NBER WORKING PAPER SERIES

HOSPITAL COST AND EFFICIENCY UNDER PER SERVICE AND PER CASE PAYMENT IN MARYLAND: A TALE OF THE CARROT AND THE STICK

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Working Paper No. 1633

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 1985

We wish to acknowledge financial support from the U.S. National Center for Health Services Research under Grant HS 03831. The thoughtful advice and comments of our project officer, Herbert Traxler, and of our colleagues, Richard Frank and Robert Seidman were gratefully received. Alison Jones and Sharon Paul provided skillful programming and Valerie Waudby helped us prepare the manuscript. The research reported here is part of the NBER's research program in Health Economics and project in Government Budget. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

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ABSTRACT

The simultaneous operation of per case and per service payment systems in Maryland, and the varying levels of stringency used in setting per case rates allows comparison of effects of differing incentive structures on hospital costs. This paper presents such a comparison with 1977-1981 data. Cost per case and total cost regressions show evidence of lower costs only when per case payment limits are very stringent. Positive net revenue incentives appear insufficient to induce reductions in length of stay and in ancillary services use. Our results suggest these changes in medical practice patterns are more likely under the threat of financial losses.

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HOSPITAL COST AND EFFICIENCY UNDER PER SERVICE AND PER CASE PAYMENT IN MARYLAND: A TALE OF THE CARROT AND THE STICK

Background

As the limitations of cost reimbursement for hospitals became widely recognized in the 1970's, a variety of prospective hospital payment systems were initiated. Generally, these systems established predetermined prices for specific types or classes of billable services. While a recent national study[1] found that some programs of this type had a significant impact on unit costs, concerns were expressed about incentives to increase volumes of services and days of inpatient care under these per service payment systems.[2] Per case payment based on discharge diagnosis (and other case-mix descriptions) was conceptualized as an alternative approach that provided incentives for conservative use of ancillary services and reductions in length of stay. Maryland was the first state to introduce a per case system in 1976 called the Guaranteed Inpatient Revenue (GIR). New Jersey introduced a DRG-based system in 1981 and Medicare's Prospective Payment System (PPS) was enacted in 1983 with full implementation set for Fiscal 1988. Since the enactment of the PPS system, numerous other states and private insurers have moved toward implementation of their own per case payment system.[3]

The present paper is an empirical analysis of experience under the Maryland per case payment system. The Maryland Health Services Cost Review Commission (HSCRC) began setting rates for all hospitals in Maryland on a per service basis on July 1, 1974. Beginning in late 1976, selected hospitals were placed by the HSCRC on per case rates (the GIR) and during the five years of our study period (July 1, 1976 to June 30, 1981) 22 of the 46 acute care hospitals in our study had experience with per case payments. Medicare and Medicaid waivers that took effect on July 1, 1977 brought all patients in the state under HSCRC rates, including the per case rates for the GIR hospitals.

Procedures and Incentives Under Per Service Payment

Per service rates were set prospectively by the HSCRC each year on the basis of budgeted volumes and costs in routine care, special care, and ancillary patient service centers. After rates were set in an initial round of detailed rate reviews (involving examination of hospitals' financial data and comparisons with peer institutions), they were trended forward annually to reflect inflation in factor costs and adjusted for volume variances. When actual revenues in a year exceeded budgeted revenues because service volumes were higher than projected, variable cost factors of .6 for routine services and .4 for ancillary services were applied to the excess revenue to determine how much of the excess the hospital was permitted to retain. An incremental variable cost factor of .7 was applied to revenues due to equivalent admissions (i.e., admissions adjusted for outpatient activity) more than 2 per cent above the projected level. This factor increased to .8 for revenues due to actual equivalent admissions more than

10 per cent above projected.

When actual revenues fell short of budgeted because of volume variances, a variable cost factor of .2 was applied to determine the unrecovered fixed costs to be included in the next year's rates. If a hospital also experienced a shortfall of more than 5 per cent from projected to actual equivalent admissions, the incremental variable cost factor increased to .6 and .4 for routine care and ancillary cost services respectively.[4] The asymmetry between the upward and downward variable cost factors was intended to encourage reductions in unnecessary utilization.[5]

By trending forward the initially-approved rates and rarely using detailed rate reviews after the initial round, the "regulatory lag" of the HSCRC system was fairly long. This influenced incentives in that net revenue gains from increased efficiency (i.e., lower unit costs <u>after</u> adjustments for volume variances) would continue to accrue to the hospital over a long period of time (until rates were readjusted to actual costs in another detailed rate review).

GIR Payments and Incentives

Per service rates were set for <u>all</u> hospitals (including the GIR hospitals) and were the basis for generating bills to individual patients or third-party payors. The GIR program superimposed on this process a projected case-mix-adjusted revenue cap per case for live discharges. If a GIR hospital realized an actual revenue per case below (above) its cap, it received additional (reduced) revenues, via higher (lower) rates in the next year, equal to the relevant variable cost factor times the number of live discharges times the difference between the cap and actual revenue per case. For example, suppose a hospital's actual revenue exceeded its projected revenue and its overall variable cost factor was approximately .5. If its case-mix-adjusted average revenue per case was $500 below its GIR cap, and it had 5,000 live discharges, it received $500 x 5,000 x .5 or $1,250,000 in additional allowable revenue in next year's rates.

The purpose of the GIR program was to create incentives to reduce length of stay and use of ancillary services. It is possible, however, that it also encouraged increased admissions. For instance, if a GIR hospital reduced its length of stay and ancillary revenues per case by 5 per cent but simultaneously increased its admissions by 5 per cent, so that its actual charges were about equal to its projected charges, it would receive a GIR "bonus" equal to 3.1 per cent of total revenues.[6] Moreover, if simultaneously decreasing length of stay and ancillary care per case and increasing admissions in the same proportion has little effect on costs, the 3.1 per cent GIR bonus is added to net revenue. A per service hospital experiencing the same situation would receive no net revenue bonus at all.

In most cases, the GIR cap level was derived from the hospital's own charges during a base period of its choosing. For this period, live discharges (excluding newborns) were grouped according to a case-mix classification and average charge per case for each group was computed. Adjustment of these average charges for rate changes between the base and current periods yielded current period average charges which were then applied to the hospital's current period frequency distribution of live discharges by group to determine its current period GIR level.

In three instances, however, hospitals were judged by the HSCRC to have excessively high costs per case and were placed on an externally-determined per case revenue cap that was below their historical experience. For these three hospitals, which we shall term CAP hospitals, all of the excess of average charge per case above the cap was deducted from next year's rates while savings below the cap were not added to next year's rates or to next year's cap. Thus, the main effect of reducing length of stay or ancillary use was to reduce losses. Bonus payments were not made for beating the cap. Of course, reductions in case-mix costliness were also encouraged since the cap for these hospitals was not case-mix-adjusted. Finally, as in the case of the regular GIR, additional admissions could offset some of the negative impacts of reduced length-of-stay or ancillary use on total revenues.

While the constraint on the CAP hospitals was mandatory, the GIR program was phased in on a voluntary basis beginning in late 1976. The HSCRC offered several inducements for hospitals to go on the GIR, including an additional 1 per cent inflation allowance and additional administrative expenses for a hospital to monitor its own performance. In some cases, the GIR was offered to hospitals as an alternative to a full review of rates which the HSCRC felt would otherwise have been necessary because of major service additions, expansions, or out-of-line cost performance.

These inducements were strong enough to permit fairly rapid implementation. Out of a total of 46 non-Federal general acute care hospitals in the State in 1976, six went on the GIR in the latter part of 1976 (including two CAP hospitals), six were added during 1977, six in 1978, three (including one CAP hospital) in 1979, and one in 1980. Six of the hospitals, however, dropped off the GIR program and returned to per service payment. These were smaller hospitals, generally lacking adequate management information systems. One of the two hospitals put on the CAP in 1976 switched to a regular GIR in 1981; the hospital put on the CAP in 1979 switched to the regular GIR in late 1980.

Study Objectives and Approach

The objective of the study reported upon in this paper was to assess the impacts of the GIR per case payment system by comparing the experience of Maryland's general acute care hospitals under per case vs. per service payment. Our analysis pertains to the fiscal years 1977-1981 and the 46 hospitals operating throughout this period.[7] Empirical impact measures used in aspects of the study reported elsewhere[8] included numbers of admissions, length of stay, hospital case-mix, charges for care per case and per episode, and readmission rates. The current paper reports estimates of GIR impacts on hospital total inpatient costs and average cost per case.

Measures of inpatient cost, and of its two components - routine and ancillary service costs, are used as our dependent variables. Two different types of regression models are employed. First, efficiency impacts of the GIR are estimated within the context of a technological cost function relating cost to the volume and mix of output, input prices, and fixed inputs (capital-stock measures). Second, we estimate behavioral cost regressions whose specification is based on a standard short-run model of hospital decision-making.[9] The hospital decision-makers are presumed to choose variable input quantities and output prices so as to maximize an objective function subject to a downward-sloping product demand curve, technology, input price, and fixed capital constraints. Assuming an interior solution to this maximization process, the resulting optimal level of cost can be related, via the first-order maximization conditions, to the exogenous factors that determine the constraints faced by the hospital. The regression model presented here may be viewed as an estimate of this relationship. Accordingly, the independent variables included in this model pertain to market demand conditions, input prices, and the hospital's fixed capital stock. Output volume and mix variables are endogenous and therefore not included.

The different specifications of these two approaches give rise to different interpretations of the estimated GIR effects. In the cost function analysis, coefficients for the GIR variables measure the effect of the GIR on efficiency, that is, on the cost of producing any given volume and mix of output. In the behavioral models, since output volume and mix variables are excluded, estimated GIR coefficients reflect both efficiency impacts and the cost implications of GIR impacts on the volume and mix of output.

Definition of Variables

The measure of cost used to define our dependent variables is the reimbursable cost of inpatient services as reported in the Medicare Cost Reports (MCRs) filed annually by the study hospitals. This figure includes: routine cost of adult, pediatric, and nursery inpatient services plus the general service ("overhead") cost allocated to these services; direct plus allocated overhead costs of intensive care and other special inpatient care units; and the inpatient portion of direct plus allocated overhead costs for ancillary services. The sum of the first two of these components is used as our routine cost dependent variable; the third is our ancillary cost dependent variable.[10]

A listing of explanatory variables is given in Table 1. Among the variables in our technological cost functions, the volume of patient service output is measured by the number of inpatient admissions (ADM) while output mix is measured by a scalar index of case-mix costliness (DRGMIX) described below. The input price measure is the nursing wage level in the area where the hospital is located (NWAGE). Capital-stock variables are bed-days available (BDDYS) (i.e., average bed-complement x 365) and the ratio of special care to total beds (SPECRTO). As a measure of teaching activity, we also include the number of approved residency positions per bed in the hospital (POSBED).

In our behavioral cost regressions, explanatory variables include county population characteristics presumed to influence product-demand conditions (MEDAGE, HSIZE, HINC, PUBASST, and

MCARE) as well as the estimated service area population (HPOP), which is simply the county population multiplied by the ratio of acute care beds in the hospital to acute care beds in the county.[11] To capture possible substitution or complementarity effects of other available health care resources, ACRATIO and MDPOP are included.[12] The capital stock, input price, and teaching activity variables are also included. (Further information on definitions and sources for independent variables is given in the Appendix.)

Our case mix costliness index (DRGMIX) is developed from data on the diagnostic classification and charges for all discharged patients. The computational method begins by defining a "market basket" set of nine DRG's. The average charge in 1980 for each of the nine DRG's in each hospital was calculated and these nine averages were themselves averaged (within each hospital) to compute an overall "market basket" average charge for each study hospital. This figure was then divided into the actual charge figure for every discharge in that hospital in 1980 so that charge data for individual patients were expressed relative to the hospital's "market basket" average.

For each of the 383 DRG's, these relative charge figures were then averaged across patients within each hospital, and then these hospital-specific averages were averaged across all hospitals reporting at least one patient in that DRG. The result was a statewide average relative costliness figure for each of the 383 DRG's. Finally, these 383 DRG figures were applied to the frequency distribution of discharges in each of the study years in each hospital to compute the case-mix costliness index.[13]

The dependent variables and independent variables expressed in dollars (HINC and NWAGE) were all deflated by a cost-of-living index. Separate index values were computed for the Baltimore area, the Washington suburban area in Maryland, and for all other parts of the state. While this deflation procedure should serve to control for general economy-wide inflation, dummy variables for individual years are also included in our regressions. Effects of technological change or other year-specific charges affecting all Maryland hospitals should be picked up by these dummy variables.

GIR Variables

Three pairs of GIR variables were employed (see Table 2). For all hospitals on the GIR for at least six months in a fiscal year, a GIR dummy variable (GIRSTAT) was set equal to 1.0. The coefficient of this variable measures the one-time cost impact of going on the GIR. To allow for the possibility that the initial GIR impact intensified or decayed over time, the length of the time period (in months) during which the hospital was on the GIR (TIME) was included.

Variables were added to allow for differences between teaching and non-teaching hospitals in GIR impacts (i.e., GIRTEACH and TIMTEACH). Such differences might be expected because clinical decisions in teaching hospitals are more likely to rest with physicians who are salaried hospital employees. Administrative control over clinical decision-making patterns may thus be easier to establish in response to GIR incentives to reduce patient stays and ancillary service volumes.

The third pair of variables, also analogous to GIRSTAT and TIME, are CAP and CAPTIME. These are only non-zero for the three hospitals whose per case payment limit was not based on their own past experience because their cost per case figures were deemed excessive. For these hospitals, the per case payment limit imposed a more stringent financial constraint than that experienced by other GIR hospitals, and thus one would expect CAP and CAPTIME to be negatively related to cost.

In addition, to capture any cost impact of going off the GIR system, the dummy variable ONOFF was set equal to 1.0 for each year in which a previously GIR hospital was off the system. Similarly, CAPOFF = 1 for 1981 for the two hospitals that went off the CAP; otherwise it equals zero.

Functional Form and Estimation Method

All regressions are estimated with the dependent and continuous independent variables entered in logarithmic form. Exceptions are POSBED, SPECRTO, TIME, TIMTEACH and CAPTIME which are entered in linear form because of zero values for many data points.

To control for possible correlation of regression disturbances for the same hospital over time, we have employed the fixed-effects method of least-squares regression with pooled data. This method involves the inclusion of dummy variables for each hospital in the sample (save one if a constant term is also included). Coefficient estimates obtained with this method will not be biased by omitted hospital-specific characteristics that are stable over the study period. This is important in that these hospital characteristics may have been correlated with the GIR variable (since hospitals were not randomly selected for the GIR program). Bear in mind, however, that this method does not take into account autocorrelation due to auto-regressive disturbances, and that it is somewhat inefficient since any information from cross-sectional variation is not used in estimating the regression coefficients. Thus, it is a rather conservative method of measuring GIR effects in the sense that it will tend to yield less significant coefficient estimates than other methods which are more susceptible to omitted variable bias.[14]

Cost Function Results

Estimated cost functions with GIRSTAT, TIME, and ONOFF included to capture overall average GIR effects are shown in Table 3.[15] In these results, none of the three GIR variables ever approaches reasonable levels of statistical significance. Thus, when the number of admissions, case mix, and other factors are controlled statistically, GIR hospitals did not incur significantly lower costs than those paid under the per service systems. Coefficients of other independent variables are generally significant and have the expected signs. The case-mix index has the expected positive sign but is not significant; this is not surprising in our fixed-effects model since case-mix does not vary much from year to year within a single hospital. It is also interesting to observe that the POSBED result implies a cost differential of about 4.5 per cent between a hospital with no residency programs and one with 0.1 residents per bed. This differential is close to the official HCFA estimate of 5.79 per cent that was doubled to arrive at the indirect teaching cost adjustment in the current version of the Medicare PPS regulations.[16]

While the three GIR variables in Table 3 did not show any significant overall average GIR effects, regressions including other GIR variables suggested differences in the GIR among our study hospitals. When each of the eight GIR variables was entered as the only GIR variable in our inpatient, routine, and ancillary cost function regressions, significant negative coefficients (one-tailed $P < 0.1$) were obtained for CAPTIME in an inpatient cost regression (coefficient = -0.00165, P = 0.0492) and a routine cost regression (coefficient = -0.00168, P = 0.0608), and for CAP in a routine cost regression (coefficient = -0.06654, P = 0.0460).[17] Since CAPTIME is measured in months, these CAPTIME coefficients imply a yearly rate of cost increase for CAP hospitals which is about 2 per cent below the rate for other hospitals. The routine cost result with CAP, rather than CAPTIME, implies a 6.4 per cent lower level of costs for CAP hospitals.

As is shown in the first two columns of Table 4, the CAPTIME coefficient in the inpatient cost function remained strongly negative when other GIR variables entered (though inclusion of CAP reduced its size and significance). The GIRSTAT and TIME results in these regressions suggest a negative initial GIR effect balanced by a more rapid rate of cost increase subsequently.

(Magnitudes of the coefficients imply that the two effects exactly cancel at TIME = 23 months.) This is consistent with the extra 1 per cent in the inflation adjustment for GIR hospitals. On the other hand, the GIRTEACH and TIMTEACH coefficients almost exactly offset the GIRSTAT and TIME coefficients implying essentially no GIR effect on teaching hospitals.

Stepwise inclusion of additional GIR variables in the routine cost regressions (columns 3, 4 and 5 of Table 4) does not markedly change the CAP and CAPTIME results but the negative CAPOFF coefficient (which is only slightly smaller than the CAP coefficient) implies that routine cost savings of being on the CAP were not reversed immediately when CAP hospitals went onto the standard GIR system. The pattern of significant and offsetting coefficients for GIRSTAT vs. GIRTEACH and TIME vs. TIMTEACH was much weaker in the routine cost regresssions. This pattern re-emerged very clearly in the ancillary cost regressions (columns 6 and 7 of Table 4) while the negative effects for the CAP variables were again somewhat weaker than in the total inpatient or routine cost analyses.

In summary, our results indicate (1) a negative cost impact of being on the CAP primarily stemming from lower routine costs and (2) a negative initial GIR cost effect for non-teaching hospitals which decays over time and which is seen mainly in the ancillary cost areas.

Results for Behavioral Cost Regressions

Coefficients for GIRSTAT, TIME and ONOFF are larger and more significant in our behavioral cost regressions (Table 5) than in the technological cost functions reported above; however none of the two-tailed P-values for those coefficients are less than 0.1. With total inpatient cost as the dependent variable, we obtain a negative initial GIR impact which decays over time and turns positive at TIME = 24 months; the negative ONOFF coefficient implies that the GIRSTAT impact is not reversed by going off the GIR. For inpatient cost per case, however, precisely the opposite time pattern is observed. (The same patterns were also observed when these regressions were re-estimated with ancillary costs and then routine costs as dependent variables. Results are available on request from the authors.) The reasons for these divergent patterns are not clear. One possible explanation is that hospitals undertaking capital expansions were placed on the GIR when these expansions were not expected to increase admissions substantially. If so, the small coefficient of BDDYS in the cost per case regressions may have understated the positive impact of capital expansion on cost per case and the positive GIRSTAT coefficient corrected for this error.

Significance levels for the coefficients of the other independent variables range widely. The capital stock variables, BDDYS and SPECRTO, are significantly positive in both regressions. The inpatient cost per case result for BDDYS arises from positive BDDYS impacts on both length of stay and case-mix costliness;[18] it is likely this case-mix effect is due to bed-size picking up effects of other correlated capital measures (e.g., major equipment and sophisticated services). The wage variable (NWAGE) is significantly positive, as expected, but the magnitude of its coefficient is rather large and suggests a correlation with other omitted factor prices. While the market population (HPOP) and teaching variable (POSBED) have strongly positive effects on total costs, it is surprising that their cost per case coefficients are negative (and insignificant for POSBED). The negative HPOP effect on cost per case reflects its negative effects on both length of stay and case-mix costliness.[19] Among the remaining variables only the Medicare population percentage (MCARE) is significant (and negative) in the total cost regression. While this result might be expected in the cost per case regression, because of differences in case-mix and length of stay between Medicare beneficiaries and the rest of the population,[20] it is unclear why this result is stronger in the total inpatient cost regression.

When each of our eight GIR variables was entered as the only GIR variable in our behavioral cost regressions, one-tailed P-values for their estimated coefficients were not generally below 0.1. Exceptions were the positive TIME and TIMTEACH coefficients (P=0.0484 and 0.0921 respectively) and the negative CAP coefficient (P=0.0558) in the total inpatient cost regressions, and the negative CAPTIME coefficient (P=0.0057) in the inpatient cost per case regression. Results when all eight GIR variables were allowed to enter stepwise are shown in Table 6. Results for the total inpatient cost regressions (columns 1-3) are similar to the corresponding cost function results (Table 4, columns 1 and 2) except that CAP is more strongly negative than CAPTIME. In the cost per case regressions in Table 6 (columns 4 and 5), the negative CAPTIME coefficient is more significant while the pattern of offsetting coefficients for GIRSTAT vs. GIRTEACH and TIME vs. TIMTEACH is weaker and the negative GIRSTAT coefficient is much smaller.[21]

Results for behavioral cost regressions with ancillary costs and routine costs as the dependent variables (not shown) paralleled the cost function results (in Table 4) in two respects. First, the pattern of offsetting GIRSTAT vs. GIRTEACH and TIME vs. TIMTEACH coefficients was only evident in the ancillary cost regressions; second, the CAP and CAPTIME results are generally weaker than in the total cost regressions, with only the negative CAP coefficient in the routine cost regression nearing conventional statistical significance levels. The same observations apply to routine and ancillary cost per case regressions with two exceptions: in both regressions CAPTIME is strongly negative and in the ancillary cost per case regression the positive GIRTEACH coefficient is clearly larger and more significant than the negative GIRSTAT coefficient. (Results of these regressions are available on request from the authors.)

Summary and Conclusions

Based on the generally weak results for our GIR variables and the strong negative results for CAPTIME in our cost function and behavioral cost per case regressions, the major conclusion which emerges from our study is that GIR impacts on cost per case were only significant for those hospitals in which the per case payment level was set in a very stringent manner (i.e., the CAP hospitals). While other GIR hospitals could have increased their net revenues by responding more vigorously to the

GIR incentives, it appears from our findings that the risk of losses (to CAP hospitals) was a more powerful inducement to cost control. Since almost all study hospitals (including all GIR hospitals) were non-profit institutions, this conclusion should not be too surprising. When the form of ownership restricts the use of net revenues, the motivation to increase profits is presumably attenuated. This seems especially likely when the opportunities to increase profits involve changes in treatment practices (i.e., length of stay, use of ancillary services) over which hospital management has less direct control. Another factor contributing to this result may be the existence of regulatory cost restraints; the incentive to accumulate retained earnings for reinvestment in expanded or more sophisticated services and facilities is weakened by the realization that regulators may be reluctant to approve higher rates to cover additional service costs. In short, as an inducement to efficiency the "stick" appears to have been mightier than the "carrot."[22]

It is also of interest that the negative impact of the CAP on cost was somewhat stronger for routine patient care rather than ancillary services.[23] This may be an indication that hospital management has greater control over the costs of nursing care than ancillary service costs, or that treatment decisions regarding length of stay are more susceptible to management influence than are decisions about specific diagnostic and therapeutic procedures. A third possible explanation is that certain overhead costs have been more susceptible to management control and that these costs tend to be allocated primarily to nursing care cost centers.

Another interesting aspect of our findings emerges from a comparison of the behavioral regressions for inpatient cost per case and total inpatient cost. The strongly negative CAPTIME coefficient disappears in the latter regressions while the positive TIME and negative CAP coefficients approach statistical significance. Thus, it appears that the negative effect of the CAP on cost per case, particularly as the period on the CAP increases, is attenuated by increases in admissions so that the negative effect on total inpatient costs is much weaker. As noted in our introduction, this type of volume response seems consistent with the incentives of a per case payment system; thus our finding reinforces the concerns about positive admissions effects of payment arrangements such as the new Medicare Prospective Payment System.[24] In part because of these incentives to increase volume, the Maryland HSCRC has recently implemented a fixed-budget or capitation payment formula for a small number of rural hospitals.

Finally, while these results may support more general conclusions about the relative merits of per case and per service payment systems, it is important to take note of factors that may have contributed to these findings. First, when judged by experience in other states, the per service payment system in Maryland appears to be fairly stringent. Thus, the additional incentives to control unit costs under the GIR may have been modest in comparisons with the overall pressures for unit cost control imposed by the system on both GIR and non-GIR hospitals. Second, the length of time on the GIR for hospitals in the study was fairly short (averaging a little over two years). Subsequent research with a longer time frame may show clearer evidence of cost impacts. Third, the statistical procedures we have employed are conservative. Use of the fixed-effects model tends to produce lower significance levels since it excludes information from cross-sectional variation in estimating the parameters of interest. This problem is exacerbated by the necessity of using a number of GIR variables, to test for differences in impacts between types of hospitals (CAP vs. non-CAP, teaching vs. non-teaching) and over time, since many of these variables will be strongly correlated with one another. Our ongoing research with a longer time series of data for Maryland will hopefully yield more powerful tests and will also allow us to compare per-case and fixed-budget payment approaches.

Table 1: Definitions of Explanatory Variables

Name	Definition
ADM	Admissions to the hospital
BDDYS	Acute care bed-days available in the hospital
SPECRTO	Ratio of special care beds to total acute care beds in the hospital
POSBED	Positions in approved residency programs per available acute care bed-day in the hospital
DRGMIX	Case-mix costliness index value for the hospital
MEDAGE	Median age of county population
HSIZE	Mean number of persons per household in county
HINC	Median county household income, deflated
PUBASST	Ratio of county AFDC, general assistance, and SSI recipients to county population
MCARE	Ratio of county Medicare aged and disabled enrollees in Part A or Part B to county population
HPOP	Estimated population in hospital market area
ACRATIO	Ratio of acute care bed days to total bed days available in the county
MDPOP	Ratio of patient-care physicians in office-based practice to population in the county
NWAGE	General duty nurse wage in the area, deflated

Table 2 : Definitions of GIR Variables

Name	Definition
GIRSTAT	= 1 if a hospital is on the GIR for at least six months of the fiscal year; =0 otherwise
GIRTEACH	= 1 if GIRSTAT =1 and the hospital has any approved residency programs; =0 otherwise
TIME	Time in months from date the hospital went on the GIR to the midpoint of the fiscal year (if GIRSTAT = 1); =0 otherwise
TIMTEACH	= GIRTEACH * TIME
CAP	= 1 if GIRSTAT = 1 and the hospital's per case rate is based on an external CAP
CAPTIME	Time in months from the date the hospital went on the CAP to the midpoint of the fiscal year (if CAP = 1); 0 otherwise
ONOFF	= 1 if the hospital was not on the GIR for six months of the fiscal year but had been previously; 0 otherwise
CAPOFF	= 1 if CAP = 0 for the current fiscal year and CAP = 1 for any previous fiscal year

Table 3 : Cost Functions With GIRSTAT, TIME, and ONOFF

Dep. Vble.:	Inpatient Cost		Routine Cost		Ancillary Cost	
Ind. Vble.[a]	Coeff.	P[b]	Coeff.	P	Coeff.	P
GIRSTAT	-0.00990	0.5617	-0.01372	0.4597	-0.00185	0.9431
TIME	0.00031	0.5647	0.00010	0.8611	0.00072	0.3778
ONOFF	-0.00131	0.9588	-0.00308	0.9108	0.00182	0.9622
ADM	0.30226	0.0000	0.28209	0.0000	0.38621	0.0000
BDDYS	0.57416	0.0000	0.68069	0.0000	0.38985	0.0001
SPECRTO	1.56727	0.0000	1.30780	0.0002	1.83015	0.0002
POSBED	161.549	0.0981	22.7652	0.8296	329.969	0.0270
NWAGE	0.75655	0.0039	0.67548	0.0173	0.94202	0.0169
DRGMIX	0.06481	0.5181	0.12046	0.2699	0.01126	0.9412
R^2	0.997		0.997		0.994	

[a] All regressions reported here and in subsequent tables include separate intercepts for each hospital and each year. All continuous dependent and independent variables are expressed as logarithms except for SPECRTO, POSBED and GIR-related time variables.

[b] All P-values reported here and below are two-tailed.

Table 4 : Cost Function Results for GIR Variables
(Two-tailed P-values in parentheses)

Dep. Vble.:	Inpatient Cost		Routine Cost			Ancillary Cost	
Ind. Vble.[a]							
CAPTIME	-0.00166 (0.0983)	-0.00134 (0.2819)		-0.00126 (0.3181)	-0.00129 (0.3422)	-0.00173 (0.2635)	-0.00138 (0.4621)
CAP		-0.05203 (0.3568)	-0.10993 (0.0409)	-0.09205 (0.1037)	-0.09820 (0.1138)		0.03059 (0.7193)
CAPOFF		-0.03974 (0.4980)	-0.07159 (0.2319)	-0.08048 (0.1840)	-0.08788 (0.1729)		0.04623 (0.6014)
GIRSTAT	-0.05275 (0.0403)	-0.05396 (0.0441)			-0.02331 (0.4299)		-0.10103 (0.0137)
GIRTEACH	0.06003 (0.0649)	0.06885 (0.0445)			0.02984 (0.4250)		0.12554 (0.0155)
TIME	0.00233 (0.0335)	0.00235 (0.0336)			0.00034 (0.7792)	0.00075 (0.2837)	0.00554 (0.0010)
TIMTEACH	-0.00237 (0.0464)	-0.00249 (0.0410)			-0.00027 (0.8390)		-0.00592 (0.0015)
ONOFF		-0.00333 (0.8951)			0.00041 (0.9881)		-0.01207 (0.7518)

Table 5 : Behavioral Cost Regressions With GIRSTAT, TIME, and ONOFF

Dep. Vble.:	Inpatient Cost		Inpatient Cost per Case	
Indep. Vbles.	Coeff.	P	Coeff.	P
GIRSTAT	-0.02158	0.1988	0.03131	0.1745
TIME	0.00089	0.1079	-0.00086	0.2568
ONOFF	-0.02912	0.2665	0.04040	0.2615
BDDYS	0.69822	0.0000	0.22160	0.0337
SPECRTO	1.35067	0.0001	1.94480	0.0000
POSBED	242.603	0.0112	-94.3274	0.4683
NWAGE	1.15859	0.0000	1.04991	0.0065
MDPOP	-0.06186	0.3871	-0.05150	0.5997
ACRATIO	-0.12708	0.4736	0.03718	0.8785
HPOP	0.16596	0.0536	-0.20085	0.0884
MCARE	-0.64638	0.0010	-0.27874	0.2941
PUBASST	0.06530	0.3400	0.07573	0.4201
HINC	-0.04863	0.8321	-0.35872	0.2555
HSIZE	0.13539	0.6019	0.30654	0.3898
MEDAGE	0.11866	0.8125	0.22147	0.7471
R^2	0.997		0.962	

Table 6 : Behavioral Cost Regression Results for GIR Variables

(Two-tailed P-values in parentheses)

Dep. Vble.:	Inpatient Cost			Inpatient Cost Per Case	
Ind. Vble.					
CAPTIME			-0.00062 (0.6103)	-0.00310 (0.0212)	-0.00358 (0.0328)
CAP	-0.05126 (0.1584)	-0.05159 (0.1715)	-0.06343 (0.2523)		0.01043 (0.8894)
CAPOFF			-0.03990 (0.4920)		-0.02361 (0.7654)
GIRSTAT		-0.05250 (0.0547)	-0.05280 (0.0544)		-0.01394 (0.6998)
GIRTEACH		0.05357 (0.1170)	0.05489 (0.1169)	0.04285 (0.1329)	0.05429 (0.2423)
TIME	0.0068 (0.1368)	0.00204 (0.0653)	0.00206 (0.0632)		0.00101 (0.4964)
TIMTEACH		-0.00155 (0.2109)	-0.00144 (0.2514)	-0.00088 (0.2736)	-0.00168 (0.3103)
ONOFF		-0.02968 (0.2406)	-0.02910 (0.2522)	0.03538 (0.2637)	0.03650 (0.2926)

Appendix: Data Sources for Independent Variables

The principal source for data on the dependent variables, BDDYS, ADM, and SPECRTO is the hospital's Medicare Cost Reports (MCRs). In a few cases where data on beds or admissions were missing from the MCRs, American Hospital Association Annual Survey data were used instead. Data on residency programs used to construct POSBED were taken from the American Medical Association Directory of Residency Training Programs. County income and demographic data (used for MEDAGE, HSIZE, HINC, and HPOP) were taken from the Salary and Marketing Management Annual Survey of Buying Power. Recipient and enrollee data for PUBASST and MCARE were obtained from publications of the U.S. Dept. of Health and Human Services publications and the Maryland Dept. of Human Resources. The numerator of MDPOP is from the American Medical Association Distribution of Physicians publications. The numerator of ACRATIO is computed from individual hospital data in the MCR's; these data were also used in constructing HPOP. The denominator of ACRATIO includes beds in the numerator, ECF and subprovider beds for acute care hospitals, and licensed chronic care hospital beds. The first two of these items were taken from the MCR's; the third was from unpublished tabulations supplied by the Maryland Dept. of Health and Mental Hygiene.

To calculate nursing wages, data on numbers of RNs and on nursing wage and fringe benefit costs per hour were compiled for each hospital for the years 1978-81 from the annual wage surveys conducted by the HSCRC. Comparable data for 1977 were gathered by the Maryland Hospital Personnel Association (MHPA). The 1977 MHPA survey data were requested from each of the responding hospitals and data were received from 26 of them. Area average wages were calculated by dividing the state into 5 regions: Western, Central, Eastern Shore, Baltimore area, and Washington area.

The cost of living deflator is an index based on the living cost for a family of four at the intermediate level as estimated by the Bureau of Labor Statistics (BLS). Data reported by BLS on the Washington Area were used for hospitals located in Montgomery, Prince Georges, and Charles Counties; Baltimore area data were used for Baltimore City, and for Baltimore, Anne Arundel, Harford, Carroll, and Howard Counties. For all remaining hospitals the BLS figures for non-metropolitan areas in the South were used. Since the data apply to Autumn in each year, a weighted average of adjacent years' data (with weights 3/4 for the earlier year and 1/4 for the later year) was used to develop estimates for the middle of the fiscal year (i.e., the end of the calendar year). Finally, all figures were divided by the 1978 value for the Baltimore area to express them in index form.

A variety of data sources were examined to determine which hospitals had been placed on the GIR and the period of time over which GIR provisions applied. Staff at the HSCRC supplied us with preliminary listings of hospitals and dates. In addition, we reveiwed the HSCRC's files of rate orders, staff reports, and minutes of commission meetings and, in a few instances, contacted administrative personnel at specific hospitals to resolve uncertain cases.[25]

Notes and References

1. C. Coelen and D. Sullivan, "An Analysis of the Effects of Prospective Reimbursement Programs on Hospital Expenditures," Health Care Financing Review 2, no. 3 (Winter, 1981); 1-40.
2. G. Melnick et al., "Effect of Rate Regulation on Selected Components of Hospital Expenses," Inquiry 18, no. 4 (Fall 1981): 240-246.
3. F. Hellinger, "Recent Evidence on Case-Based Systems for Setting Hospital Rates," Inquiry 22, No. 1 (Spring 1985):78-91.
4. The details of the volume adjustment procedure are described in Maryland Health Services Cost Review Commission, Inflation Adjustment System (n.d.), Section II.D.
5. Maryland Health Services Cost Review Commission, Design of the Modified GIR and the Capitation Payment System for Application in Maryland. Report prepared under HCFA Contract 500-80-0044, 1982. See, in particular, Appendix D: "Methodology for Computing Prospective Rate Adjustments Under the Guaranteed Inpatient Revenue Program."
6. Assuming that the hospital's revenues are evenly split between routine and ancillary departments, its variable cost factor for the first 2 per cent increase in admissions would be 0.5; for the next 3 per cent increase its variable cost factor would be .7. The weighted average of these two factors is 0.62; applying it to the 5 per cent difference between actual revenue and allowable revenue under the GIR yields a bonus of 3.1 per cent.

Notes and References (Continued)

7. Of the 230 data points in our study sample, 3 were deleted because one hospital had no cost data available for 1977 and two others did not have cost data available for 1978.

8. D. Salkever and D. Steinwachs, "Hospital Admissions, Length-of-Stay, and Case-Mix Impacts of Per Case Payment: The Maryland Experience." Health Services Research and Development Center, The Johns Hopkins School of Hygiene and Public Health, June 1985 (forthcoming).

9. This model has been applied in a number of previous studies. For recent examples, see F. Sloan, R. Feldman and A.B. Steinwald, "Effects of Teaching on Hospital Costs," Journal of Health Economics 2 (March 1983): 1-28 and D. Salkever, "Cost Implications of Hospital Unionization: A Behavioral Analysis," Health Services Research 19 (December 1984): 639-664.

10. Direct and allocated costs for SNFs, sub-providers and outpatient services rendered to inpatients were not included. Also excluded were expenses for personal patient care services rendered by physicians (since these are not covered under Part A of Medicare). This latter exclusion is particularly important in rendering the dependent variable comparable across teaching and non-teaching hospitals, and in controlling for shifts to direct billing by hospital-based specialists to avoid regulatory controls on rates.

Notes and References (Continued)

11. Note that this measure increases as the hospital increases its bed stock (unless there are no other hospitals in the county) and decreases as other hospitals in the county expand their bed stock.

12. Lower values of ACRATIO and higher values of MDPOP are indicative of greater availability of other health care resources. With HPOP and BDDYS already included in our regressions, we assume in effect that physicians are distributed among hospital service areas within the county in proportion to HPOP while non-acute beds (e.g., ECF's, chronic care hospitals) are distributed in proportion to BDDYS.

13. Use of this index based on relative weights has one important advantage over an index based on absolute charges. In particular, this index is much less sensitive to variations among DRGs in the distribution of patients across hospitals. Thus, any particular DRG that might happen to be more common in less efficient hospitals will not have a high relative costliness weight simply because of this fact. Since the potential correlation between the case mix index and efficiency is thereby attenuated, efficiency impacts of the GIR variables should be measured more precisely. For further information on the construction of our index and the calculated index values, see D. Steinwachs and D. Salkever, "Impact of 'Per Case' Versus 'Per Service' Hospital Payment

Notes and References (Continued)

in Maryland." Final Report on Grant HS 03831 from the U.S. National Center for Health Services Research, Health Services Research and Development Center, The Johns Hopkins School of Hygiene and Public Health, May 1984.

14. See R. Pindyck and D. Rubinfeld, Econometric Models and Economic Forecasts, 2nd edition (New York: McGraw Hill, 1981), Chapter 9 and Y. Mundlak, "On the Pooling of Time Series and Cross Section Data," Econometrica 46 (January, 1978): 69-85.

15. In all equations reported here, regression coefficients for the hospital and year dummy variables are not reported. Complete results of all equations are available from the authors.

16. To arrive at the 4.5 per cent figure, we divide the POSBED coefficient (161.549) by 365 to get the coefficient for residents per bed rather than per bed day. We then multiply this result (0.4426) by 0.1, take the antilog (1.045), subtract 1.0 and multiply by 100 to arrive at our percentage change figure. For a discussion of the HCFA result, see J. Lave, The Medicare Adjustment for the Indirect Costs of Medical Education: Historical Development and Current Status. American Association of Medical Colleges, 1985. It is interesting to note that the interns and residents per bed figure used in the HCFA analysis had 1.0 added to it to avoid taking logarithms of zero values for non-teaching hospitals. Thus, the difference

Notes and References (Continued)

in logarithms of costs between values of 0.0 and 0.1 for interns and residents per bed is actually (ln 1.1 - ln 1.0) x .579 = .0953 x .579 = .0552. The antilog gives a cost differential of 5.68 per cent for the HCFA analysis.

17. Where a single GIR variable is used to test the hypothesis of a negative GIR cost effect, a one-tailed P is appropriate; P-values reported here are one-tailed.
18. These impacts are estimated from length-of-stay and case-mix regressions reported in Salkever and Steinwachs (note 8).
19. See note 18.
20. See note 18.
21. The results described in this paragraph were obtained from regressions in which the five least significant independent variables (other than GIR variables) were deleted. These five variables were identified by reestimating the regressions in Table 5 with all GIR variables included. Exclusion of these variables from the regressions reported on here had no material effects on the findings for the GIR variables. Regression results with all variables included are available on request from the authors.
22. Note the similarity between our conclusion and the argument recently advanced by Fuchs that the ongoing changes nationally in hospital financing will impact on hospital behavior precisely because "there is a real prospect that the hospital will not have enough revenue to cover its costs." See

Notes and References (Continued)

V. Fuchs, "Paying the Piper and Calling the Tune: Implications of Changes in Reimbursement," National Burea of Economic Research Working Paper No. 1605, April 1985.

23. The ancillary cost per case behavioral regression is the sole exception to this statement.

24. For more direct evidence of this positive admission effect under the GIR in Maryland, see Salkever and Steinwachs (note 8).

25. More detailed information on data sources and variable construction is given in Steinwachs and Salkever (note 13), Chapters 2 and 3 and Appendices A-C.