HOSPITAL ‘PROFITS’
The Effects of Reimbursement Policies*

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This paper provides a theoretical and empirical analysis of the effect of cost-based reimbursement (CBR) on hospital costs and charges. It takes issue with previous analyses which have treated CBR as paying economic costs plus a mark-up, and have concluded that the mark-up is too small to significantly distort hospital decision-making. The basic thesis here is that if reimbursement is based on costs, accounting costs become a price to cost-paying patients, and will be optimized to maximize revenue. A hospital serving both cost and charge-paying (private) patients can set two price schedules. Accounting profits (ratio of charges to costs) are not a measure of economic profit but of relative prices to these two groups of patients. In the absence of constraints from regulation or patient co-payment, the optimum level of accounting costs would be infinite.

In practice, the Medicare reimbursement formula links allowable costs to charges received from charge-paying patients. This formula creates incentives for the hospital to raise charges above the single-price, profit-maximizing monopoly level. This inflationary effect of the Medicare formula does not presuppose that Medicare pays less than full cost.

The empirical analysis of hospital laboratory costs and charges generally supports the predictions; for other departments, the conclusions are consistent but more tentative because of data limitations. Overall, evidence suggests minimal cross-subsidy between cost and charge-paying patients. Comparisons of cost and charge levels in for-profit, voluntary non-profit and government hospitals are presented, but it is emphasized that inferences about relative efficiency and profitability cannot be drawn from accounting data, given the incentives created by CBR.

1. Introduction

There are two basic systems of reimbursement of hospital services in the United States. Medicare, Medicaid and many Blue Cross plans pay on the basis of costs incurred on behalf of program beneficiaries. Most commercial insurers and the remaining Blue Cross plans pay on the basis of charges, as is typical for ambulatory care.

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It has been widely argued that retroactive cost-based reimbursement (CBR), by encouraging inefficient production and inflation of input prices, has contributed significantly to the rise in hospital costs [see, for example, Pauly (1976) and Bauer (1978)]. However, the prevailing theoretical and empirical analysis provides little support for this belief [Davis (1973), Sloan and Steinwald (1980)]. It is also argued that recent attempts at cost control by Medicare, Medicaid, and state regulators have forced hospitals to raise charges in order to cover costs, effecting a cross-subsidy from charge to cost-paying patients.\(^1\)

This paper takes issue with the fundamental premise underlying these conclusions, that CBR pays economic costs. The basic thesis is that accounting costs reported for reimbursement should not be interpreted as economic costs but rather as prices to cost-paying patients. Like any price, accounting costs will be optimized to maximize revenue. A hospital serving both cost and charge-paying patients can effectively set two price schedules: ‘charges’ are prices to charge-paying patients and ‘costs’ are prices to cost-paying patients. Accounting profits are not a measure of economic profit but of the relative prices to these two groups of patients.\(^2\)

Once accounting costs are recognized as prices, then the traditional theoretical analysis of CBR is misplaced. For example, Davis (1973) and Sloan and Steinwald (1980) characterize CBR as paying economic cost, with a markup if a ‘plus’ over costs is allowed, and show that incentives for production inefficiency are minimal.\(^3\) They conclude that CBR is irrelevant to hospital cost inflation. I characterize CBR as modifying the hospital’s demand structure, but having no effect (initially) on economic costs. If the hospital can increase accounting ‘costs’ with no increase in economic costs, the optimum increase in ‘costs’ is infinite in the absence of patient co-payment or direct constraints.\(^4\)

In practice, accounting costs are limited both by absolute ceilings and by a reimbursement formula that links reimbursable costs to charges received from charge-paying patients. It is shown below that Medicare’s mechanisms for controlling costs induce an increase in charges to charge-paying patients above the single-price, profit-maximizing monopoly level, and induce cost shifting among departments. The inflationary effect on charges follows from the Medicare reimbursement formula alone. It does not presuppose that

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\(^1\) For example, John Betjemann, Administrator, University Hospital, Boston, in the National Journal, January 6, 1979.

\(^2\) An accounting profit ratio is the ratio of hypothetical total charges (the amount that would be received if all patients paid charges in full) to total costs. Alternatively, it is the volume-weighted ratio of average price to average cost, aggregated over all services.

\(^3\) Prior to 1972, Medicare paid a one and one-half percent markup over costs. In 1972 this was replaced by an eight and one-half percent markup on routine nursing services only.

\(^4\) Overtime, inflation of accounting costs may induce inflation of economic costs if potential profits are captured by factors other than capital. Newhouse (1978) shows the effect of zero co-payment on hospital charges.
Medicare pays less than full cost. These predictions are generally supported by the empirical evidence from a sample of hospital laboratories in California.

An evaluation of alternative methods of reimbursement is beyond the scope of this paper. It does suggest that basing reimbursement on 'costs' is unlikely to achieve its goal of limiting payment to economic cost, and that the conventional analysis of CBR has underestimated its potential inflationary impact on both costs and charges. The analysis is also relevant to the policy debate over the relative efficiency and profitability of for-profit and non-profit hospitals, and to the debate over cross-subsidy across hospital departments and between groups of patients [Relman (1980), Harris (1979), Hellinger (1975)].

The structure of the paper is as follows: Section 2 develops a simple model of hospital response to the incentives created by Medicare reimbursement policies, including the basic CBR formula and the two constraints: (1) Medicare pays the lesser of costs and charges, and (2) an absolute limit on cost per diem for day services. I also discuss the effects of proprietary status and the incentives of the Medicare fiscal agent to monitor costs, depending on whether it pays costs or charges for its own subscribers. Section 3 briefly discusses data and estimation. Section 4 reports empirical tests of the theory for hospital laboratories. Section 5 summarizes estimates for day services and total hospital operations. Section 6 reviews the results and policy implications.

2. Model of hospital behavior

To illustrate the incentives created by Medicare cost reimbursement, consider a hospital that operates two revenue-producing departments — day services and a laboratory — and one non-revenue-producing or overhead department. Each revenue-producing department produces a single service at a constant direct cost per unit. The cost of the overhead department is assumed fixed but its allocation between the two revenue-producing departments is discretionary.

The hospital serves two types of patient, who are distinguished by whether their third-party co-payers pay costs or charges. Charge-paying patients pay (some fraction of) charges. The demand of charge-paying patients is assumed sensitive to the level of charges because charge-based insurance plans typically contain deductible or co-insurance provisions. Demand for laboratory services is expected to be more elastic than demand for day

6For brevity, I drop the distinction between patients and co-payers and write as if the patients paid directly.
services because hospital laboratories serve both outpatients and inpatients, and insurance coverage of outpatient services is less complete.\textsuperscript{7}

Cost-paying patients pay their fraction of costs, determined by the Medicare reimbursement formula. First, overhead costs are allocated to the revenue-producing departments.\textsuperscript{8} Then Medicare’s share of costs in each revenue-producing department is calculated by computing the ratio of (hypothetical) departmental charges to Medicare patients to (hypothetical) charges to total patients, and multiplying this ratio by total departmental costs. This formula is referred to as the ratio of charges to charges applied to costs (RCCAC). Hereafter I refer to cost-paying patients as Medicare patients, but the analysis applies equally to the California Medicaid program (Medi-Cal) or any insurance plan using a similar formula.\textsuperscript{9} The demand of cost-paying patients is assumed unaffected by costs or charges. This seems appropriate because Medi-Cal has zero co-payment on all services, and co-payment under Medicare is independent of the actual level of hospital costs or charges.\textsuperscript{10}

There are two constraints on costs reimbursable by Medicare: (1) an absolute ceiling on the per diem cost for day services; and (2) Medicare pays the lesser of costs and charges, i.e., costs to Medicare, aggregated over all departments, cannot exceed hypothetical charges Medicare would pay if it paid on a charge basis and paid the fraction of charges actually collected from charge-paying patients.

\textsuperscript{7}The average inpatient co-insurance rate (fraction of hospital costs paid by patients) is 8 to 10 percent and the marginal co-insurance rate for a non-trivial number of charge-paying patients may well be zero. As the marginal co-insurance tends to zero, so does the elasticity of demand. Most insurance plans, including Medicare, contain at least 20 percent co-insurance for outpatient services. Medicare regulations forbid different prices for outpatient and inpatient laboratory services. Therefore the overall elasticity of demand for laboratory services is the weighted average of the inpatient and outpatient demand elasticities.

\textsuperscript{8}There are guidelines for the allocation of overhead among departments, but some flexibility remains. For example, administration costs are allocated in proportion to direct costs, cafeteria in proportion to meals served. Certain costs are disallowed, including bad debts to non-Medicare patients, luxury accommodations, gift shop, etc. Costs of hospital-based physicians are treated separately. See below.

\textsuperscript{9}It does not apply to the CBR formula of Blue Cross of Southern California, which computes an average cost per day, inclusive of all routine (day) and ancillary services, multiplied by the number of Blue Cross patient days:

\[
\text{Blue Cross reimbursement} = \left\{ \frac{[\text{total Blue Cross allowable cost} \times 1.06]}{\text{total patient days}} \right\} \times \text{Blue Cross days}.
\]

Blue Cross pays the lesser of costs and (hypothetical) charges. Reimbursement is described in more detail in Danzon (1980).

\textsuperscript{10}The Medicare co-payment provisions for inpatient hospital service are as follows: a fixed annual deductible; zero co-payment for the first 60 days per spell of illness; a per diem equal to one-quarter of the deductible for the next 30 days per spell of illness; a per diem equal to one-half of the deductible for subsequent days, up to a lifetime reserve of 60 days. A new spell of illness may begin only after 60 days discharged from a hospital or skilled nursing facility. The deductible has increased from $84 in 1974 to $204 in 1981. Medicare outpatient services are reimbursed on the basis of charges, with deductible ($60 in 1979) and 20 percent co-payment.
The hospital’s objective is to maximize net revenue subject to these two constraints. The choice variables are the charge for laboratory services, $P_l$, the charge for day services, $P_d$, and the fraction of overhead to be allocated to the laboratory, $\alpha$,

$$\max \quad \text{Lab Medicare Revenues} + \text{Day Service Medicare Revenues}$$
$$+ \text{Collectible Charges} - \text{Total Costs},$$

subject to

(i) \text{Per Diem Cost} \leq \text{Per Diem Ceiling},

(ii) \text{Total Medicare Revenues} \leq \text{Imputed Medicare Charges},

or

$$\max_{P_l, P_d, \alpha}: \frac{L_m}{L} [c_l L + \alpha Z] + \frac{D_m}{D} [c_d D + (1 - \alpha) Z] + \beta [P_l L_m + P_d D_n]$$
$$- c_l L - c_d D - Z + \mu_1 \left[ c_d - \left( \frac{(1 - \alpha) Z}{D} \right) \right]$$
$$+ \mu_2 \left[ \beta (P_l L_m + P_d D_m) - \frac{L_m}{L} (c_l L + \alpha Z) - \frac{D_m}{D} [c_d D + (1 - \alpha) Z] \right], \quad (1)$$

where

$L_m = \text{laboratory services of cost-paying patients, } M$,
$L_n = \text{laboratory services of charge-paying patients, } N$,
$L = L_m + L_n$,
$D_m = \text{day services of cost-paying patients}$,
$D_n = \text{day services of charge-paying patients}$,
$D = D_m + D_n$,
$P_l = \text{average charge for laboratory services}$,
$c_l = \text{average cost of laboratory services}$,
$P_d = \text{average charge for day services}$,
$c_d = \text{average cost of day services}$,
$Z = \text{overhead cost of non-revenue-producing centers}$,
$\alpha = \text{fraction of overhead allocated to laboratory}$,
$(1 - \alpha) = \text{fraction of overhead allocated to day services}$,
$\beta = \text{charges collected/charges billed, from charge-paying patients}$,
$C_d = \text{per diem ceiling}$,
$\mu_1, \mu_2 = \text{Lagrange multipliers}$. 
Maximization of (1) with respect to $P_l$, $P_d$, $\alpha$, $\mu_1$ and $\mu_2$ yields the following first-order conditions:

\[
\beta P_l\{1 + \varepsilon_{L_l}^{-1}[1 + \varepsilon_{P,P_l}(1 + P_d D_m/P_l L_n)]\} - \alpha Z / L^2 [L_m(1 - \mu_2)] + \mu_2 \beta L_m[1 + \varepsilon_{P,P_l}(1 + P_d D_m/P_l L_m)](\partial P_l/\partial L_m) = c_l,
\]

(2)

\[
\beta P_d\{1 + \varepsilon_{D_d}^{-1}[1 + \varepsilon_{P,P_d}(1 + P_l L_m/P_d D_m)]\} - (1 - \alpha)Z / D^2 [D_m(1 - \mu_2) - \mu_1] + \mu_2 \beta D_m[1 + \varepsilon_{P,P_d}(1 + P_l L_m/P_d D_m)](\partial P_d/\partial D_m) = c_d,
\]

(3)

\[
[L_m/L - D_m/D](1 - \mu_2) + \mu_1 / D = 0,
\]

(4)

\[
\bar{C}_D = c_d + (1 - \alpha)Z / D,
\]

(5)

\[
\beta(P_l L_m + P_d D_m) = L_m / L (c_l L + \alpha Z) + D_m / D [c_d D + (1 - \alpha)Z].
\]

(6)

where

\[
\varepsilon_{L_l} = \text{charge elasticity of demand for laboratory services},
\]

\[
\varepsilon_{D_d} = \text{charge elasticity of demand for day services},
\]

\[
\varepsilon_{P,P_l} = \text{elasticity of collection ratio with respect to } P_l.
\]

Eqs. (2) and (3), which define the optimum charges $\bar{P}_l$ and $\bar{P}_d$, show how the RCCAC formula for CBR and the per diem and lesser of costs or charges constraints affect optimum charges to charge-paying patients. To isolate the effects of each of these features, consider first a situation where all patients pay charges. In this case, only the first term would appear on the left-hand side of eqs. (2) and (3). Optimum charges for laboratory and day services are those of a profit-maximizing monopolist. The optimum markup over marginal cost depends only upon the charge elasticity of demand and the elasticity of the collection ratio,

\[
(\beta P_l - c_l)/\beta P_l = -[1 + \varepsilon_{P,P_l}(1 + P_d D_m/P_l L_n)]/\varepsilon_{L_l}.
\]

Now introduce cost reimbursement for one group of patients, but without further constraints, i.e., $\mu_1 = \mu_2 = 0$. The first-order conditions under these

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11This formulation assumes that the demand for laboratory and day services is independent. It also assumes that constraints on reimbursable costs apply as equality rather than inequality constraints. If the values of $\mu_1$ and $\mu_2$ so obtained are non-negative, the associated optimum is also the optimum subject to inequality constraints. If the resulting values of $\mu_1$ and $\mu_2$ are negative, the associated constraint is not binding and the problem can be solved without it. The resulting optimum will usually satisfy the disregarded constraint and will be the solution to the problem, subject to the inequality constraint.
assumptions are

\[ \beta P_l \{1 + \varepsilon_{l, m}^{-1} [1 + \varepsilon_{l, P_l} (1 + P_d D_m / P_l L_m)]\} - \alpha Z \frac{L_m}{L^2} = c_l, \quad (2') \]

\[ \beta P_d \{1 + \varepsilon_{l, m}^{-1} [1 + \varepsilon_{l, P_d} (1 + P_d D_m / P_l L_m)]\} - (1 - \alpha) Z \frac{D_m}{D^2} = c_d, \quad (3') \]

\[ L_m / L - D_m / D = 0. \quad (4') \]

Rearranging eq. (2') shows how introducing RCCAC cost reimbursement for a second group of patients raises the optimum markup to charge-paying patients,

\[ \beta P_l - \{c_l + \alpha Z \frac{L_m}{L^2}\} / \beta P_l = - \{1 + \varepsilon_{l, P_l} [(1 + P_d D^m / P_l L_m)]\} \varepsilon_{l, m}^{-1}. \]

An increase in charges reduces the quantity of services demanded by charge-paying patients, while services demanded by Medicare are unaffected. The Medicare share of services, therefore, rises and the Medicare contribution to the overhead costs allocated to the laboratory increases. This increase in revenue from Medicare partially offsets the loss in revenue from charge-paying patients due to raising charges above the simple profit-maximizing level. Optimum charges are higher, the larger the Medicare share of services and the larger the allocated overhead cost.\(^{12}\)

Eq. (4') shows that the profit-maximizing allocation of overhead among departments requires that the Medicare share of services be the same in all departments. This is an intuitively obvious result. The Medicare share determines the fraction of each dollar of overhead allocated to the department that can be recouped from Medicare. Alternatively stated, $L_m / L$ is the marginal revenue of shifting a dollar of overhead to the laboratory, and $D_m / D$ is the marginal cost of shifting a dollar of overhead from day services. The profit-maximizing allocation of overhead requires equality of these marginal quantities. A further implication is that if for some reason the Medicare share is not uniform across departments, revenue maximization requires allocating all overhead to the department used most intensively by Medicare.\(^{13}\)

\(^{12}\)Note that the result with respect to quantity does not depend on the assumption that the hospital has monopoly power. If the hospital is a price-taker with respect to $P_l$, its choice variable is $L_m$, the quantity of services provided to charge-paying patients. The first-order condition for an optimum is identical to eq. (2') except that the elasticity terms drop out. Thus the optimum quantity supplied is less than in the absence of any cost-paying patients.

If decreasing (increasing) direct costs is assumed, there is an additional positive (negative) term on the right-hand side of eqs. (2') and (3') that represents the decrease (increase) in average direct costs and hence in Medicare reimbursement because of expanding services to patients who do not pay costs. This is the effect noted by Davis (1970).

\(^{13}\)If a department produces multiple services, the crucial variable is the volume-weighted Medicare share of total charges. This encourages distortion of relative charges within a department, as shown by Davis (1970) and Hellinger (1975).
Consider now the effect of imposing a ceiling, \( C_d \), on allowable cost per day for day services. The first-order conditions for \( P_d \) and \( \alpha \) now involve \( \mu_1 \),

\[
\beta P_d \{ 1 + \varepsilon_{D_n}^{-1} [ 1 + \varepsilon_{P_d, P_d} (1 + P_l L_m/P_m D_m) ] \} \\
-(1-\alpha) Z/D^2 (D_m - \mu_1) = c_d, \\
L_m/L - (D_m - \mu_1)/D = 0.
\]

If the constraint is binding, \( \mu_1 \) is positive and marginal revenue from allocating overhead costs to day services is reduced. This implies an increase in \( \hat{\mu}_1 \), the optimum fraction of overhead allocated to the laboratory. This in turn implies an increase in \( \hat{P}_1 \), whereas \( \hat{P}_d \) falls because of the reduction in the term \( (1-\alpha)Z/D^2(D_m - \mu_1) \).

Finally, introduce the additional constraint that reimbursement from Medicare is equal to the lesser of costs and collectible charges. Eqs. (2) and (3) for \( \hat{P}_1 \) and \( \hat{P}_d \) now contain terms involving \( \mu_2 \), which is non-negative if the constraint is binding. The effect of this constraint on optimum charges is ambiguous a priori. On the one hand, an increase in charge levels raises the ceiling on allowable reimbursement from Medicare. On the other hand, an increase in charge levels may reduce the percentage of charges actually collected, \( \beta \). Because the partial derivative \( \partial P_l/\partial L_m \) is negative, the sign of the last expression in eq. (2) is negative if the term in brackets is positive. The necessary condition for this to be the case is 14

\[
|\varepsilon_{P_l, P_l}| < P_l L_m/(P_l L_m + P_d D_m).
\]

Thus, if the elasticity of the collection ratio with respect to the charge level is less than the laboratory share of total Medicare charges, the lesser-of-costs-or-charges constraint raises the optimum level of charges.15 For services that are heavily insured with a service benefit form of insurance, an increase in charge levels is borne largely by third-party payers. In this case, \( \beta \) is close to unity and \( |\varepsilon_{P_l, P_l}| \) is negligibly small. Thus a high level of insurance coverage of charge-paying patients increases the likelihood that the lesser-of-costs-or-charges constraint leads to an increase in charge levels, in order to raise the

14Note that \( \mu_2 > 0 \) reduces the upward pressure on charges because of the first effect [second term in eqs. (2) and (3)], which derives from the increase in the Medicare multiplier, \( L_m/L \). However, the sign is reversed — i.e., a lower optimum price — only if \( \mu_2 > 1 \), which is unlikely. The Lagrange multiplier \( \mu_2 \) represents the increment in revenue due to an increase in the charge ceiling. If \( \mu_2 = 1 \) there is a dollar increase in Medicare revenue for each dollar increase in charge levels. However, there is a loss in revenue from charge-paying patients, as charges increase above the optimal level for that group alone. This implies \( 0 < \mu_2 < 1 \).

15For the sample of California hospitals used in this study, the mean ratio of Medicare laboratory charges to total Medicare charges is 0.14.
ceiling and hence Medicare reimbursement. This constraint raises the cost to the hospital of providing charity care.

This analysis implies the following propositions, which will be tested to the extent data permit:

(1) The presence of Medicare patients, reimbursed by the RCCAC formula, increases the charge quoted to charge-paying patients by an unconstrained, profit-maximizing hospital monopoly; (1a) for a competitive firm, there would be a reduction in services to charge-paying patients.

(2) If Medicare imposes a binding constraint on per diem costs, then the allocation of overhead to the laboratory and charges for laboratory services are increased, whereas the per diem charge is reduced.

(3) If insurance coverage of charge-paying patients is extensive, then the constraint that Medicare pays the lesser of costs and imputed charges increases charges to charge-paying patients.

Qualifications of the model's assumptions suggests the following additional propositions:

(4) Overhead costs. If overhead costs, $Z$, are endogenous, the first-order condition for an optimum is

$$
(1 - \mu_2)[\alpha L_{m}/D + (1 - \alpha)D_{m}/D] - \mu_1(1 - \alpha)/D = 1.
$$

Eq. (7) assumes that $Z$ represents economic costs that have no effect on demand by charge-paying patients. The left-hand side of eq. (7) is necessarily less than one, because only the Medicare fraction of overhead costs is recouped. With this assumption it is never optimal to increase $Z$, whether or not the constraints $\mu_1$ and $\mu_2$ are binding. On the other hand, if increasing $Z$ improves quality, which is valued by charge-paying patients or hospital personnel, or if $Z$ is simply an accounting artifact, then eq. (7) does not apply. Without specifying a rigorous model, the qualitative implications seem intuitively obvious. If $Z$ entails some increase in quality and in economic costs, that is valued by charge-paying patients and hospital personnel, then $Z$ and hence total operating costs will be higher: the less elastic the demand of charge-paying patients; the greater their demand for quality; and the more hospital personnel are willing and able to trade utility for dollars.

(5) Proprietary status. Many authors have argued that profit maximization does not accurately describe the objectives of decision-makers in voluntary non-profit, government, and district hospitals, but there is no consensus on an alternative [see, for example, Newhouse (1970), Davis (1973), Pauly

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16 This is an extreme case of the result reached in Davis (1973).
Although the rights to residual profit in a non-profit hospital are not well defined, profit maximization is nevertheless an appropriate model provided the various claimants can agree on maximizing their joint gain. It is therefore an empirical question whether significant differences exist.

Assuming profit maximization, if all types of hospitals operate in the same factor and product markets, no systematic difference is expected in charges or production costs. Absent CBR, accounting costs net of taxes and profit might be higher in non-profit hospitals, by the amount of taxes plus accounting profit in for-profit hospitals. However, with CBR based on accounting costs, net of profit, for-profits have incentives to disguise economic profit as higher accounting costs. If so, non-profits' accounting costs will be higher only by the for-profits' tax margin.

‘Profit’ ratios. If accounting cost is a pure price — an increase in accounting cost does not increase economic costs — the profit-maximizing accounting profit ratio is greater or less than unity as the elasticity of demand of charge-paying patients is less or greater than the elasticity of demand of Medicare patients. If Medicare demand is less elastic, optimum accounting profits would be negative. However, because of the constraint that costs not exceed charges, optimum accounting profits are zero and the optimum accounting profit ratio is unity.

Monitor effects. Medicare reimbursement is typically handled by a private insurer on behalf of the federal government. A hypothesis to be tested is that the incentive of the Medicare carrier to monitor hospital costs for Medicare is greater where the carrier pays costs for its private beneficiaries, as does Blue Cross of Southern California, then where the carrier pays charges for its private beneficiaries, as does Blue Cross of Northern California. Some costs are joint costs of serving cost and charge-paying patients. If these costs are disallowed by cost-payers, the full cost is borne by charge-payers. Therefore a carrier that pays charges for its beneficiaries has more incentive to allow questionable costs than one that also pays costs.

Competition in the market for ambulatory care. Hospital laboratories may compete with independent laboratories in serving office-based physicians. Because insurance coverage for ambulatory care is lower than for inpatient services, the profit-maximizing strategy would be to set lower charges for the ambulatory market. However, Medicare regulations prohibit a two-part tariff. Therefore the single laboratory charge level will be lower, the greater the number of competitors (hospital and independent laboratories) in the locality.

17 The differential reflects the rents implicit in non-profit status.
18 In California in 1976, the majority of hospitals used Blue Cross (North or South); the remainder used two commercial insurers.
3. The data

The sample consists of 274 short-term general, non-teaching hospitals in California.\(^{19}\) Data on these hospitals were derived from two sources. Medicare costs reports, which are the hospital accounting statements filed with Medicare for reimbursement purposes, were used for data on laboratory costs, charges, Medicare share of charges, remuneration of pathologists, day service costs, and ceilings on per diem costs, for accounting years ending in 1976. Reports filed with the California Health Facilities Commission (CHFC) provided data on laboratory output, the case mix of the hospital, the fraction of laboratory services provided to Medi-Cal patients and to outpatients, hourly wage rates of laboratory personnel, day service costs and charges, and total operating costs and charges.\(^{20}\) Data on county demographic characteristics and on the number of hospital and independent laboratories, by three-digit zip code, were merged with the hospital file.\(^{21}\)

To test the predicted effects of the reimbursement and other factors on costs, the appropriate variables are included in an equation that corresponds to a cost function. Under the null hypothesis that accounting costs reflect economic costs, only those variables that affect economic costs — scale, mix of output and input prices — should be significant.

Unfortunately, the available data are severely deficient for measuring cost-function parameters and reimbursement effects. Laboratory output is a weighted aggregate of tests, where weights are units assigned by the College of American Pathologists (CAP). Since CAP units are intended to measure minutes of technician time required to perform a test, the total number of CAP units is a rough complexity-adjusted measure of output.\(^ {22}\) To provide some control for bias in the measure of output due to differences in test mix across hospitals, I include the specialty distribution of the physician staff as an indicator of hospital case mix.\(^ {23}\) There are no adequate data on input quantities or prices, or on the fraction of tests purchased from independent laboratories. To provide some control for unmeasured variation in supply

\(^{19}\)University teaching hospitals are excluded because they produce both teaching and patient care.

\(^{20}\)The CHFC data base was designed for the purpose of setting rates. The accounting conventions differ slightly from those used by Medicare. To test the effects of Medicare reimbursement policies on accounting costs requires data on costs reported for reimbursement. I did not obtain Medicare data on day service charges and total operating costs and charges, so these variables were taken from the CHFC. Medicare cost report data were not available for many hospitals, and the final sample probably underrepresents small hospitals.

\(^{21}\)These data were obtained from *Laboratory Management*.

\(^{22}\)The personnel costs measured by the CAP technique may represent as little as 20 percent of total costs of operating a laboratory. Hereafter I refer to ‘units’ as ‘tests’, but the distinction must be borne in mind.

\(^{23}\)Mix of medical staff had greater explanatory power than mix of patient days. After controlling for medical staff, measures of hospital output (hours of surgery, hours of dialysis, number of EKGs, number of emergency outpatient visits) were insignificant.
price of laboratory personnel, supplies and purchased tests, I include the number of physicians per capita and the percentage of the country classified as urban. Indicators of proprietary status may reflect differences in supply price of capital.

Measures of laboratory costs and charges may contain error due to the complex contractual arrangements that exist between hospitals and pathologists and the Medicare regulations for reimbursement of pathologists. For Medicare reimbursement, the hospital is required to allocate the time of pathologists (and other hospital-based physicians) into the fraction spent in general hospital functions, such as administration and research, and the fraction spent in direct patient care, the 'professional component'. The former is reimbursed on a cost basis, together with other hospital costs. The professional component is subtracted out of hospital costs, billed to the Medicare Part B fiscal agent, and reimbursed on the basis of charges. In practice, some hospitals bill on behalf of the pathologist, using an RCCAC formula applied to the professional component, whereas other pathologists bill their own charges directly. The Medicare cost reports do not specify whether reported laboratory charges are gross or net of the professional component. Laboratory costs in principle include all costs net of the professional component. In fact, there may be measurement error because in some hospitals the pathologist contracts to provide other laboratory inputs, such as technicians or supplies. In these cases, the professional component may include part of the cost of these inputs, in addition to part of the pathologist's time. In sum, reported laboratory costs may be a downward-biased measure of non-physician costs where the pathologist contracts to supply other inputs, and laboratory charges may be a downward biased measure of total charges where the pathologist bills for his professional services. I attempt to adjust for these possible errors below.

No good measure is available of the demand elasticity of charge-paying patients, the collection ratio ($\beta$), or the elasticity of the collection ratio with respect to charges. As a proxy for all of these, I include the percentage of tests performed for outpatients. It should be positively related to the elasticity of demand and the elasticity of the collection ratio, inversely related to $\beta$.

Means and standard deviations of all variables are reported in table 1.

4. Empirical estimates: Laboratory costs and charges

The theoretical analysis predicts that with RCCAC cost reimbursement,  

24This follows the general principle that inpatient hospital services are reimbursed under Medicare Part A on the basis of cost, whereas physician services are reimbursed under Medicare Part B on the basis of charges.

25Because the data do not identify the reimbursement or contractual arrangements of the pathologist, I have not attempted to model them as choice variables.

26Per capita income in the county was tried but was insignificant.
Table 1
Mean and standard deviation of variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Sourcea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs and charges</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct lab costs</td>
<td>12.99</td>
<td>0.92</td>
<td>MCR</td>
</tr>
<tr>
<td>Fully allocated lab costs</td>
<td>13.33</td>
<td>0.94</td>
<td>MCR</td>
</tr>
<tr>
<td>Lab charges</td>
<td>13.70</td>
<td>0.97</td>
<td>MCR</td>
</tr>
<tr>
<td>Adjusted lab costs</td>
<td>13.43</td>
<td>0.96</td>
<td>MCR</td>
</tr>
<tr>
<td>Adjusted lab charges</td>
<td>13.71</td>
<td>0.98</td>
<td>MCR</td>
</tr>
<tr>
<td>Day service costs</td>
<td>14.69</td>
<td>0.96</td>
<td>MCR</td>
</tr>
<tr>
<td>Day service costs</td>
<td>14.93</td>
<td>0.98</td>
<td>CHFC</td>
</tr>
<tr>
<td>Day service charges</td>
<td>13.53</td>
<td>1.07</td>
<td>CHFC</td>
</tr>
<tr>
<td>Total operating costs</td>
<td>15.68</td>
<td>0.96</td>
<td>CHFC</td>
</tr>
<tr>
<td>Total operating charges</td>
<td>15.68</td>
<td>0.99</td>
<td>CHFC</td>
</tr>
<tr>
<td>Total lab costs</td>
<td>13.39</td>
<td>0.95</td>
<td>CHFC</td>
</tr>
<tr>
<td>Total lab revenue</td>
<td>13.53</td>
<td>0.96</td>
<td>CHFC</td>
</tr>
<tr>
<td>Output</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total units</td>
<td>13.87</td>
<td>1.25</td>
<td>CHFC</td>
</tr>
<tr>
<td>(Total units)²</td>
<td>193.84</td>
<td>33.39</td>
<td>CHFC</td>
</tr>
<tr>
<td>Days</td>
<td>10.25</td>
<td>0.96</td>
<td>MCR</td>
</tr>
<tr>
<td>(Days)²</td>
<td>105.66</td>
<td>19.14</td>
<td>MCR</td>
</tr>
<tr>
<td>Input prices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab contracted</td>
<td>0.17</td>
<td>0.37</td>
<td>LM</td>
</tr>
<tr>
<td>%urban</td>
<td>90.47</td>
<td>14.55</td>
<td>ARF</td>
</tr>
<tr>
<td>Sum</td>
<td>0.40</td>
<td>0.49</td>
<td>MCR</td>
</tr>
<tr>
<td>MDs per capita</td>
<td>0.002</td>
<td>0.0008</td>
<td>ARF</td>
</tr>
<tr>
<td>Reimbursement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% tests, outpatient</td>
<td>0.21</td>
<td>0.13</td>
<td>CHFC</td>
</tr>
<tr>
<td>% lab charges, Medicare</td>
<td>0.29</td>
<td>0.18</td>
<td>MCR</td>
</tr>
<tr>
<td>% lab charges, Medicaid</td>
<td>0.16</td>
<td>0.12</td>
<td>CHFC</td>
</tr>
<tr>
<td>Lab share Medicare</td>
<td>0.14</td>
<td>0.09</td>
<td>MCR</td>
</tr>
<tr>
<td>Actual -- limit per diem</td>
<td>0.92</td>
<td>0.21</td>
<td>MCR</td>
</tr>
<tr>
<td>%days, Medicare</td>
<td>0.38</td>
<td>0.13</td>
<td>MCR</td>
</tr>
<tr>
<td>%days, Medicare</td>
<td>0.16</td>
<td>0.13</td>
<td>CHFC</td>
</tr>
<tr>
<td>Monitor, ownership, case mix, competition, etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North</td>
<td>0.23</td>
<td>—b</td>
<td>CHCF</td>
</tr>
<tr>
<td>For-profit</td>
<td>0.33</td>
<td>—b</td>
<td>CHCF</td>
</tr>
<tr>
<td>Government</td>
<td>0.06</td>
<td>—b</td>
<td>CHCF</td>
</tr>
<tr>
<td>District</td>
<td>0.12</td>
<td>—b</td>
<td>CHCF</td>
</tr>
<tr>
<td>%staff, surgeons</td>
<td>0.15</td>
<td>0.07</td>
<td>CHCF</td>
</tr>
<tr>
<td>%staff, internal medicine</td>
<td>0.17</td>
<td>0.08</td>
<td>CHCF</td>
</tr>
<tr>
<td>%staff, pediatricians</td>
<td>0.04</td>
<td>0.04</td>
<td>CHCF</td>
</tr>
<tr>
<td>%staff, ob/gyn</td>
<td>0.07</td>
<td>0.06</td>
<td>CHCF</td>
</tr>
<tr>
<td>%staff, family or general practice</td>
<td>0.21</td>
<td>0.15</td>
<td>CHCF</td>
</tr>
<tr>
<td>Zero dialysis</td>
<td>0.72</td>
<td>0.45</td>
<td>CHCF</td>
</tr>
<tr>
<td>Independent labs in zip (3)</td>
<td>26.97</td>
<td>23.57</td>
<td>LM</td>
</tr>
<tr>
<td>Hospital labs in zip (3)</td>
<td>12.20</td>
<td>8.09</td>
<td>LM</td>
</tr>
</tbody>
</table>

aCHFC = California Health Facilities Commission, LM = Laboratory Management, ARF = Area Resource File, MCR = Medicare Cost Reports.
bNot relevant.
both charges and fully allocated costs in the laboratory are positively related to the Medicare share of total laboratory charges. If ceilings on per diem costs are binding, laboratory charges and costs are predicted to be negatively related to the per diem ceiling. If the lesser-of-costs-and-charges constraint is binding, laboratory costs and charges are predicted to be positively related to the laboratory share of total Medicare charges, and charge levels are predicted to be negatively related to the elasticity of demand of charge-paying patients and the elasticity of the collection ratio with respect to charge levels. To test these hypotheses and those relating to proprietary status, monitor effects, and competition (see section 2), appropriate variables are included in a cost function. If accounting costs reflected only economic costs, only variables affecting economic costs should be significant.

The equations are estimated in the form
\[
\ln C = \beta_0 + \beta_1 \ln Y + \beta_2 (\ln Y)^2 + \beta_3 P + \beta_4 X + u,
\]
where
- \(\ln C\) = total costs or charges (log),
- \(\ln Y\) = total output (log),
- \(P\) = vector of proxies for input prices,
- \(X\) = vector of other exogenous variables (reimbursement, case mix, ownership, monitor, independent laboratories, etc.),
- \(u\) = random error.

A similar functional form is then estimated for charges. Because dependent variables are in logs, tests for significant differences between coefficients in the cost and charge equations are equivalent to tests for significant effects on the accounting profit ratio. In this section, laboratory costs and charges are compared first net and then gross of the professional component.

4.1. Costs and charges: Net of professional component

Table 2 reports the cost function estimates for direct and fully allocated laboratory costs.\(^{28}\)

*Production function parameters.* The estimated output coefficients imply economies of scale of 0.5 at the sample mean. This suggests the potential for

---

\(^{27}\)This cost function corresponds to a restricted translog production function. Omitting interactions between input prices and input prices and output is equivalent to assuming homotheticity and unitary elasticities of substitution. This specification presupposes that output and input prices are exogenous, whereas the theory treated output is endogenous. Endogeneity of output is one among several reasons for mistrusting the estimates of economies of scale.

\(^{28}\)Direct cost includes supplies and personnel costs net of the professional component. Fully allocated cost includes direct cost plus capital cost of the laboratory and the share of non-revenue-producing departments allocated to the laboratory.
substantial savings in production costs if smaller hospitals pooled facilities or purchased tests from larger hospitals or independent laboratories. However, because CAP units measure technician time input rather than a homogeneous output, the apparent economies of scale may simply reflect a more labor-intensive mix in larger hospitals.

The various proxies for input supply prices were generally insignificant, with the exception of urbanization, which is positive. Controlling for urbanization, all measures of the supply price of physicians were insignificant: physicians per capita, pathology interns and residents per pathologist on the medical staff, percentage of hospital-based pathologists, average wage rate of laboratory personnel, and per capita income in the county.

Reimbursement effects. The evidence in table 2 strongly supports the conclusion that the RCCAC formula for cost reimbursement results in higher laboratory costs. A 10 percent increase in the Medicare share of charges is associated with an 8.3 percent increase in direct costs and an 8.2 percent increase in fully allocated costs; a 10 percent increase in the Medicaid share is associated with a 10.1 percent increase in direct cost and an 8.6 percent increase in fully allocated cost. The effect of Medicare and Medicaid shares on direct costs was not predicted, since the theory relates to the allocation of overhead. A plausible explanation is that the increase in direct cost is induced by the Medicare allocation rules, which tend to require an increase in accounting direct cost in a department as a necessary condition of increasing the allocation of overhead.

Laboratory costs are higher, the larger the laboratory share of total Medicare charges, as predicted if the lesser-of-costs-and-charges constraint is binding. The per diem ceiling has no effect. However, the per diem ceilings were not binding on most hospitals at this time, so these data do not permit a valid test of the hypothesis that binding constraints on per diem costs will be at least partially offset by reallocating costs from day services to ancillary services.

29Costs appear to be 10 to 14 percent higher in hospitals where the laboratory is contracted out. However, this may reflect different reporting conventions. Without data on tests purchased from independent laboratories, I cannot evaluate the common allegation that CBR induces an inefficient substitution of in-house testing for lower cost purchased tests.

30The average wage rate paid to non-physician personnel does not measure the supply price of labor of a homogeneous quality.

31The direct accounting cost differential may reflect an economic cost differential, if tests performed on Medicare and Medicaid patients typically utilize more costly non-labor inputs. However, since the two programs alone represent different population subgroups and together encompass a broad, if not fully representative cross-section, it seems unlikely that this is the sole cause of the large and similar effects. Controlling for mix of patient days and tests (4 large subgroups) did not affect the result.

32The Medicare share of laboratory charges and the laboratory share of total Medicare charges are highly correlated (0.66). Adding the latter, therefore, reduces the magnitude and significance of the coefficient of the former.
### Table 2
Laboratory direct costs and fully allocated costs (n=274).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Direct costs (log$_a$)</th>
<th>Fully allocated costs (log$_a$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient (t)</td>
<td>Coefficient (t)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coefficient (t)</td>
</tr>
<tr>
<td>Intercept</td>
<td>20.79 (8.48)</td>
<td>21.186 (8.74)</td>
</tr>
<tr>
<td>Total units</td>
<td>-1.80 (-4.81)</td>
<td>-1.822 (-4.92)</td>
</tr>
<tr>
<td>(Total units)$^2$</td>
<td>0.083 (5.80)</td>
<td>0.083 (5.96)</td>
</tr>
<tr>
<td>Lab contracted</td>
<td>0.136 (1.79)</td>
<td>0.138 (1.83)</td>
</tr>
<tr>
<td>%urban</td>
<td>0.004 (1.79)</td>
<td>0.003 (1.41)</td>
</tr>
<tr>
<td>North</td>
<td>0.276 (3.61)</td>
<td>0.256 (3.37)</td>
</tr>
<tr>
<td>For-profit</td>
<td>-0.297 (-3.9)</td>
<td>-0.327 (-4.29)</td>
</tr>
<tr>
<td>Government</td>
<td>-0.333 (-2.43)</td>
<td>-0.412 (-2.94)</td>
</tr>
<tr>
<td>District</td>
<td>0.020 (0.21)</td>
<td>-0.005 (-0.05)</td>
</tr>
<tr>
<td>Sum</td>
<td>0.214 (3.53)</td>
<td>0.21 (3.5)</td>
</tr>
<tr>
<td>%tests, outpatient</td>
<td>-0.597 (-2.31)</td>
<td>-0.561 (-2.2)</td>
</tr>
<tr>
<td>%charges, Medicare</td>
<td>0.830 (6.62)</td>
<td>0.396 (1.72)</td>
</tr>
<tr>
<td>%charges, Medicaid</td>
<td>1.01 (3.56)</td>
<td>0.844 (2.95)</td>
</tr>
<tr>
<td>Lab share Medicare</td>
<td>-0.3 (2.94)</td>
<td>1.191 (2.94)</td>
</tr>
<tr>
<td>Actual + per diem</td>
<td>-0.3 (0.39)</td>
<td>0.056 (0.39)</td>
</tr>
<tr>
<td>%staff, surgeons</td>
<td>0.814 (1.74)</td>
<td>0.532 (1.13)</td>
</tr>
<tr>
<td>%staff, internal medicine</td>
<td>1.167 (2.38)</td>
<td>1.252 (2.58)</td>
</tr>
<tr>
<td>%staff, pediatricians</td>
<td>2.815 (3.03)</td>
<td>2.422 (2.60)</td>
</tr>
<tr>
<td>%staff, ob/gyn</td>
<td>0.195 (0.34)</td>
<td>-0.019 (-0.03)</td>
</tr>
<tr>
<td>%staff, family or general practice</td>
<td>0.025 (0.08)</td>
<td>-0.004 (-0.02)</td>
</tr>
<tr>
<td>Zero dialysis</td>
<td>-0.163 (-2.63)</td>
<td>-0.185 (-2.13)</td>
</tr>
<tr>
<td>Independent labs</td>
<td>-0.002 (-0.89)</td>
<td>-0.001 (-0.26)</td>
</tr>
<tr>
<td>Hospital labs</td>
<td>0.004 (0.52)</td>
<td>0.0002 (0.03)</td>
</tr>
</tbody>
</table>

$^a$Significant difference, at ≥ 10 percent level, between coefficients in direct and fully allocated cost equations.

$^b$Significant difference, at ≥ 5 percent level, between coefficients in direct and fully allocated cost equations.

$^c$Variable not included in regression.
Proprietary status. There are significant differences in laboratory costs by proprietary status of the hospital. For-profit hospitals have 26–28 percent lower direct cost, 23–25 percent lower fully allocated costs than non-profits; government hospitals have 28–34 percent lower direct costs, 24–30 percent lower fully allocated costs than non-profits. District hospitals show no significant difference. Higher pretax accounting costs for non-profits were predicted, if the potential rents due to lower cost of capital and tax-exempt status are captured by other inputs or dissipated in production inefficiency. These data cannot distinguish between these hypotheses. The non-profit differential is slightly greater in direct laboratory costs (labor, supplies) than in the overhead departments.

Monitor effects. Laboratory costs are approximately 25 percent higher in Northern than in Southern California, controlling for urbanization and physician density. This is consistent with the hypothesis that Blue Cross South has a greater incentive to monitor costs.33

4.2. Costs vs. charges: The 'profit ratio'34

Table 3 shows accounting ‘profits’ by department, for various hospital samples. Note that the apparent profitability of the laboratory and other ancillary departments is in part an artefact of the Medicare reimbursement convention for hospital-based physicians, whereby costs are understated by the amount of the professional component. Adjusting for this reduces the average profit ratio for the 1976 California sample from 1.53 to 1.37. Table 4 reports the analysis of fully allocated cost and total charges for laboratory services. Significant differences between coefficients in the two equations imply a significant effect on the profit ratio.35

Reimbursement effects. Consistent with the predicted effects of the RCCAC formula, charges are positively related to the fraction of laboratory charges attributable to cost-paying patients. This is evidence that insurance coverage has not eliminated the demand constraint on charges. The elasticity of laboratory charges with respect to %Medicare is 0.93, and the elasticity with respect to %Medicaid is 1.17.36 The gross effect of %Medicare and %Medicaid on charges is greater than on costs. The differential is larger and more significant in the case of Medicaid (23 percentage points greater effect

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33 This conclusion, based on the laboratory alone, does not hold up for total operating results.
34 Recall that total charges is the hypothetical revenue the hospital would receive if all patients paid charges. Whereas costs exclude the pathologist professional component, charges may include the corresponding charges in some hospitals.
35 To test for significant differences in coefficients, the two equations were estimated as seemingly unrelated regressions and each restriction was tested sequentially by an F test. See Zellner (1962).
36 This is the gross effect, without controlling for the laboratory share of total Medicare charges or the Medicare ceiling on per diem costs.
Table 3
Hospital accounting profits by department.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Laboratory</th>
<th>Delivery room</th>
<th>Other ancillary</th>
<th>Daily services</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1962–66 Nationala</td>
<td>1.66</td>
<td>0.89</td>
<td>1.34 (radiology)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>n=462</td>
<td></td>
<td></td>
<td>1.40 (operating room)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970 Ohiob</td>
<td>1.41</td>
<td>0.69</td>
<td>1.39 (radiology)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>n=17</td>
<td></td>
<td></td>
<td>1.29 (operating room)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1975-76 Californiac</td>
<td>— Unadjusted: 1.53</td>
<td>0.60</td>
<td>1.38</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>— Adjusted:</td>
<td>1.37</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>1976 N. Californiad</td>
<td>— Total: 1.06</td>
<td>0.60</td>
<td>1.06</td>
<td>0.91</td>
<td>0.98</td>
</tr>
<tr>
<td>— Profit:</td>
<td>1.08</td>
<td>0.54</td>
<td>1.15</td>
<td>0.94</td>
<td>1.04</td>
</tr>
<tr>
<td>— Non-profit:</td>
<td>1.07</td>
<td>0.58</td>
<td>1.01</td>
<td>0.97</td>
<td>1.03</td>
</tr>
<tr>
<td>— Government:</td>
<td>1.03</td>
<td>0.64</td>
<td>0.95</td>
<td>0.81</td>
<td>0.88</td>
</tr>
<tr>
<td>1976 S. Californiad</td>
<td>— Total: 1.20</td>
<td>0.55</td>
<td>1.09</td>
<td>0.88</td>
<td>0.99</td>
</tr>
<tr>
<td>— Profit:</td>
<td>1.31</td>
<td>0.53</td>
<td>1.13</td>
<td>0.87</td>
<td>1.02</td>
</tr>
<tr>
<td>— Non-profit:</td>
<td>1.15</td>
<td>0.58</td>
<td>1.09</td>
<td>0.93</td>
<td>1.01</td>
</tr>
<tr>
<td>— Government:</td>
<td>0.98</td>
<td>0.53</td>
<td>0.96</td>
<td>0.79</td>
<td>0.87</td>
</tr>
</tbody>
</table>

*aSource: Medicare Cost Reports [Davis and Foster (1972)].
*Definition: (total charges + direct cost).
*bSource: Medicare Cost Reports [Hellinger (1975)].
*Definition: (total charges + fully allocated cost).
*cSource: Medicare Cost Reports.
*Definition: (total charges + fully allocated cost). Unadjusted: costs net of professional component, some charges gross of professional component. Adjusted: costs and charges gross of professional component.
*dSource: California Health Facilities Commission.
*Definition: Total (net) charges ÷ total (net) cost. Hospital component only, net of cost and charges for professional component.

on charges than on costs). One possible explanation for this is that Medicare patients pay charges for outpatient tests, with a 20 percent coinsurance rate, whereas Medicaid pays for outpatient tests according to a schedule, with zero coinsurance. Medicare demand will therefore be more elastic.

The positive effect of the laboratory share of total Medicare charges on total laboratory charges is consistent with a binding lesser-of-costs-and-charges constraint, as predicted if the elasticity of the collection ratio with respect to charges is low. The limit on per diem costs shows no significant effect on charges, plausibly because it was not a binding constraint for most hospitals.

**Proprietary status.** Whereas for-profit hospitals have 23–25 percent lower laboratory costs than non-profit hospitals, their charge levels are only 0–13 percent lower. For government hospitals, the 24–30 percent cost differential, relative to non-profits, is fully reflected in an equivalent charge differential.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Fully allocated costs</th>
<th>Total charges</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient (t)</td>
<td>Coefficient (t)</td>
</tr>
<tr>
<td>Intercept</td>
<td>21.664 (9.27)</td>
<td>22.03 (5.55)</td>
</tr>
<tr>
<td>(Total units)</td>
<td>-1.871 (-5.2)</td>
<td>-1.909 (-5.2)</td>
</tr>
<tr>
<td>Lab contracted</td>
<td>0.086 (3.29)</td>
<td>0.087 (6.42)</td>
</tr>
<tr>
<td>%urban</td>
<td>0.100 (4.25)</td>
<td>0.101 (4.55)</td>
</tr>
<tr>
<td>North</td>
<td>0.008 (1.33)</td>
<td>0.008 (4.13)</td>
</tr>
<tr>
<td>For-profit</td>
<td>0.039 (3.31)</td>
<td>0.039 (2.43)</td>
</tr>
<tr>
<td>Government</td>
<td>0.026 (2.71)</td>
<td>0.025 (2.71)</td>
</tr>
<tr>
<td>District</td>
<td>0.004 (1.47)</td>
<td>0.004 (1.47)</td>
</tr>
<tr>
<td>%testK outpatient</td>
<td>0.087 (5.86)</td>
<td>0.087 (5.86)</td>
</tr>
<tr>
<td>%lab charges, Medicare</td>
<td>0.041 (2.7)</td>
<td>0.041 (2.7)</td>
</tr>
<tr>
<td>%lab charges, Medicaid</td>
<td>0.019 (1.33)</td>
<td>0.019 (1.33)</td>
</tr>
<tr>
<td>Lab share Medicare</td>
<td>0.046 (4.44)</td>
<td>0.046 (4.44)</td>
</tr>
<tr>
<td>Actual – limit per diem</td>
<td>0.018 (1.33)</td>
<td>0.018 (1.33)</td>
</tr>
<tr>
<td>%staff, surgeons</td>
<td>0.293 (5.52)</td>
<td>0.293 (5.52)</td>
</tr>
<tr>
<td>%staff, Internal medicine</td>
<td>2.6 (2.44)</td>
<td>2.6 (2.44)</td>
</tr>
<tr>
<td>%staff, pediatrics</td>
<td>0.263 (2.71)</td>
<td>0.263 (2.71)</td>
</tr>
<tr>
<td>%staff, ob/gyn</td>
<td>0.143 (1.16)</td>
<td>0.143 (1.16)</td>
</tr>
<tr>
<td>%staff, family or general practice</td>
<td>-0.022 (-0.07)</td>
<td>-0.022 (-0.07)</td>
</tr>
<tr>
<td>Zero dialysis</td>
<td>-0.142 (-2.13)</td>
<td>-0.157 (-2.35)</td>
</tr>
<tr>
<td>Independent labs</td>
<td>0.108 (0.35)</td>
<td>0.108 (0.35)</td>
</tr>
<tr>
<td>Hospital labs</td>
<td>0.108 (0.35)</td>
<td>0.108 (0.35)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.801 (0.43)</td>
<td>0.8074 (0.43)</td>
</tr>
</tbody>
</table>

*Charge and cost coefficients significantly different at 10 percent level.

*Charge and cost coefficients significantly different at 5 percent level.

Variable not included in regression.
One explanation is that for-profit and non-profit hospitals serve a similar charge-paying market so are constrained by competition, whereas government hospitals operate in a separate market. An alternative but not mutually exclusive interpretation is that property rights over potential profit, hence the incentives facing administrators, are different in government hospitals.

Monitor effects. Laboratory charges, like costs, are higher in Northern than Southern California. The charge differential is significantly less than the cost differential. This is consistent with the hypothesis that a carrier that pays charges has less incentive to monitor costs than a carrier that also pays costs.

Competition. Two findings confirm that the elasticity of demand for laboratory services is not zero and that competitive forces operate to some extent. The elasticity of charges with respect to percent of tests performed for outpatients is significantly more negative (−0.90) than the elasticity of costs (−0.50). The effect on costs may reflect variations in test mix. The difference between cost and the charge elasticities suggests sensitivity to demand.37 Second, charges are negatively related to the number of independent laboratories in the area, as predicted if they compete for the office-based physician market.38

4.3. Costs and charges: Gross of professional component

The analysis so far has examined hospital laboratory costs net of pathologist costs attributable to direct patient care (professional component).39 Total charges used so far may be either gross or net of the professional component. To investigate the effect of this measurement error, the same analysis was performed using estimates of costs and charges constructed to include both hospital and professional components. The procedure for computing gross costs and charges and equation estimates are described elsewhere.40 The results are summarized here.

The elasticity of total gross costs (hospital plus professional component) with respect to %Medicare is 17 percentage points greater than the elasticity of the hospital component alone. This suggests that the Medicare

37 Less extensive insurance coverage of outpatient services implies more elastic demand, hence lower profit-maximizing charge levels.

38 Since costs are not affected, the lower charges are apparently not simply due to (unmeasured) lower supply price of inputs in areas with a high density of laboratories.

39 This could bias the other parameter estimates if the physician share of costs differs systematically across hospitals because of systematic differences in production functions or in the physician assumption of other input costs, by size, ownership type, or other hospital characteristics.

40 See Danzon (1980). The unexplained variance of costs is slightly decreased by adding in the pathologist remuneration, whereas the unexplained variance of charges is increased by the attempt to adjust for omitted charges for pathologists' services.
reimbursement policy, which requires separation of these two components and separates the monitoring of these costs between the Part A and Part B carriers, results in a higher total cost. Medicaid does not make this distinction between professional and other costs. The elasticity of total costs with respect to %Medicaid falls 9 percentage points when the professional component is added. The changes in the charge elasticities are less than 3 percent. None of the other coefficients changes significantly when the professional component is added to the hospital component.

5. Day services and total operating costs and charges

The theoretical model predicts that charge levels in all departments are positively related to the Medicare and Medicaid shares; negatively related to the elasticity of demand of charge-paying patients and the elasticity of the collection ratio; and that overhead costs are shifted toward departments used relatively intensively by Medicare patients. Predictions for the level of overhead costs and hence total operating costs were ambiguous. If accounting costs are a pure price, i.e., can be increased without increasing economic costs, then total operating costs will increase or decrease relative to total operating charges, depending on whether Medicare demand is more or less elastic than the demand of charge-paying patients. Limits on per diem costs, if binding, should restrict costs in the day service department, but increase costs in other departments. The results so far confirm that the Medicare and Medicaid shares do tend to increase costs and charges in the laboratory, with the increase in charges significantly greater than the increase in costs.

Unfortunately, the data available to me are not ideal for testing the theory in other departments. The theory relates to costs and charges reported to Medicare for reimbursement. I have data on day service costs from Medicare costs reports, but for day service charges and total operating costs and charges, I have had to use CHFC data. CHFC reports were designed for rate-setting rather than reimbursement, use different accounting conventions, and may create different incentives for hospitals. Analysis of these data on day service and total operating costs and charges is reported in detail elsewhere [Danzon (1980)]. The results are summarized here.

A comparison of costs reported to Medicare and to CHFC suggests that hospitals with a relatively large share of cost-paying patients report relatively higher day service costs to Medicare than to CHFC. This is consistent with the general hypothesis, that CBR encourages manipulation of accounting costs to maximize reimbursement.

For total operating costs and charges (CHFC data), the Medicare share has no effect, while the Medicaid share has a negative effect (elasticity: $-0.35$ for charges, $-0.24$ for costs). The latter result is consistent with the theory,
assuming that the demand of charge-paying patients is more elastic and quality of care is lower in hospitals frequented by Medicaid patients, because of lower income and less insurance. Unmeasured variations in quality if systematically related to %Medicare and %Medicaid, would bias their coefficients as indicators of the effect of the RCCAC formula. Such differences in quality are less likely in the laboratory, where the product is relatively standardized, than in day services or total operations.

Relative to non-profit hospitals, for-profits have 8 percent higher total charges, and district hospitals have 11 percent lower charges. There are no significant differences in costs. Overall accounting profits are positive in for-profits, negative in government and district hospitals. Recall that a negative accounting profit is optimal if the demand of cost-paying patients is less elastic than that of charge-paying patients. It is quite plausible that charge-paying patients utilizing government and district hospitals have lower income, less insurance, and therefore more elastic demand than private patients utilizing non-profit and for-profit hospitals. Assuming a uniform demand elasticity of cost-paying patients by proprietary status, this implies a lower optimal profit ratio for government and district hospitals than non-profit and for-profit hospitals, as is in fact observed.

Contrary to the findings for laboratories, total operating costs and charges are 8 to 9 percent higher in Northern California but with no difference in the markup of charges over costs. Thus, for the hospital as a whole, there is no support for the hypothesis that a Medicare carrier that pays charges has less incentive to hold down costs and more incentive to hold down charges than a carrier that pays costs. The real differences in hospital costs and charges across departments in the north and south, after controlling for case mix and demographic factors, is a puzzle that remains to be explained.

Also contrary to the laboratory evidence, day service and total operating costs and charges are not significantly affected by the number of hospitals in the three-digit zip, intended as a proxy for competitive pressures. This tends to confirm that the high level of insurance coverage has eliminated the constraints of market forces over hospital costs and charges.

6. Conclusions

The basic thesis of this paper is that if reimbursement is based on costs, accounting costs become a price to cost-paying patients. Like any price, accounting costs will be optimized to maximize revenue. A hospital serving both cost and charge-paying patients can effectively set two price schedules. In the absence of constraints, the optimum accounting profit ratio is negative if the demand of cost-paying patients is less elastic than the demand of

41This assumes that accounting costs are a pure price and ignores the lesser-of-costs-and-charges constraint.
charge-paying patients. If cost-paying patients pay no share of costs, and accounting costs can be increased with no corresponding increase in economic costs, then the optimal level of accounting costs is infinite.

In practice, the Medicare reimbursement formula limits the hospital’s ability to practice perfect price discrimination by linking costs payable by Medicare to charges received from charge-paying patients. It has been shown that this method of constraining costs raises charges to charge-paying patients above the level that would be charged by a single-price, profit-maximizing monopolist. This results from (1) the basic formula for determining Medicare’s share of costs, (2) the Medicare ceiling on per diem rates, and (3) the constraint that Medicare pays the lesser of costs and charges. These inflationary effects of the Medicare reimbursement formula do not depend on any assumption that Medicare pays less than full cost.

The empirical analysis of hospital laboratory costs and charges generally supports these predictions, with the exception of the effects of per diem ceilings, which could not be tested because the per diem ceilings were not binding during the period under study. The Medicare system of separating reimbursement for hospital-based physicians from reimbursement for other hospital costs result in higher total costs.

Conclusions for other departments are consistent but more tentative because the data available were reported for purposes other than reimbursement. There is no evidence of significant differences by proprietary status in total operating costs, but for-profit hospitals have lower laboratory costs and charges than non-profit hospitals. The mean total operating profit ratio is 1.03 in for-profits, 1.02 in non-profits, and 0.88 in government and district hospitals. This ranking of accounting profit ratios, by type of hospital, is consistent with the theory based on net revenue maximization, if the demand of charge-paying patients is more elastic than the demand of cost-paying patients in government hospitals, less elastic in for-profit and non-profit hospitals. Because cost-based reimbursement creates incentives to report economic profit as accounting costs, these accounting cost data do not support inferences about the relative efficiency or profitability of different types of hospitals, or of particular departments. They do permit inference about cross-subsidy between cost and charge-paying patients, assuming no difference in economic costs. Granted this assumption, one may infer subsidy from charge to cost-paying patients in private hospitals, and vice versa in government hospitals.

The main implication of this study for reimbursement policy is that, in the absence of prohibitively costly surveillance, basing reimbursement on ‘costs’ is unlikely to achieve its goals of limiting payment to opportunity cost. More generally, it illustrates the basic dilemma of a publicly funded insurance program which elects not to use patient co-payment as a means of constraining prices to the public program. In the absence of constraint,
optimum prices — 'costs' or charges — are infinite. So far, Medicare has relied on two types of constraint. The first links payments for Medicare patients to charges to private patients. Elsewhere [Danzon (1981)] I have shown how the ambulatory care formula, based on charges, has similar inflationary effects on charges to private patients.

Since 1972, Medicare has also used direct controls. If binding, these may result in price and input distortions, lack of access for public patients, and non-price rationing. If we continue to subsidize health care for a large subgroup of the population through a government-operated insurance program, reimbursement policies of the government program will affect the price and availability of services to all subgroups of the population.

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