	2,854	4,570	7,260	9,866
Gastrointestinal Hemorrhage	4,425	5,401	(5,581)	2,642	3,962	6,160	9,662	14,108
Heart Failure and Shock	8,152	6,564	(7,810)	2,953	4,615	7,317	12,384	17,572
Hip and Femur Procedures	1,074	12,010	(11,015)	6,307	8,925	13,807	21,119	28,568
Kidney and Urinary Tract Infection	2,370	5,188	(5,202)	2,503	3,916	6,002	9,613	12,632
Nutritional and Metabolic Disorders	3,626	4,660	(5,475)	1,874	3,176	5,484	9,348	13,165
Pneumonia	5,859	6,397	(5,427)	3,220	4,948	7,616	12,003	15,875

Table 3. Ten-Year Annualized Growth in RCC-Adjusted Charges at Selected Percentiles of the Spending Distribution: Age 65+

Table 3a. 1983-1993 Growth within Unadjusted Distribution

	N	Mean	*Unadjusted Percentiles* 25th	50th	75th	90th	95th
Acute Myocardial Infarction	-0.7	-0.2	0.3	0.0	0.0	-0.2	-0.5
Angina	2.1	-1.5	-1.2	-1.4	-1.4	-1.6	-1.6
Arrhythmia	1.0	-0.8	-0.2	-0.7	-1.0	-1.0	-1.0
Cerebrovascular Accident	1.8	-3.0	0.0	-1.6	-3.0	-4.1	-4.4
Chronic Obstructive Pulmonary Disease	2.7	-2.0	0.9	-0.1	-1.2	-2.6	-3.8
Esophageal and Gastrointestinal Misc. Disorders	-4.7	1.5	2.1	2.0	1.8	1.2	1.2
Gastrointestinal Hemorrhage	7.5	0.5	1.9	1.5	1.0	0.3	-0.2
Heart Failure and Shock	5.9	-1.1	0.3	-0.3	-0.8	-1.5	-2.0
Hip and Femur Procedures	1.2	-1.5	-0.8	-1.1	-1.5	-2.1	-2.2
Kidney and Urinary Tract Infection	4.8	-0.9	0.9	-0.1	-0.8	-1.6	-1.8
Nutritional and Metabolic Disorders	6.0	-0.7	0.7	0.3	-0.3	-1.2	-1.7
Pneumonia	3.8	-2.2	0.6	-0.3	-1.6	-2.9	-3.8

Table 3b. 1983-1993 Growth within Adjusted Distribution

	N	Mean	*Unadjusted Percentiles* 25th	50th	75th	90th	95th
Acute Myocardial Infarction	0.0	-0.9	-0.9	-0.6	-0.4	-0.5	-0.9
Angina	2.1	-1.5	-1.2	-1.4	-1.4	-1.6	-1.6
Arrhythmia	1.0	-0.8	-0.2	-0.7	-1.0	-1.0	-1.0
Cerebrovascular Accident	1.8	-3.0	0.0	-1.6	-3.0	-4.1	-4.4
Chronic Obstructive Pulmonary Disease	2.7	-2.0	0.9	-0.1	-1.2	-2.6	-3.8
Esophageal and Gastrointestinal Misc. Disorders	0.0	-1.7	-3.1	-1.5	-1.0	-1.0	-1.0
Gastrointestinal Hemorrhage	7.5	0.5	1.9	1.5	1.0	0.3	-0.2
Heart Failure and Shock	5.9	-1.1	0.3	-0.3	-0.8	-1.5	-2.0
Hip and Femur Procedures	1.2	-1.5	-0.8	-1.1	-1.5	-2.1	-2.2
Kidney and Urinary Tract Infection	4.8	-0.9	0.9	-0.1	-0.8	-1.6	-1.8
Nutritional and Metabolic Disorders	6.0	-0.7	0.7	0.3	-0.3	-1.2	-1.7
Pneumonia	3.8	-2.2	0.6	-0.3	-1.6	-2.9	-3.8

Table 4. Ten-Year Annualized Growth in RCC-Adjusted Charges at Selected Percentiles of the Spending Distribution: Age 55 - 64

Table 4a. 1983-1993 Growth within Unadjusted Distribution

			Unadjusted Percentiles				
	N	Mean	25th	50th	75th	90th	95th
Acute Myocardial Infarction	-5.3	0.6	1.2	0.9	0.7	0.5	0.2
Angina	-1.8	-0.3	-0.5	-0.6	-0.4	-0.2	-0.2
Arrhythmia	-3.6	0.3	0.5	0.2	0.2	0.6	0.3
Cerebrovascular Accident	-0.2	-2.7	0.7	-0.9	-2.5	-4.0	-4.1
Chronic Obstructive Pulmonary Disease	-0.4	-2.1	1.2	0.2	-0.8	-2.5	-3.9
Esophageal and Gastrointestinal Misc. Disorders	-6.6	2.2	2.0	2.1	2.2	2.3	2.4
Gastrointestinal Hemorrhage	2.3	1.4	2.7	1.9	1.4	0.9	1.2
Heart Failure and Shock	3.5	0.1	0.8	0.5	-0.1	-0.1	-0.1
Hip and Femur Procedures	-4.1	-0.4	-0.1	-0.2	-0.1	-0.5	-1.2
Kidney and Urinary Tract Infection	1.4	1.4	1.9	1.9	0.8	0.8	0.7
Nutritional and Metabolic Disorders	4.3	-0.1	0.9	1.0	1.0	0.7	-0.3
Pneumonia	0.8	-1.2	1.7	0.9	-0.3	-1.4	-2.8

Table 4b. 1983-1993 Growth within Adjusted Distribution

			Unadjusted Percentiles				
	N	Mean	25th	50th	75th	90th	95th
Acute Myocardial Infarction	0.0	-2.8	-4.5	-2.5	-1.8	-1.8	-2.2
Angina	0.0	-1.5	-2.5	-1.7	-1.2	-0.9	-0.8
Arrhythmia	0.0	-2.3	-3.8	-2.5	-1.7	-1.2	-1.6
Cerebrovascular Accident	0.0	-2.8	0.3	-7.9	-9.2	-8.0	-10.9
Chronic Obstructive Pulmonary Disease	0.0	-2.5	0.4	-0.2	-1.0	-2.7	-4.1
Esophageal and Gastrointestinal Misc. Disorders	0.0	-2.0	-4.5	-2.5	-1.3	-0.6	-0.1
Gastrointestinal Hemorrhage	2.3	1.4	2.7	1.9	1.4	0.9	1.2
Heart Failure and Shock	3.5	0.1	0.8	0.5	-0.1	-0.1	-0.1
Hip and Femur Procedures	0.0	-3.0	-3.7	-3.0	-2.1	-2.8	-3.4
Kidney and Urinary Tract Infection	1.4	1.4	1.9	1.9	0.8	0.8	0.7
Nutritional and Metabolic Disorders	4.3	-0.1	0.9	1.0	1.0	0.7	-0.3
Pneumonia	0.8	-1.2	1.7	0.9	-0.3	-1.4	-2.8

Table 5. Quantile Regression Parameter Estimates: Acute Myocardial Infarction, Age 65+

1983	25 Percentile	Median	75 Percentile	90 Percentile	95 Percentile
Payor [Omit: Private & HMO]					
Medicare	310	449 *	827 +	2,237 *	1,350
Medi-Cal	207	547 *	1,239 *	2,954 *	2,683
Other Non-Private	-165	-197	-509	804	-1,634
Log Physicians per Capita	494 **	865 **	1,733 **	3,064 **	3,444 *
Log HMO Enrollment Ratio	-21	42	61	46	-278
Level of Competition [Omit: Low]†					
Moderate	327 *	612 **	1,123 **	2,219 *	2,879 *
Competitive	418 *	899 **	1,034 **	2,807 **	4,226 *
Very Competitive	1,243 **	2,327 **	3,775 **	7,232 **	11,730 **
Log Population	-78	-273 **	-323 **	-523 +	-672
Log Income per Capita	1,232 **	1,568 **	1,372 **	893	621
Investor-Owned [Omit: NFP&Other]	-374 **	-468 **	-566 **	-690	-797
Number of Licensed Beds	0	2 **	2 **	4 *	11 **
Total Number of Discharges [1983]	0 **	0 **	0 **	0 +	0 +
Teaching Hospital [Omit: Non-Teaching]	607 **	839 **	1,042 **	1,809 **	2,498 **
Constant	-12,370 **	-13,067 **	-6,102	6,976	17,089

1993	25 Percentile	Median	75 Percentile	90 Percentile	95 Percentile
Payor [Omit: Private & HMO]					
Medicare	712 **	1,017 **	1,517 **	2,384 **	2,977 **
Medi-Cal	1,125 **	1,857 **	2,726 **	4,778 **	9,405 **
Other Non-Private	-47	44	585	1,854 +	970
Log Physicians per Capita	-358 *	-575 *	-931 *	-954	-1,974
Log HMO Enrollment Ratio	15	32	67	0	-14
Level of Competition [Omit: Low]†					
Moderate	-642 **	-1,048 **	-1,623 **	-1,903 **	-4,222 **
Competitive	-822 **	-1,382 **	-2,287 **	-3,729 **	-6,394 **
Very Competitive	-1,454 **	-2,423 **	-3,544 **	-4,745 **	-8,338 **
Log Population	356 **	628 **	1,037 **	1,737 **	2,892 **
Log Income per Capita	3,180 **	4,781 **	6,969 **	7,788 **	11,828 **
Investor-Owned [Omit: NFP&Other]	135	260 *	693 **	1,718 **	2,998 **
Number of Licensed Beds	-1 **	-2 **	-3 **	-4 **	-8 *
Total Number of Discharges [1993]	0 **	0 **	0 **	0 **	0 **
Teaching Hospital [Omit: Non-Teaching]	-28	255 *	666 **	1,220 **	1,244 +
Constant	-34,452 **	-52,872 **	-79,199 **	-92,734 **	-149,329 **

+p<0.10 *p<0.05 **p<0.01

† Low [1.00 ≥ Herf > 0.20], Moderate [0.20 ≥ Herf > 0.10], Competitive [0.10 ≥ Herf > 0.05], Very competitive [0.05 ≥ Herf]

Table 6. Quantile Regression Parameter Estimates: Acute Myocardial Infarction, Age 55 - 64

1983	25 Percentile	Median	75 Percentile	90 Percentile	95 Percentile
Payor [Omit: Private & HMO]					
Medicare	126	106	438 +	1,820 **	2,665 *
Medi-Cal	114	509 **	864 **	2,956 **	6,865 **
Other Non-Private	-106	-186	-65	326	990
Log Physicians per Capita	232	290	642 +	553	1,581
Log HMO Enrollment Ratio	16	-54	-48 +	42	-172
Level of Competition [Omit: Low]†					
Moderate	269	441 *	1,240 **	1,625 +	2,610 +
Competitive	623 *	987 **	1,461 **	1,264	2,469
Very Competitive	839 *	1,955 **	3,268 **	4,275 **	7,826 **
Log Population	-2	-74	-119	-26	-64
Log Income per Capita	936 **	1,804 **	1,922 **	2,158 +	1,493
Investor-Owned [Omit: NFP&Other]	-226 +	-429 **	-588 *	-658	-1,782 +
Number of Licensed Beds	0	1	3 **	3	2
Total Number of Discharges [1983]	0 **	0 **	0 *	0	0 +
Teaching Hospital [Omit: Non-Teaching]	263 *	646 **	1,519 **	2,708 **	3,837 **
Constant	-9,022 *	-18,760 **	-17,396	-18,392	-3,923

1993	25 Percentile	Median	75 Percentile	90 Percentile	95 Percentile
Payor [Omit: Private & HMO]					
Medicare	331 +	583 *	946 **	3,222 **	4,274 **
Medi-Cal	443 *	886 **	1,728 **	3,321 **	6,131 **
Other Non-Private	242	527 *	749	924	1,457 +
Log Physicians per Capita	-1,038 **	-1,289 **	-919	-1,424	-3,497 +
Log HMO Enrollment Ratio	-87	-167 +	-271 +	-177	-651
Level of Competition [Omit: Low]†					
Moderate	-914 **	-903	-326	-271	1,001
Competitive	-1,049 **	-989 *	-1,606 *	-2,724 *	-1,894
Very Competitive	-1,811 **	-1,458 *	-1,827 *	-3,643 *	-1,814
Log Population	453 **	325 +	508 *	1,141 *	1,173 *
Log Income per Capita	4,069 **	5,803 **	5,637 **	7,213 *	11,508 **
Investor-Owned [Omit: NFP&Other]	391 **	817 **	1,577 **	3,489 **	4,243 **
Number of Licensed Beds	-1 **	0	0	0	-4
Total Number of Discharges [1993]	0 **	0 **	0 **	0 **	0 *
Teaching Hospital [Omit: Non-Teaching]	148	385 *	547 *	1,295 **	2,548 **
Constant	-48,210 **	-63,669 **	-59,541 **	-83,656 *	-137,415 *

+p<0.10 *p<0.05 **p<0.01

† Low [1.00 ≥ Herf > 0.20], Moderate [0.20 ≥ Herf > 0.10], Competitive [0.10 ≥ Herf > 0.05], Very competitive [0.05 ≥ Herf]

Table 7. Summary of Quantile Regression Parameter Estimates: Effect of Competition on RCC-Adjusted Costs within 12 Largest DRGs in 1983 and 1993, by Age Group

OLD 65+	Year	Level of Competition (Omit: Low)†	25 Percentile	Median	75 Percentile	90 Percentile	95 Percentile
1. Acute Myocardial Infarction	1983	Moderate	327 *	612 **	1,123 **	2,219 **	2,879 *
		Competitive	418 *	899 **	1,045 **	2,807 **	4,227 *
		Highly Competitive	1,243 **	2,327 **	3,775 **	7,232 **	11,730 **
	1993	Moderate	-642 **	-1,048 **	-1,623 **	-1,903 **	-4,222 **
		Competitive	-822 **	-1,382 **	-2,287 **	-3,729 **	-6,394 **
		Highly Competitive	-1,454 **	-2,423 **	-3,544 **	-4,745 **	-8,338 **
2. Angina	1983	Moderate	243 **	395 **	529 **	960 **	1,202 *
		Competitive	252 **	440 **	614 **	616 *	563
		Highly Competitive	656 **	1,147 **	1,665 **	2,436 **	3,242 **
	1993	Moderate	-118 **	-338 **	-567 **	-951 **	-1,271 **
		Competitive	-257 **	-528 **	-854 **	-1,474 **	-1,876 **
		Highly Competitive	-433 **	-817 **	-1,240 **	-1,939 **	-2,255 **
3. Arrhythmia	1983	Moderate	257 **	845 **	1,427 **	3,048 **	2,085
		Competitive	698 **	1,426 **	2,386 **	5,688 **	5,527 *
		Highly Competitive	1,197 **	2,025 **	3,984 **	8,713 **	11,652 **
	1993	Moderate	-453 **	-729 **	-1,265 **	-2,187 **	-3,689 **
		Competitive	-422 **	-534 **	-1,385 **	-2,598 **	-4,872 **
		Highly Competitive	-747 **	-865 **	-1,742 **	-3,120 **	-6,906 **
4. Cerebrovascular Accident	1983	Moderate	257 **	845 **	1,427 **	3,048 **	2,085
		Competitive	698 **	1,426 **	2,386 **	5,688 **	5,527 *
		Highly Competitive	1,197 **	2,025 **	3,984 **	8,713 **	11,652 *
	1993	Moderate	-453 **	-729 **	-1,265 **	-2,187 **	-3,689 **
		Competitive	-422 **	-534 **	-1,385 **	-2,598 **	-4,872 **
		Highly Competitive	-747 **	-865 **	-1,742 **	-3,120 **	-6,906 **
5. Chronic Obstructive Pulmonary Disorder	1983	Moderate	97	106	23	866	1,154
		Competitive	557 **	803 **	1,206 **	3,223 **	4,763 *
		Highly Competitive	1,084 **	1,577 **	2,416 **	5,429 **	9,139 **
	1993	Moderate	-160 *	-159	-497 *	-578	-510
		Competitive	-378 **	-509 **	-1,097 **	-1,525 *	-2,001 *
		Highly Competitive	-330 *	-473 *	-970 *	-1,541 *	-2,005 +
6. Esophageal and Gastrointestinal Miscellaneous Disorders	1983	Moderate	213 **	333 **	428 **	598 *	919 +
		Competitive	287 **	428 **	569 **	819 *	1,534 *
		Highly Competitive	519 **	824 **	1,257 **	1,660 **	3,169 **
	1993	Moderate	-16	-302 **	-555 **	-823 *	-1,644 *
		Competitive	-67	-329 **	-671 **	-964 +	-1,706 *
		Highly Competitive	-226 *	-585 **	-1,160 **	-1,165 +	-1,492

YOUNG 55-64	Year	Level of Competition (Omit: Low)†	25 Percentile	Median	75 Percentile	90 Percentile	95 Percentile
1. Acute Myocardial Infarction	1983	Moderate	269	441 *	1,240 **	1,625 +	2,610 +
		Competitive	623 *	987 **	1,461 **	1,265	2,469
		Highly Competitive	839 *	1,955 **	3,268 **	4,275 **	7,826 **
	1993	Moderate	-914 **	-903 *	-326	-271	1,001
		Competitive	-1,049 **	-989 *	-1,606 *	-2,724 *	-1,894
		Highly Competitive	-1,812 **	-1,458 *	-1,827 *	-3,643 *	-1,814
2. Angina	1983	Moderate	151 +	257 **	555 **	623 *	701
		Competitive	139	214 +	389 *	-86	-627
		Highly Competitive	448 **	721 **	1,178 **	1,313 *	1,168
	1993	Moderate	-87	-351 **	-668 **	-977 **	-1,322 **
		Competitive	-156 +	-356 *	-542 *	-626	-1,448 *
		Highly Competitive	-208 +	-507 *	-744 *	-78	-336
3. Arrhythmia	1983	Moderate	189 +	337 *	673 **	1,193 +	1,936 +
		Competitive	443 **	541 **	905 **	1,048	3,039 *
		Highly Competitive	775 **	956 **	1,678 **	2,887 *	3,661 +
	1993	Moderate	-378 **	-581 **	-1,322 **	-2,505 **	-1,495
		Competitive	-442 **	-693 **	-1,388 **	-3,020 **	-1,994
		Highly Competitive	-841 **	-1,275 **	-2,428 **	-5,125 **	-3,369
4. Cerebrovascular Accident	1983	Moderate	318	625	1,011	8,104 **	10,304 *
		Competitive	935 **	1,395 **	3,639 **	16,727 **	27,287 **
		Highly Competitive	1,263 **	1,688 *	3,471 *	18,941 **	32,865 **
	1993	Moderate	-355 +	-652 *	-1,403 +	-1,442	-1,958
		Competitive	-476 *	-654 *	-1,294	-952	240
		Highly Competitive	-634 +	-683	-1,770	-1,272	-1,594
5. Chronic Obstructive Pulmonary Disorder	1983	Moderate	-80	-332	-808	-1,329	-2,734
		Competitive	389 +	338	1,091 +	2,956	2,034
		Highly Competitive	634 *	793	1,494	2,824	4,228
	1993	Moderate	-362 *	-662 **	-930 *	-1,337 +	-2,455 +
		Competitive	-545 *	-568 *	-798 +	-1,720 +	-2,986 +
		Highly Competitive	-423	-414	254	273	-504
6. Esophageal and Gastrointestinal Miscellaneous Disorders	1983	Moderate	132 *	196 *	415 **	583 +	654
		Competitive	233 **	336 **	385 *	528	1,223
		Highly Competitive	447 **	579 **	616 *	815	1,022
	1993	Moderate	-181 +	-323 *	-536	-680	-232
		Competitive	-22	-185	-346	-130	-1,473
		Highly Competitive	-298 +	-661 *	-908	-472	-1,973

+p<0.10 * p<0.05 **p<0.01

† Low [1.00 ≥ Herf > 0.20], Moderate [0.20 ≥ Herf > 0.10], Competitive [0.10 ≥ Herf > 0.05], Very competitive [0.05 ≥ Herf]

Table 7. Summary of Quantile Regression Parameter Estimates: Effect of Competition on RCC-Adjusted Costs within 12 Largest DRGs in 1983 and 1993, by Age Group (Continued)

OLD 65+	Year	Level of Competition (Omit: Low)†	25 Percentile	Median	75 Percentile	90 Percentile	95 Percentile
7. Gastrointestinal Hemorrhage	1983	Moderate	146	221 +	344	1,297 +	847
		Competitive	128	226	236	800	-96
		Highly Competitive	516 **	933 **	1,705 **	2,730 *	1,647
	1993	Moderate	-225 **	-320 **	-653 **	-1,063 *	-835
		Competitive	-361 **	-495 **	-935 **	-1,712 **	-1,950 *
		Highly Competitive	-705 **	-917 **	-1,737 **	-2,375 **	-2,088
8. Heart Failure and Shock	1983	Moderate	225 **	318 **	546 *	774 +	1,618 *
		Competitive	418 **	544 **	774 **	1,089 *	1,510
		Highly Competitive	1,054 **	1,593 **	2,648 **	4,542 **	7,687 **
	1993	Moderate	-333 **	-414 **	-717 **	-1,310 **	-2,654 **
		Competitive	-583 **	-782 **	-1,351 **	-2,336 **	-4,777 **
		Highly Competitive	-857 **	-1,002 **	-1,655 **	-2,684 **	-5,081 **
9. Hip and Femur Procedures	1983	Moderate	952 **	1,494 **	2,274 **	3,261 **	5,236 *
		Competitive	1,669 **	2,621 **	4,039 **	4,736 **	8,736 **
		Highly Competitive	3,024 **	4,696 **	6,804 **	9,188 **	14,942 **
	1993	Moderate	35	51	267	-456	-1,568
		Competitive	-242	-217	72	-1,874 *	-3,217 *
		Highly Competitive	-962 **	-910 **	-131	-1,902	-2,940
10. Kidney and Urinary Tract Infection	1983	Moderate	386 **	321 *	504 +	-174	-1,330
		Competitive	471 **	594 **	954 *	895	-61
		Highly Competitive	1,119 **	1,551 **	2,413 **	1,242	624
	1993	Moderate	-267 **	-573 **	-786 **	-1,793 **	-2,077 *
		Competitive	-456 **	-840 **	-1,186 **	-2,321 **	-2,270 *
		Highly Competitive	-524 **	-884 **	-1,269 **	-2,103 *	-1,250
11. Nutritional and Metabolic Disorders	1983	Moderate	31	185	360	496	785
		Competitive	104	398 *	797 *	1,513	3,407 *
		Highly Competitive	329 *	904 **	1,651 **	3,095 *	5,576 *
	1993	Moderate	42	-40	-237	-722 +	-1,031
		Competitive	-174 *	-313 **	-783 **	-1,667 **	-2,356 *
		Highly Competitive	-236 *	-491 **	-826 *	-1,713 *	-2,984 *
12. Pneumonia	1983	Moderate	186 *	324 *	582 +	934	2,339 +
		Competitive	504 **	844 **	1,476 **	2,398 *	3,607 *
		Highly Competitive	1,075 **	1,884 **	3,553 **	6,314 **	8,823 **
	1993	Moderate	-153 *	-273 **	-174	1	272
		Competitive	-104	-250 *	-422 +	-349	-890
		Highly Competitive	-230 +	-501 **	-549 +	-450	-156

YOUNG 55-64	Year	Level of Competition (Omit: Low)†	25 Percentile	Median	75 Percentile	90 Percentile	95 Percentile
7. Gastrointestinal Hemorrhage	1983	Moderate	165	336 +	543	1,635 *	-1,290
		Competitive	78	358	378	1,702	-432
		Highly Competitive	196	957 *	1,338	3,422 *	1,503
	1993	Moderate	-62	-235	-532	-1,756 *	-2,480
		Competitive	35	-190	-490	-2,291 *	-3,590
		Highly Competitive	-168	-787 *	-851	-3,594 *	-6,150 +
8. Heart Failure and Shock	1983	Moderate	89	344 +	69	2,528 *	6,176 **
		Competitive	392 *	770 **	926	4,587 **	10,280 **
		Highly Competitive	951 **	1,704 **	2,197 *	8,463 **	17,259 **
	1993	Moderate	-267 *	-554 *	-649 +	-929	-1,283
		Competitive	-664 **	-1,128 **	-1,384 **	-3,261 *	-7,014 **
		Highly Competitive	-793 **	-1,464 **	-1,154 +	-1,970	-4,748
9. Hip and Femur Procedures	1983	Moderate	424	228	1,766	-334	276
		Competitive	166	-2	3,344 +	4,002	3,631
		Highly Competitive	1,111	1,730	7,425 **	8,672	11,293
	1993	Moderate	1,059 *	236	1,397	6,976 +	2,633
		Competitive	958	347	1,888	5,160	-731
		Highly Competitive	445	-1,255	2,281	6,872	349
10. Kidney and Urinary Tract Infection	1983	Moderate	-53	119	23	819	580
		Competitive	-91	283	1,271 +	1,875	2,418
		Highly Competitive	118	839	2,010 +	3,520 *	2,040
	1993	Moderate	-197	-121	-346	-1,256	-2,053
		Competitive	-39	572	-49	1,569	2,551
		Highly Competitive	340	905 +	501	1,253	5,661
11. Nutritional and Metabolic Disorders	1983	Moderate	5	-63	-197	241	-506
		Competitive	144	225	194	938	-1,267
		Highly Competitive	428 +	714	1,624	3,620	3,386
	1993	Moderate	155	-331	-649	-303	-705
		Competitive	-256	-977 **	-1,156 +	-890	-1,862
		Highly Competitive	-143	-940 *	-296	1,494	1,010
12. Pneumonia	1983	Moderate	225	576 *	997 +	1,671	1,988
		Competitive	445 +	799 *	1,541 *	1,711	3,043
		Highly Competitive	1,141 **	2,220 **	3,596 **	3,731	3,318
	1993	Moderate	-357 **	-258	-504	-704	-1,339
		Competitive	-491 **	-309	-221	-1,183	-1,050
		Highly Competitive	-682 **	-78	209	1,025	1,533

+$p<0.10$ * $p<0.05$ ** $p<0.01$

† Low [1.00 ≥ Herf > 0.20], Moderate [0.20 ≥ Herf > 0.10], Competitive [0.10 ≥ Herf > 0.05], Very competitive [0.05 ≥ Herf]