CHAPTER 3

Accounting for variation in hospital financial performance under prospective payment

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In this chapter

This chapter describes findings from research designed to disentangle the roles of payment policies and other factors that affect hospitals' financial performance under Medicare's inpatient prospective payment system. Although the payment system affects hospitals' Medicare inpatient margins—accounting for one-quarter of the variation across all facilities—it appears to operate largely as the Congress intended. Most of the payment system's effects on hospitals' inpatient margins are attributable to deliberate policy adjustments that the Congress has added to the payment formulas, such as extra payments for teaching hospitals, those that serve a disproportionate share of low-income patients, and certain rural facilities. Problems with Medicare's case-mix and wage-index adjustments also contribute to margin variation. A substantial portion of the variation in Medicare inpatient margins, however, is attributable to hospitals' operating characteristics, which are at least partially under management control. This finding is consistent with one of the fundamental assumptions of prospective payment: Hospital managers can exert substantial control over efficiency and the cost of care.

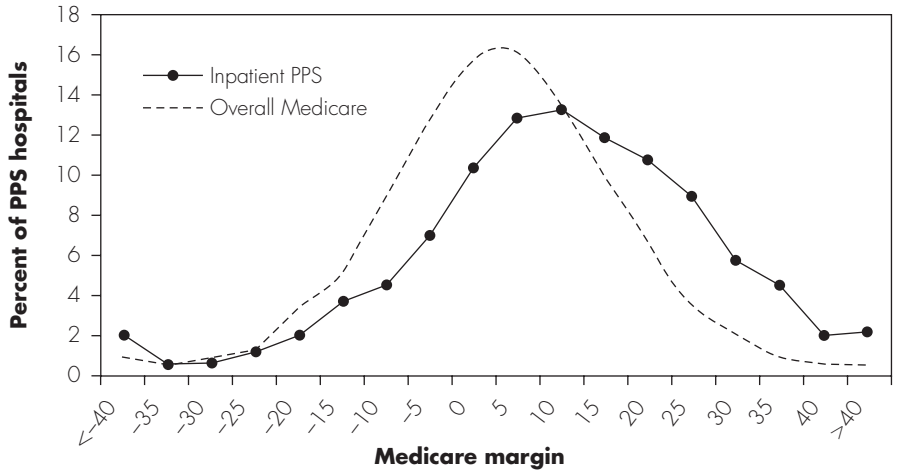
In developing recommendations for the Congress on Medicare's payment policies, MedPAC annually considers payment updates and other policy changes needed to ensure that Medicare's payments to providers are adequate and that they accurately reflect the effects on care delivery costs of factors beyond providers' control. The Commission examines a variety of indicators of payment adequacy, including: providers' willingness to offer services to Medicare beneficiaries; changes in the volume, mix, and cost of the care furnished; beneficiaries' access to and the quality of care; and providers' financial performance for the services they furnish under Medicare's payment systems.

Financial performance measured by financial margins—the difference between payments and costs as a percentage of payments—varies widely among hospitals. In 1999, for instance, the lowest and highest 10 percent of hospitals had financial margins under Medicare's inpatient prospective payment system (PPS) below –13 and above +28 percent (Figure 3-1).[1] Hospitals' overall Medicare margins, which reflect their Medicare payments and costs for all of the major types of services they furnish to beneficiaries, show almost as much variation.

How policymakers should interpret and respond to variation in financial performance depends on why it occurs. Often, health care advocates or other observers cite providers' financial margins under Medicare and the proportion of providers with negative margins to argue that the Congress should raise Medicare's payment rates overall or for specific services or groups of providers. Yet, if margins vary because of systematic problems with the payment system, this would not necessarily mean that the overall level of the payment rates is inadequate. Instead, it might indicate the need to address specific payment system components, such as the case-mix adjustment or the payment policies for hospitals serving low-income patients. Alternatively, if variations in inpatient margins partly reflect differences in business strategies and other management decisions that affect efficiency, policymakers should not alter Medicare's payments to make up the difference; by design, the payment system rewards effective management.

FIGURE 3-1

Distribution of inpatient and overall Medicare margins, 1999



Note: PPS (prospective payment system). Medicare inpatient PPS margin equals PPS payments minus PPS costs, divided by PPS payments. Overall Medicare margin equals Medicare payments for all major services hospitals furnish to beneficiaries (such as inpatient, outpatient, skilled nursing, and home health), minus related costs, divided by Medicare payments.

Source: MedPAC analysis of hospital cost report data from CMS.

This chapter describes the objectives, methods, and findings of research designed to help us understand why hospitals' financial performance varies so much under the inpatient PPS. This research is motivated by two objectives. The primary objective is to disentangle the roles of Medicare's payment policies and other factors that contribute to differences in hospital financial performance under Medicare's hospital inpatient PPS. The knowledge gained will help us to evaluate the payment system and identify potential areas for improvement. The second objective is to develop a general approach to evaluating sources of variation in financial performance and the functioning of PPSs in other settings.

We first identify factors that contribute to variation in performance across hospitals in any given year and then measure their separate effects. We started with hospitals' Medicare inpatient operating payments and costs because hospital data are more readily available and reliable than those for other care settings, and payments for hospital inpatient care account for about 40 percent of Medicare spending. We developed our analytic approach using data from fiscal year 1998, but results from a single year can be misleading, so we also applied the model to data from 1992 and 1999 to test the stability of our findings. Most of the results are very similar across time periods, suggesting that the structural relationships among payments, costs, and hospital characteristics are generally stable. For simplicity, we present only the findings based on 1998 data, although we note differences for other years where they occur.

1 In 1999, about 71 percent of all hospitals paid under Medicare's inpatient PPS had positive inpatient margins; these facilities treated about 78 percent of all Medicare PPS discharges.

Summary of findings

The analysis described in this chapter supports several major findings:

- Our model accounts for about one-half of the variability in PPS inpatient margins across hospitals when we include variables to capture the effects of the hospital inpatient PPS, local market circumstances, and operating characteristics at least partially under management control.
- More than one-quarter of the variability in inpatient margins is associated with the payment factors included in the hospital inpatient PPS. Most of this explained variation is attributable to three policy adjustments (that are only partly related to hospitals' costs for treating Medicare beneficiaries): payments for indirect medical education (IME) costs; payments for treating a disproportionate share (DSH) of low-income patients; and additional payments for rural sole community and Medicare-dependent facilities. About three-fifths of all PPS hospitals benefit from one or more of these policy adjustments.
- Policy adjustments are designed to improve the margins of eligible hospitals; thus some or all of their contribution to variation in financial performance is intentional. The magnitude and distribution of their effects, however, may differ from the outcomes policymakers intended.
- A small portion of the variation in hospital inpatient margins is created by problems with cost adjusters in the PPS payment formula—such as the case-mix and wage-index adjustments that are designed to capture the influence of factors beyond hospitals' control. The evidence suggests that both the case-mix and wage indexes overadjust for expected differences in cost per case for hospitals with high index values. These effects also increase the influence of two of the three policy adjustments (IME and DSH) because all of these factors apply as multipliers. Any contribution of the case-mix or wage-index adjustments to variation in margins is unintended and undesirable.
- After controlling for the effects of PPS policy and cost adjusters, we do not find substantial differences in margins associated with specific demographic or market characteristics, such as the proportion of the population over age 85, household income, supply of substitute and complementary services, and the market share of health maintenance organizations.
- We do find substantial differences in margins associated with operating characteristics that reflect management decisions, such as inpatient occupancy rates, length of stay (relative to expected length of stay based on their case mix), wage levels (relative to the local market), and scope of services offered. Although adding these variables to our model explains an additional 20 percent of the variation in inpatient margins across hospitals, much of the effect of management choices may be unmeasured because management effectiveness is not easily captured in available data.

These findings suggest that key features of the PPS are partly responsible for variation in Medicare inpatient margins. Policymakers might reduce their influence somewhat by refining the PPS case-mix and wage-index adjustments. Further, if policymakers were to conclude that the effects of the policy adjustments are greater than intended, they could alter these adjustments or change related eligibility rules to reduce variation in hospitals' inpatient margins.

Nearly three-quarters of the variation in hospitals' inpatient PPS margins is associated with management choices and other factors outside the PPS, or is unexplained. This finding should not be interpreted as an indication that the PPS is malfunctioning. The Congress adopted the PPS to promote efficiency by breaking the automatic link between hospitals' Medicare operating costs and their Medicare payments, thereby creating both incentives for good management and the prospect of variations in margins. Fixed payment rates create the opportunity for gain or loss. Like organizations supplying products or services in all other markets, some hospitals adopt business strategies that work well, while others are less successful, but the payment system provides an ongoing incentive to furnish care efficiently.

The finding that much of the variation in inpatient margins is unrelated to the features of the PPS is also consistent with the results of earlier analyses carried out by the Prospective Payment Assessment Commission (ProPAC 1992a, 1992b, 1991). ProPAC's case studies of matched pairs of high- and low-performing hospitals facing similar market circumstances suggested that differences in their PPS inpatient margins were strongly associated with management performance, especially managers' understanding of and responsiveness to their market circumstances and their relations with the hospital medical staff.

Modeling sources of variation in hospitals' Medicare inpatient PPS margins

The payment rates under the various Medicare PPSs are set before the period in which they apply and are largely unaffected by individual providers' costs or charges. Setting fixed payment rates for different types of products and services puts providers at risk for gains and losses if their costs differ from the payment rates. The objective of prospective payment is to set prices that compensate providers fairly while giving them

incentives to produce services efficiently. This objective can be achieved by setting payment rates that approximate the costs reasonably efficient providers would incur in furnishing care to Medicare beneficiaries (MedPAC 2001b).

Providers' financial margins under a PPS thus reflect two factors:

- overall average margin implicit in the level of the payment rates, and
- differences between their actual average costs per service unit and those predicted by the payment system, given the mixes of services they furnish and their values for other factors included in the payment formula.

As a result, variation in margins across providers is neither unexpected nor undesirable. Like market prices, PPS payment rates create incentives that reflect the opportunity for gains and losses. But how well providers fare depends, in part, on their ability to craft appropriate business strategies, and manage production to achieve reasonable levels of operating efficiency, given their market circumstances.

To place hospitals at risk fairly, Medicare's inpatient PPS payment rates are adjusted to account for expected differences in cost per case that result from factors outside of management control, such as case mix or local market wages (see text box below). If properly

Factors that determine inpatient prospective payment system (PPS) payments

National base payment amounts. PPS payments are based on per discharge amounts, which differ for hospitals located in large urban and all other areas.

Cost adjusters. The base payment amounts are adjusted to account for the effects of certain factors (wage index, case mix, and the cost-related portion of the indirect medical education adjustment) that are expected to affect providers' costs, but are outside of their control.

- The wage index measures the average wage for hospital workers in each local market area relative to the national average.
- The case-mix index measures the expected relative costliness of a hospital's mix of Medicare discharges. Each discharge is assigned to one of 508 diagnosis related groups (DRGs) and each DRG has a national weight that reflects its expected relative costliness compared with the national average Medicare case. The case-mix index is the hospital's average relative weight across all Medicare cases.
- Teaching hospitals qualify for additional payments that are intended to cover indirect medical education (IME) costs—costs associated with operating approved residency training programs that are not directly measurable. Add-on IME payments are based on hospitals' teaching intensity as measured by their numbers of residents per bed.

Policy adjusters. The base payment amounts are also adjusted for certain factors that are only partly related to providers' inpatient care costs; these payments are intended to support other valued activities (such as uncompensated care, or additional support for teaching activities).

- Disproportionate share (DSH) hospitals qualify for additional payments because they treat an unusually high share of low-income patients, including Medicaid patients and Medicare beneficiaries eligible to receive Supplemental Security Income payments.
- The current IME adjustment factor is substantially greater than the estimated effect that teaching intensity has on hospitals' Medicare operating costs per case.
- Certain rural hospitals qualify for additional payments if they are geographically isolated or heavily dependent on Medicare and payments based on their hospital-specific, inflation-adjusted costs per case for selected years would be higher than those based on the usual PPS payment rates.

Gain/loss limiting adjusters. PPS payment rates also may be adjusted by the transfer and outlier policies, which are intended to limit providers' gains and losses on extraordinary cases.

- Hospitals receive per diem payments up to the full DRG payment rate for cases that are transferred to another PPS hospital or (in 10 DRGs) to a post-acute care setting (such as a skilled nursing facility, rehabilitation facility, or to related home health care) after a very short inpatient stay.
- Hospitals receive extra payments, called outlier payments, when the estimated cost of a case exceeds a fixed loss threshold. Costs are estimated by multiplying the patient's covered charges by the hospital's most recent cost to charge ratio. The fixed-loss threshold is based on the normal DRG payment plus IME, DSH, certain other payments, and a national fixed loss amount. The hospital is paid the normal DRG payment rate for the case plus 80 percent of the costs above the threshold. ■

constructed, these adjustments should not systematically affect providers' Medicare inpatient margins. But the Congress has also deliberately incorporated adjustments (referred to as policy adjustments) that are only partly related to expected cost differences, and therefore create systematic differences in Medicare inpatient margins across types of providers.

Apart from the influence of these policy adjustments, most of the variation in financial performance should reflect differences in efficiency that result, in turn, from management choices and effectiveness. Previous studies from ProPAC and MedPAC have documented that IME or DSH payments account for substantial differences in Medicare inpatient margins (ProPAC 1992a, MedPAC 2000). But when hospitals are grouped according to eligibility for these policy adjustments, aggregate average inpatient margins still differ by location and margins also vary widely among hospitals within these groups (Figure 3-2).[2]

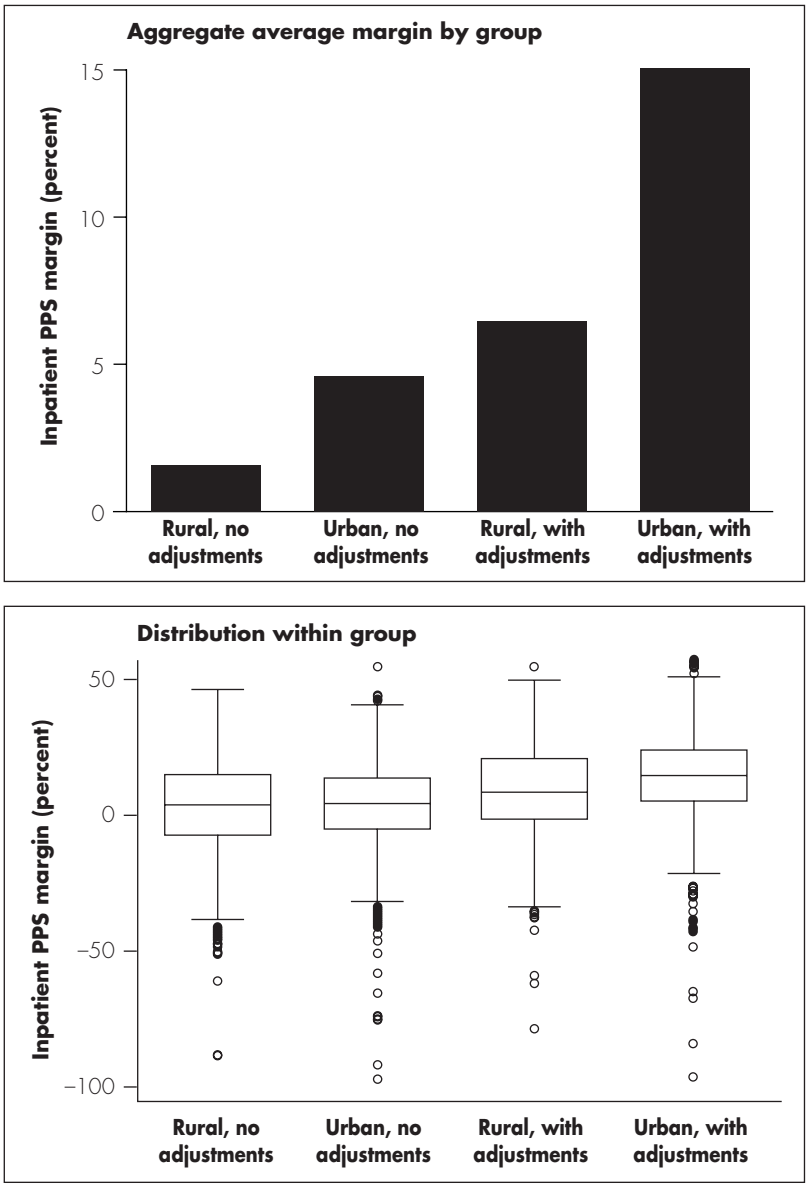
Analytic approach

Differences in hospitals' Medicare inpatient margins may arise from multiple sources (Figure 3-3, p. 46). We begin by separating the contributions of the payment system from those of individual provider characteristics. Variations that flow from the payment system may be unintended—the result of measurement error; or they may be intended—the result of a deliberate policy intervention. Margin differences associated with other provider characteristics can also be separated into two categories: those related to hospitals' external environments (including population demographics or measures of market competition), and those that may reflect providers' choices (such as case-mix adjusted average length of stay, payer and service mix, quality of care, or institutional mission).

Our analysis builds on this framework to address the following questions:

FIGURE 3-2

Differences in performance, by hospitals' eligibility for policy adjustments, fiscal year 1999



Note: PPS (prospective payment system). Inpatient PPS margin equals PPS operating payments minus PPS operating costs, divided by PPS operating payments. In the lower panel, each box diagram shows the distribution of hospitals' inpatient PPS margins among the facilities in the specific group. The top and bottom lines of each box show the 75th and 25th percentiles, respectively, of the margin distribution for the category; the horizontal line inside the box is the median margin. The small circles indicate hospitals that fall outside the range of expected performance as defined by the threshold lines above and below each box.

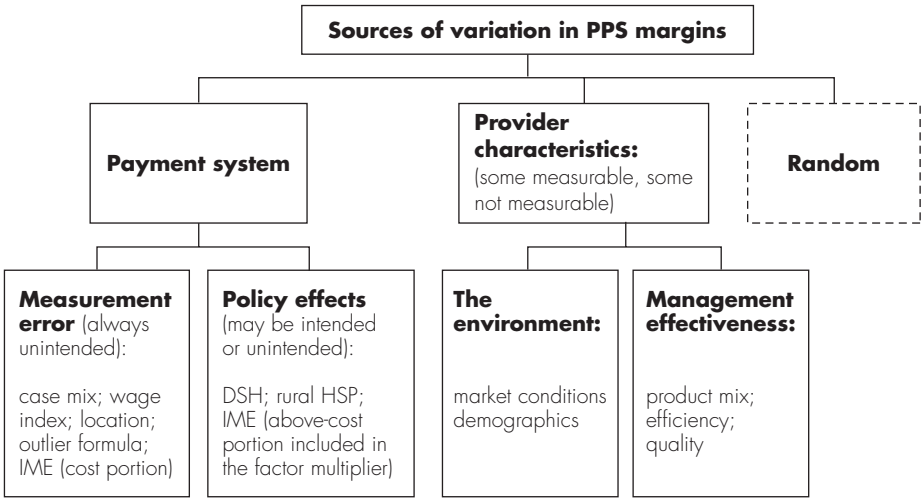
Source: Analysis by Kathleen Dalton, Sheps Center for Health Services Research, University of North Carolina, of fiscal year 1999 hospital cost report information from CMS.

- Of the total variation in hospitals' margins, how much might be due to the PPS payment formula?
- What are the independent effects of each of the payment factors on the margins? Are the payment factors operating as intended?

2 The aggregate average Medicare inpatient margin reflects the hospitals where most Medicare patients receive care. The aggregate margin for a hospital group is calculated by summing the differences between hospitals' Medicare inpatient operating payments and costs over all hospitals in the group, then dividing the result by the sum of their payments.

FIGURE 3-3

Conceptual framework for modeling PPS inpatient margins



Note: DSH (disproportionate share) payments, HSP (hospital-specific payments) for certain rural providers, IME (indirect medical education) payments, PPS (prospective payment system).

- What is the practical significance of each factor? How important is any one of them, given the range of hospital inpatient PPS margins?
- Are there other factors, outside management control, to address in the payment formula?

A strong association between factors in hospitals' external environments and their Medicare hospital inpatient PPS margins might indicate that the payment formula needs additional components or further refinement of existing components. These interpretations would be consistent with the principle that PPS rates should adjust for factors that affect providers' costs but are outside of their control. Hypothetically, if our model showed Medicare inpatient margins negatively associated with the elderly population over age 85, this might mean that the case-mix measure in the inpatient PPS is not fully capturing differences in illness severity among beneficiaries. If margin variation is primarily associated with variables reflecting management decisions, however, changes in policy may not be indicated. Although we are interested in understanding how management behavior contributes to performance variation, these influences have few implications for an evaluation of the payment system.

The model's conceptual distinction between external conditions and provider choices is important, but in practice, it is not always clear how to categorize a given variable. Payer mix, for example, can be influenced by managers through marketing or other means, although in communities with few providers it may be largely dictated by demographics. The task of modeling is further complicated because many of the measures we use to capture payment factors and provider characteristics are correlated. As a result, it can be hard to separate the effect of one factor from another, even with multivariate modeling techniques. In addition, although many provider choices—such as length of stay, capacity use, or scale and scope of operations—can be measured and analyzed directly, it is difficult to fully capture differences in efficiency and quality. To the extent that they are not correlated with other variables we can include, their contribution to the variation in financial performance will remain in the unexplained portion of any quantitative model.

Some portion of the variation in performance will also remain unexplained because it is random—the result of multiple chance occurrences that affect operations. In addition, changes in volume will alter a hospital's fixed cost per case, so year-to-year fluctuations in demand can also have an effect on margins; in any model of a single year of data, the contribution of volume fluctuations will appear as part of the random component.

Data

For this analysis, we used payment and cost data for all PPS providers (except those in Puerto Rico) taken from hospital cost reports and various CMS system files for 1992, 1998, and 1999. We adjusted the payment and cost amounts for inflation using the PPS hospital market basket index, which measures changes over time in national average prices for the inputs (labor, supplies, and so forth) that hospitals buy to furnish care. Thus, our modeling results are stated in real (1992) dollars.

The number of hospitals with usable data varies depending on the cost reporting year (Table 3-1). We excluded hospitals reporting PPS payments that appeared erroneous and those where we were missing important variables. In addition, we excluded hospitals with PPS data in the study years that have subsequently chosen to become critical access hospitals (CAHs). These hospitals are very small (CAHs are required by statute to have an inpatient census of no more than 15 acute-care patients, but most have an average daily census that is below 5). Removing them from the analysis may dilute any empirical effects associated with low volume and isolated rural location. However, these hospitals will not be affected by future changes to the PPS rules and arguably should not influence rule changes affecting the remaining PPS hospitals.

TABLE 3-1 **Hospitals included in analysis by cost reporting year**

	Main analysis	Other years	
Data category	**1998**	**1992**	**1999**
PPS providers in HCRIS file	4,489	5,233	4,377
Records available for analysis*	3,843	4,168	3,443
Less: hospitals excluded as CAHs (as of July 1, 2002)	423	398	368
Sample	3,420	3,770	3,075

Note: CAH (critical access hospital), HCRIS (Hospital Cost Report Information System), PPS (prospective payment system).
*Hospitals were excluded if they had fewer than 25 Medicare discharges, a reporting period of less than 6 months, or if they were acute long-term or rehabilitation facilities temporarily paid under the PPS rules. Depending on the year, between 8 and 9 percent of hospitals were excluded from the analysis based on cost report data edits. These edits also excluded providers for which we could not predict total PPS payments with reasonable accuracy using the payment factors included in the PPS payment system. We dropped additional hospitals because claims-based variables or the market-level measures were missing. In the 1998 file, missing data eliminated 5.7 percent of hospitals, but in 1992 this figure was about 20 percent.

Source: Analysis by Kathleen Dalton, Sheps Center for Health Services Research, University of North Carolina, of 1992, 1998, and 1999 data from hospital cost reports; other CMS systems files; and information on population demographic characteristics and health care supply for hospital markets defined by ZIP codes of origin for Medicare acute-care discharges.

In addition to cost report data, we used Part A claims to construct several variables. For each hospital, we computed the ratio of its actual to expected Medicare length of stay (LOS), based on the national geometric mean LOS for the hospital's cases in each diagnosis related group (DRG).[3] Other things being equal, hospitals that keep patients longer than expected (and have higher ratios of actual to expected LOS) should have lower PPS margins. We also constructed measures of the extent to which hospitals choose to specialize in treating certain types of patients, including cardiovascular surgery and orthopedic surgery.

Methods

We used multivariate regression techniques to address the study questions, and simulations to translate model results into a form that provides a sense of how important any one explanatory factor is compared with another. Our model is a variant of the Medicare average cost function—used elsewhere by MedPAC to estimate the indirect effects of hospitals' resident training activities—which regresses hospitals' Medicare operating costs per discharge on measures reflecting the adjusters incorporated in the payment formula for the inpatient operating PPS. We modified the approach, however, both because the outcome of interest is the hospital inpatient PPS margin—a ratio derived from both payments and costs—and we want to study the effects of several factors not included in the PPS rate formula (see text box, p. 48).

We conducted the modeling in stages, adding explanatory variables to the cost equation at each stage (Table 3-2, p. 49). In the first stage, we are interested in the contribution of the PPS payment factors to margin variation, so the first model includes only PPS payment factors. We estimate the effects of the case-mix and wage indexes in separate ranges (sometimes called piece-wise regression) to test whether either of these factors has different effects on cost per case for hospitals at the lower or upper ends of the measures.

In the second stage, we expand the cost equation to include sets of variables identifying market conditions and rural locations. We include hospital size in this stage, using a measure of total inpatient discharge volume broken into four ranges to capture different effects (if any) based on hospitals' scale.

In the third stage, we test the effects of management choices by including variables for operating characteristics thought to be important determinants of cost per case. In this last stage we also test for any remaining effects associated with hospital location and type of ownership, recognizing that these attributes may represent other differences that are not directly measured.

Findings

A model limited to the factors included in the payment system explains 27 percent of the variation in inpatient PPS margins in 1998 (slightly less in 1992). The lion's share of this appears to be by design, because it is primarily associated with IME and DSH adjustments, or special rural hospital payments. A smaller but still distinct portion is attributable to problems in other PPS payment factors.

If PPS payments were adjusted only for case mix, local market wage rates, and other cost factors outside hospitals' control, we would expect the payment system to account for none of the variation in hospitals' Medicare inpatient margins. Because the formula includes additional policy adjustments, we expect to see some variation in inpatient margins that is systematically associated with those policy factors. However, we find that the case-mix and wage-index variables also contribute to the margin variation, contrary to the intent of the payment system's design.

3 To avoid estimation and interpretation problems that might be associated with predicting hospitals' expected costs using their LOS in the same year, we used their Part A claims for the preceding years (1991, 1997, and 1998).

Methods

Since the outcome of interest is hospital payment margins in the inpatient prospective payment system (PPS), we use a two-equation model that simultaneously estimates hospitals' average Medicare payments and costs per case. We estimate both the payment and cost equations in log form using explanatory variables for each of the payment factors in the inpatient PPS formula. We can add other variables that are not part of the payment system to the cost equation to test their effects on costs and margins. In addition, we can test whether the effects that some factors have on costs or payments differ across types of hospitals.

The multiple equation technique is called seemingly unrelated regression (SUR) because it allows for different outcome variables with overlapping (though not identical) sets of explanatory variables to be estimated within a single model (Greene 2000). The results from SUR are very similar to results from an ordinary regression analysis where the outcome variable is the hospital's PPS inpatient margin and each hospital has equal weight. However, the two-equation technique provides more information about the components of the margin. It also allows us to incorporate information from the PPS payment formula in the form of restrictions imposed on certain variables in the payment equation, which improve the estimates for other, correlated variables.

The profitability measure obtained indirectly from the two-equation model is a payment-to-cost ratio. This is closely related to the PPS margin MedPAC generally uses, but it has a different scale. A payment-to-cost ratio will be between zero and one if the facility is paid below cost, and greater than one if the facility is paid above cost. The Medicare margin used elsewhere in MedPAC analyses is computed as the difference between PPS payments and cost expressed as a percent of payments; it is therefore negative if the facility has a loss, positive if it has a profit. ■

Relatively little of the variation in hospitals' margins appears to be independently associated with differences in environmental characteristics, such as population demographics, provider supply, or local competition. Although environmental factors are often significant predictors of cost per case, they tend to be correlated with hospital case mix, the market wage index, teaching intensity, disproportionate share status, and urban location. Consequently, market characteristics add only a few percentage points to the variation already explained by the payment factors. When we add other provider characteristics to the model—those generally thought to reflect management decisions or mission, such as capacity use, length of stay adjusted for case mix, scope of services offered, and ownership—we can explain another 20 percent of the margin variation. Thus, after including all of the explanatory variables—PPS payment factors, environmental conditions, and operating characteristics—the model accounts for about half of the variation.

The role of PPS payment factors

By construction, payments to a hospital with a case-mix index (CMI) of 1.10 will be 10 percent higher than payments to a hospital with an index of 1.00. Other things being equal, if the DRG relative weights are accurate, a 10 percent difference in average case-mix weight should be associated with a 10 percent difference in cost per case, when averaged across all hospitals. We would not expect this association to hold exactly true for each hospital, because the inpatient PPS is a system based on averages, but we do expect it to hold true for the sample as a whole.

The wage index works in a similar fashion, but it is used to adjust only the labor-related portion of the PPS payment per case, now about 71 percent of the base payment rate. Payments to a hospital located in a region with a wage index of 1.10 will be 7.1 percent higher than payments to a hospital with an index of 1.00. If the wage index accurately tracks the effects on operating costs per case of differences in market wages for hospital workers, we would expect to find that the same 10 percent difference in the wage index is associated with about a 7 percent difference in cost per case, when averaged across the sample.

The results indicate that both the case-mix and wage indexes may be overadjusting for cost differences at the hospital level. The best way to demonstrate this is with a simulation that shows the estimated effect of changes in one of these measures for a realistic base case hospital. We have used the model estimates to calculate predicted payments and costs for this base case hospital—which is merely a device we use to isolate the effects of one factor—by holding all of the other explanatory factors constant. In the illustrations that follow, the base case hospital is a typical facility that:

- is located in an "other urban" area with a wage index of 1.00,
- does not receive any policy adjustments (IME or DSH) under the PPS,
- has a case-mix index of 1.26 (the sample mean value), and
- has outlier payments that equal 3 percent of its DRG payments (again the sample mean).

TABLE 3-2

Variables included in models of Medicare hospital inpatient margins

Payment factors (included in both equations)

- Case-mix index (estimated in three pieces)
- Wage index (estimated in two pieces)
- Indirect medical education (ratio of IME dollars paid to DRG dollars paid)
- Disproportionate share (ratio of DSH dollars paid to DRG dollars paid, identified separately for urban hospitals with more than 100 beds and all others)
- Hospital-specific payments (increment of HSP amount over DRG amount, as a ratio to DRG dollars that otherwise would have been paid)
- Outlier ratio (outlier dollars paid divided by the DRG amounts paid)
- Location in large urban area (actual location or reclassified)
- Location in Alaska or Hawaii (eligibility for adjustment for higher nonlabor input prices)

Environmental and market factors (included only in cost equations)

- Median household income in hospital market
- Percent of workforce unemployed in hospital market
- Percent of population over age 85 in hospital market
- Percent of population nonwhite in hospital market
- Physician-to-population ratio in hospital market
- Managed care penetration (county-level estimate of enrollees per population, Medicare and non-Medicare, as of 1997)
- Numbers of hospitals, nursing homes, and ambulatory surgery facilities within a 15-mile radius
- Numbers of specialty hospitals and federal clinics within a 25-mile radius (measured as of 1998)
- Indicator for "very rural" status (nonmetropolitan county, fewer than 20,000 residents in urbanized settings)
- Number of acute-care discharges, annualized (estimated in four pieces)

Hospital operating characteristics (included only in cost equations)

- Ratio of actual to expected length of stay
- Ratio of hospital hourly wage to PPS market hourly wage
- Hospital occupancy rate (including patients in swing beds)
- Participation in long-term care, based on ratio of LTC days to acute days; variables for low (ratio<0.10); medium (ratio 0.10—0.50); high (ratio≥ 0.50)
- Participation in inpatient rehabilitation, inpatient psychiatry, home health, or federal clinics (dummy variable)
- Specialized service mix: variable indicating that percent of Medicare claims from MDC 5 or MDC 8 surgical DRGs greater than 95th percentile for all hospitals
- Ownership indicators (for-profit or public ownership) in combinations with indicators for regions

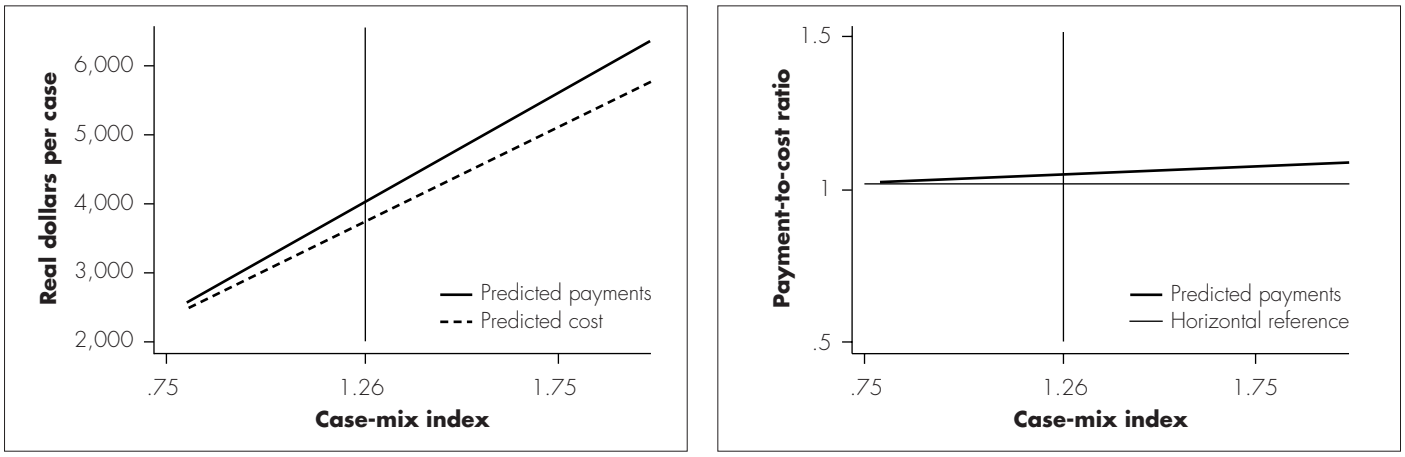
Note: DRG (diagnosis related group), DSH (disproportionate share) hospital, HSP (hospital-specific payment), IME (indirect medical education), LTC (long-term care), MDC (major diagnostic category), MDC 5 (diseases and disorders of the circulatory system), MDC 8 (diseases and disorders of the musculoskeletal system and connective tissue), PPS (prospective payment system). Hospital market definitions based on ZIP codes of origin for Medicare acute-care discharges. All continuous variables are transformed to natural log values.

Source: Kathleen Dalton, Sheps Center for Health Services Research, University of North Carolina.

Using this base case as a reference point, we can trace out the predicted effect of a change in any payment factor or other variable—on PPS payments, costs, and the inpatient margin—while holding the effects of other factors constant. The first illustration focuses on the effects of the CMI (Figure 3-4, p. 50). The left-hand panel shows how predicted payments and costs per case each increase as case mix increases. Payments increase at about the same rate as predicted costs for hospitals with index values of 1.08 or below. At higher levels of the index, however, the increase in payments is proportionally greater than the predicted rise in costs. The panel on the right shows the resulting predicted payment-to-cost ratio. For hospitals with case-mix values less than 1.08 the line is almost flat. This indicates that, at low levels, the case-mix index tracks costs as it should, making no contribution to inpatient PPS margins. For hospitals with case-mix indexes above

FIGURE 3-4

Sample simulation for base case hospital: predicted effect of case-mix weights on payments, costs, and payment margins



Source: Analysis by Kathleen Dalton, Sheps Center for Health Services Research, University of North Carolina, of 1998 data from hospital cost reports; other CMS systems files; and information on population demographic characteristics and health care supply for hospital markets defined by ZIP codes of origin for Medicare acute-care discharges.

1.08, however, the margin line slopes upward—the horizontal line provides a reference—indicating that the case-mix index overcompensates for expected cost differences associated with higher case complexity. If the DRG relative weights were functioning perfectly, the margin line would be flat for all ranges of the case mix index; higher DRG weights should not, by themselves, be associated with higher margins.

The definition of the base case does not alter the findings on the effect of any factor on the inpatient PPS margin. The gap between predicted payments and costs indicates the size of the margin. For this particular base case with a CMI of 1.26 (marked with a vertical line in the figure), predicted payments are about 6 percent above predicted cost. If the characteristics of the base case hospital were altered, the predicted margin line would shift up or down, but the slopes of the lines in both panels would remain unchanged. The gap between the payment and cost lines reflects the overall adequacy of the PPS rates, while the difference between the two slopes indicates the contribution of the simulated variable (case mix, in this example) to the variation in PPS inpatient margins.

We have repeated this simulation exercise for each of the factors in the PPS payment formula and displayed the results for predicted payment-to-cost ratios (Figure 3-5). The vertical axis for each panel is the predicted payment-to-cost ratio, while the horizontal axis reflects the range of the simulated payment factor. As the vertical scales are the same for each panel, we can gauge the relative importance of each factor (the relative size of its contribution to margin variation) by how steep the slope of its line is compared with those for other payment factors. To give perspective on where hospitals fall along these predicted margin lines, we have added horizontal and vertical lines encompassing the middle 50 percent of the distribution of hospitals. The horizontal and vertical lines in each panel indicate the 25th and 75th percentiles of the distribution of actual payment-to-cost ratios for hospitals in the sample and the simulated payment factor, respectively.

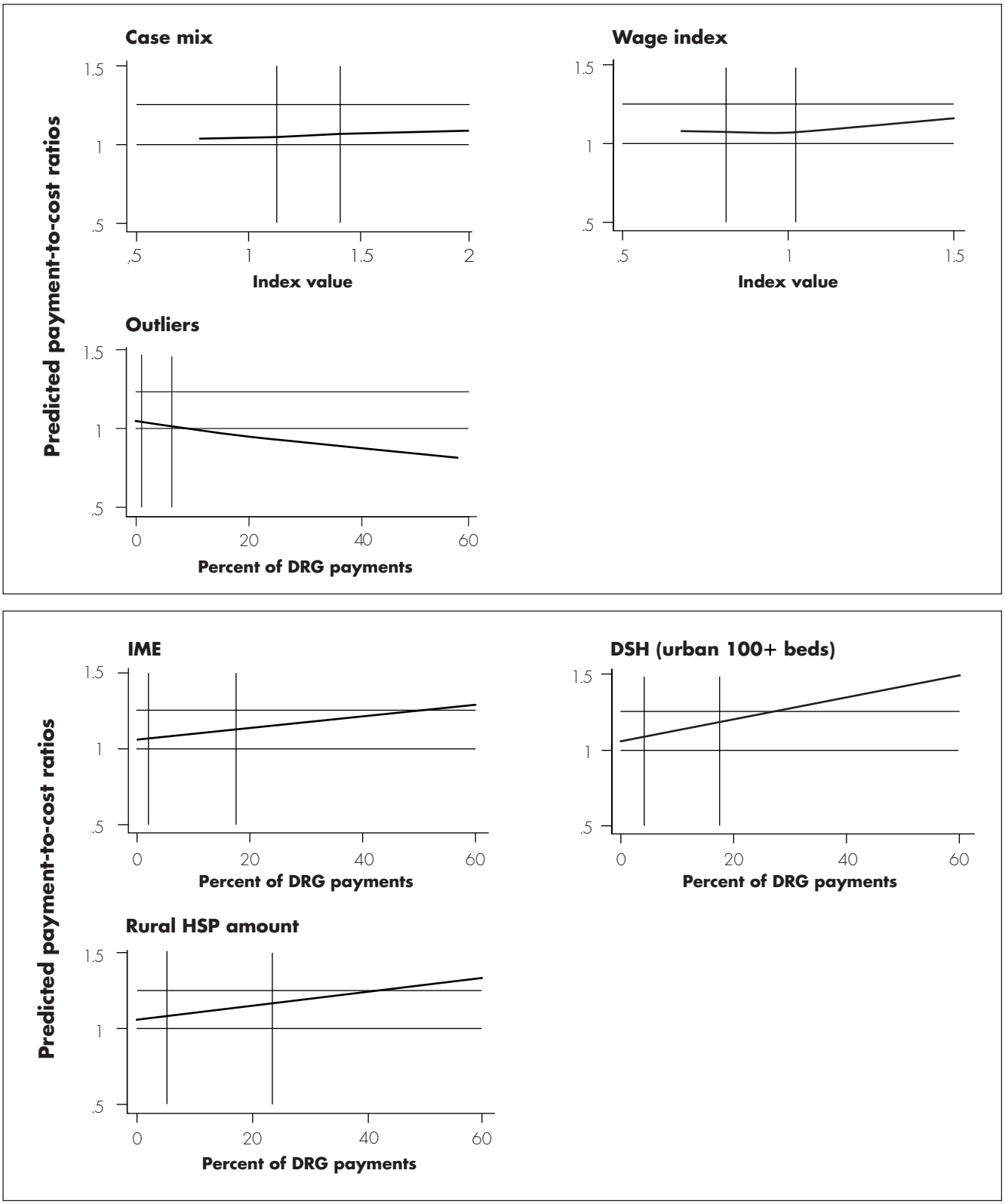
The graphs in Figure 3-5 show the strong influences the IME and DSH adjustments have on the margins of eligible facilities. The proportional effect of rural hospital-specific payments received by sole community and small rural Medicare-dependent hospitals is also quite large.

Each of these policy adjustments is significantly and positively associated with costs per case. If we had included graphs of the separate predicted cost and payment lines, it would be clear that hospitals' costs per case rise with increases in their teaching intensity and low-income patient share (the DSH proxy for uncompensated care). For eligible rural hospitals, the size of the incremental hospital-specific payment per case (compared with the PPS payment per case they otherwise would have received) is also positively related to cost per case—even though eligibility for this adjustment is not based on higher costs.

As expected, the PPS policy adjustments are considerably greater than the related cost differentials. The difference between the cost and payment effects is what can be considered the policy portion of the adjustment. In the case of IME, the payment effects are more than twice the predicted cost effects. Among urban DSH providers with more than 100 beds, the effects are nearly 5 times greater. The disproportionate share variable is not significantly associated with cost per case among smaller urban and rural hospitals that qualify, implying that all of their DSH dollars can be considered a policy subsidy

FIGURE 3-5

Summary of margin effects for three PPS cost adjusters and three PPS policy adjusters



Note: DRG (diagnosis related group), DSH (disproportionate share), HSP (hospital-specific payment), IME (indirect medical education), PPS (prospective payment system). The horizontal and vertical lines show the 25th and 75th percentiles of the sample distributions.

Source: Analysis by Kathleen Dalton, Sheps Center for Health Services Research, University of North Carolina, of 1998 data from hospital cost reports; other CMS systems files; and information on population demographic characteristics and health care supply for hospital markets defined by ZIP codes of origin for Medicare acute-care discharges.

for underwriting uncompensated care. Among rural hospitals receiving hospital-specific payments instead of DRG amounts, the additional payments are nearly twice the size of the related cost differentials. With nearly 60 percent of PPS hospitals eligible for one or more of these three policy adjustments, it is clear that they account for a large share of the margin variation attributable to PPS payment factors.

The case-mix and wage adjustments also contribute to the explained variation in inpatient PPS margins. Although the individual influence of these factors is smaller than that of the policy adjustments, their combined impact could still be substantial because they are highly correlated. Further, all of the contribution of the case-mix and wage indexes—unlike that of the policy adjustments—is unintended. The evidence that both of these measures may overadjust for cost differences is also present in the 1992 and 1999 data. Like the case-mix index, the wage index appears to overstate expected cost differences only at the higher end of the distribution. In markets with index values below 1.00 in 1998, the wage index appears to function as intended—the predicted effects on payments and costs per case are very similar.

The outlier payment variable is negatively associated with PPS margins, but this is consistent with the design of the outlier policy. Providers have always had to absorb the initial excess costs of an outlier case, and are reimbursed for 80 percent of estimated costs in excess of the specified cost threshold. On average, payments are less than costs by design and in the model, an increase in the proportion of outlier payments is associated with a decrease in margins, other factors being equal. The slope of the margin line for the outlier variable is not very steep; in 1998 and 1999 the effect on margins was not very great. The rules governing outlier cases and payments have changed over the last decade, however, and in the 1992 data the margin line had a much steeper declining slope, indicating that losses on outlier cases were proportionally greater.[4]

The effects of other hospital characteristics and market circumstances

We apply the same simulations to a model that includes variables for hospital environmental and operating characteristics. These variables have no independent influence on PPS payments, but they often do have an independent effect on cost per case, and therefore on PPS margins (Figure 3-6).[5]

Adding providers' operating characteristics substantially increases the proportion of margin variation explained by the model. Still, the individual contributions of most of the management choice variables are relatively small. For all but one of the variables shown here the direction of the effect is as we expected. For example, higher average occupancy rates are associated with higher margins; higher hourly wages (relative to the hourly wages of the local labor market) and higher ratios of actual to expected LOS are each associated with higher cost per case and therefore lower margins. Within the range of commonly occurring values for these factors, however, the lines have relatively shallow slopes. With the exception of the ratio of actual to expected LOS, the contribution of any one of these operating characteristics to the overall level of variation is probably modest.

The findings on the effects of discharge volume, the share of hospital revenues derived from outpatient business, and the extent of hospitals' participation in other levels of care (such as post-acute and long-term care) tell us something about the effects of economies of scale and scope. Generally, larger overall discharge volume is associated with lower cost per case. The estimates for different volume ranges, however, suggest that Medicare operating costs per case decline only for hospitals with fewer than 10,000 annual discharges (including more than 75 percent of all hospitals in the sample). The estimated decline in costs per case was strongest for hospitals with volumes between 5,000 and 10,000 discharges per year. These findings, however, have been heavily influenced by the exclusion of many small rural facilities that converted to CAH status.[6]

Somewhat surprisingly, greater reliance on outpatient services is associated with higher cost per inpatient discharge, and therefore with lower margins. This finding, however, may simply reflect the strong negative correlations between reliance on outpatient services and other key variables, including the case-mix and wage indexes, IME, and DSH.

Other variables that capture the extent to which hospitals offer other levels of patient care also present mixed evidence about economies of scope. Providing small amounts of post-acute and

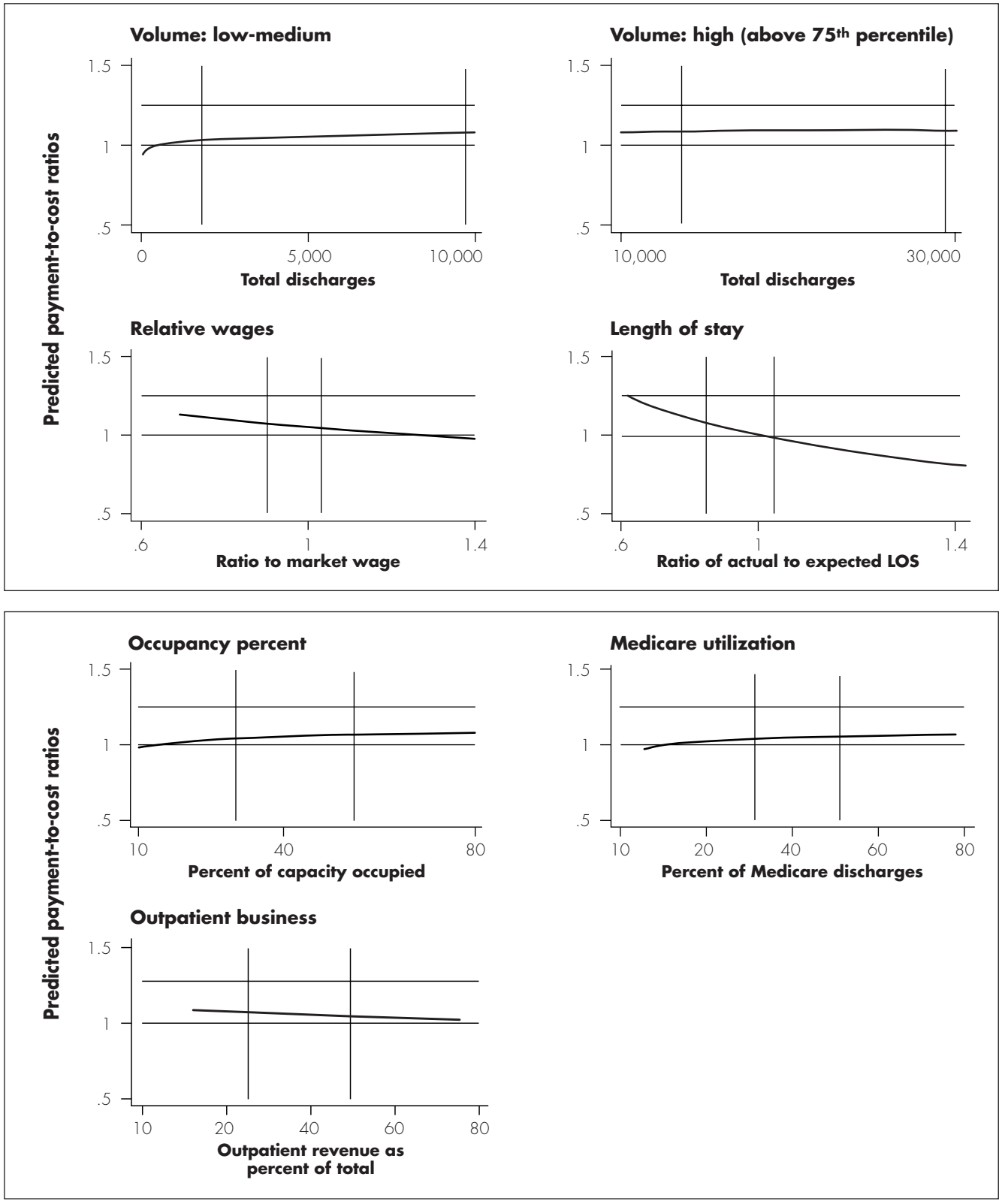
4 We reanalyzed the 1998 data after removing from the sample all hospitals in which outlier payments accounted for 50 percent or more of their total PPS payments. In this analysis, the margin line for the outlier variable had a much steeper declining slope, indicating that the effect of the outlier policy on hospitals' margins is sensitive to extreme values in the outlier payment distribution. Recent data indicate that a small number of hospitals have increased their service charges rapidly, causing a huge increase in their PPS outlier revenues. Thus, an analysis of the outlier policy's effect on the margins of this subgroup might show a very shallow downward or shallowly increasing slope. Proposed changes in the outlier payment regulations (CMS 2003), however, are likely to largely resolve this problem.

5 For these simulations, the definition of a base case hospital must expand to incorporate typical values of the new variables in the model. For Figure 3-6 we assume the same PPS payment-related characteristics as applied in Figure 3-5 (p. 51) and the facility has median values for each of the other continuous characteristics added to the model, operates no post-acute or other subproviders, is under private not-for-profit control, and is located in the South.

6 Before removing the converting CAHs from the sample, the model showed that the lowest volume hospitals had substantially higher costs, with a pronounced drop in predicted cost per case occurring as facilities increased volume up to about 500 cases per year. Above 500 cases, the marginal effect of volume changes was much smaller. These results are consistent with earlier MedPAC findings (MedPAC 2001a) that led to the recommendation for a new low-volume adjustment to PPS rates. With the withdrawal from PPS of low-volume hospitals that also had unusually high adjusted costs per case (Dalton et al. 2003), the data no longer show distinctly higher costs for low-volume providers.

FIGURE 3-6

Summary of margin effects for other cost factors



Note: LOS (length of stay). The horizontal and vertical lines show the 25th and 75th percentiles of the sample distributions.

Source: Analysis by Kathleen Dalton, Sheps Center for Health Services Research, University of North Carolina, of 1998 data from hospital cost reports; other CMS systems files; and information on population demographic characteristics and health care supply for hospital markets defined by ZIP codes of origin for Medicare acute-care discharges.

long-term care (LTC) does not appear to be associated with higher inpatient margins, but among providers in which LTC days constitute more than a third of total hospitals days (most of these are in rural areas), inpatient costs per case are estimated to be 2.3 percent lower (and margins are correspondingly higher).[7] We found similar cost reductions associated with operating hospital-based home health agencies, but none associated with other subproviders such as clinics, inpatient rehabilitation, or psychiatric units. Some of these services may help hospitals reduce length of stay by allowing earlier discharges into post-acute settings, but interpreting the results for the service variables is not straightforward because the model already controls for differences in Medicare lengths of stay. Also, some of the findings appear to be sensitive to whether we include detailed controls for geographic location. These results suggest that further modeling might be helpful to identify expected economies of scope (for example, from sharing fixed overhead over more service areas), and to assess the influence of reimbursement incentives on cost allocation practices in facilities that provide services in settings not previously subject to prospective payment under Medicare. It also might be fruitful to explore further factors associated with differences in the ratio of actual to expected LOS, including the availability of post-acute care alternatives.

Some of the market-level sociodemographic characteristics and a few of the health care supply measures have statistically significant but small effects in the model's cost equation. Both household income and physician-to-population ratios were positively associated with average costs. The proportion of the service area population over age 85 was negatively associated with cost per case in rural areas, though there was no significant association in urban areas. Other local health care supply measures had very little effect on model results either individually or as a group, with the exception of the county-level measure of managed care penetration. In urban areas only, this measure is associated with lower costs per discharge, although the size of the effect differs by region.

Regional differences in cost and treatment patterns have been noted in the hospital cost literature for many years, and though they are less pronounced now than when prospective payment first started, they are still difficult to explain. We found some reductions in the differences by region between 1992 and the 1998 and 1999 data, but the model continues to identify substantial differences associated with regional location combined with type of ownership (Table 3-3). That these differences remain even after controlling for ownership, length of stay, health care supply, and other competition measures is puzzling.

The differences in margins by type of ownership are also substantial. The simulations show predicted PPS payment to cost margins in for-profit facilities 10 to 15 percentage points higher than those for similar publicly-owned facilities. Average differences in performance of this magnitude are clearly important, but need to be interpreted with some caution. Much of the greater profitability associated with for-profit ownership may reflect the unmeasured management characteristics mentioned earlier, as well as differences in patient characteristics or service mix not captured by the case-mix index. But selection and survival also may play a role. For example, investor-owned firms may be more likely to acquire facilities with potentially profitable types of patients and services, while public ownership may tend to occur in disadvantaged communities (including very small ones) where the private sector has been unable to succeed. Further, and possibly more important, investor-owned firms may be more likely than others to divest themselves of facilities that prove to be unable to earn a profit under PPS. Teasing out the margin differences associated with selection, survival, and other management choices in the for-profit environment would require a different type of multivariate technique and multiple years of data spanning periods before and after ownership changes.

TABLE 3-3

Predicted payment-to-cost margins by location and type of ownership, for an otherwise identical base case facility, 1998

Region	For profit	Nonprofit	Public	All types
Northeast	1.106	1.088	1.008	1.084
Midwest	1.096	1.013	0.997	1.015
South	1.175	1.063	1.044	1.086
West	1.125	1.025	0.989	1.037
All regions	1.154	1.046	1.021	1.058

Source: Analysis by Kathleen Dalton, Sheps Center for Health Services Research, University of North Carolina, of 1998 data from hospital cost reports; other CMS systems files; and information on population demographic characteristics and health care supply for hospital markets defined by ZIP codes of origin for Medicare acute-care discharges.

7 This variable is based on LTC days reported in the hospital's cost report and could include a combination of skilled nursing facility days, swing-bed days, and other nursing facility days.

The underlying margin implicit in the level of the base payment rates

Our analysis has focused on the contribution of various payment variables and other factors to the differences between PPS payments and costs. Each factor, however, operates on an underlying margin implicit in the level of the national base payment amounts. Our model also provides information on this underlying margin. We estimate that the standard payment amount in fiscal year 1998 was about 5 percent above the standardized cost per case, averaged across all hospitals paid under PPS that did not convert to CAH status. (Before we removed the hospitals converting later to CAH, the standard payment rate was only about 2 percent above the standardized average cost per case.) This figure measures baseline average PPS profitability for a hospital with a case mix of 1.0 (which is well below average) in an other urban location with a wage index of 1.0, before taking any policy adjustments, location differentials, or outlier cases into account.[8] Policy, case-mix, wage, and location adjusters all tend to add to this baseline profitability in varying degrees, such that in total, the average operating payment exceeds operating cost by about 15 percent. In 1999, the excess was substantially smaller than in 1998; in 1992, the underlying margin was slightly negative.

Since the introduction of the inpatient PPS, the size of the large urban and other urban base payment differential has also contributed to variation in margins along urban and rural lines. In 1992 the PPS rate differentials were substantially smaller than the average cost differentials by urban location. This partially offset other factors that tended to increase the margins in urban areas. Since that time the models have shown a steady decline in the cost differentials associated with urban settings. During the 1990s the PPS base rate differential between rural and other urban areas was phased out, but the differential for large urban areas continued to be 1.6 percent until 2003. By 1998, our Medicare average cost model no longer shows a statistically significant cost differential associated with location in large urban areas. The base rate differential therefore also contributed a small amount to the observed variation in PPS inpatient margins in 1998 and 1999.

Study limitations

There are many limitations to this approach to modeling profitability. First among them may be that we are only looking at inpatient Medicare margins, which reflect payments and costs for only one of the various types of Medicare-covered services that hospitals furnish. In addition, although we have examined these models for three different years, these are still three separate snapshots of variation across facilities. The cross-sectional approach is appropriate where the primary study question concerns the extent to which PPS payment factors intentionally or unintentionally contribute to margin variation. But a study of the dynamics of individual hospitals' performance over time could contribute a great deal to our understanding of the effects of market and management factors.

Another limitation of this study is that we are unable to distinguish differences in profitability across types of cases or patients because we are analyzing aggregate hospital data. The absence of accurate DRG-specific cost data limits our ability to consider product mix as a potential explanatory variable in a model of financial performance under PPS. We have tried to offset this lack to the extent possible by testing differences across subsets of hospitals; explicitly modeling interactions between some of the independent variables; and adding variables computed from the claims data that attempt to capture the degree of specialization within hospitals.

The factors we have identified thus far explain one-half of the variation in performance across hospitals. Whether that should be considered adequate depends on what is potentially hidden in the unexplained portion of the model. With multiple years of payment and cost data it is possible to estimate an upper bound for the random component of variation in margins (Newhouse et al. 1988). Results from this approach suggest that somewhere between 15 and 20 percent of the variation in a given year may be random, but that leaves 30 to 35 percent of variation attributable to factors not yet measured. Much of this may fall in the category of unobservable differences in efficiency, effectiveness, and quality.

A portion of the unexplained variation is also attributable to year-to-year fluctuations in demand. Smaller hospitals experience more instability in demand, and in our analyses, the model error (the absolute value of the difference between the predicted and the actual margin) is greater for smaller hospitals than for larger ones. This finding confirms that the levels of risk experienced under prospective payment are greater for smaller hospitals.

Discussion and policy implications

Our primary objective in conducting this study was to identify the contribution of the PPS payment factors to the variation in hospitals' Medicare inpatient margins, and to determine if these factors are operating as intended. We find that slightly more than one-quarter of the total variation in inpatient margins is attributable to components of the PPS

8 In the context of this type of regression model, "average" means a simple average where each hospital has equal weight. If this were a case or dollar-weighted analysis, both the baseline margin estimate and the average payment margin would be higher, because the larger facilities in the sample tend to have higher margins. In other presentations of average Medicare margins, MedPAC uses an aggregate margin ratio, which is effectively a weighted rather than a simple average.

payment formula. Most of the margin variation related to PPS payment factors can be traced to three policy adjustments. Simulations from the model identify not just the presence and direction but also the magnitude of the effects of IME, DSH, and rural HSP adjustments on the margins of eligible facilities. Whether the impact of these policy adjustments is more or less than the Congress intended, and whether the adjustments are accurately targeted to the types of providers for which they were intended, are matters for policy debate rather than estimation.

A small portion of the variation can be attributed to the case-mix and wage index adjustments. This variation is not deliberate and probably could be addressed by modifying the payment system. Our findings on the wage index, for example, suggest that hospitals located in markets with relatively high wage rates tend to have a smaller portion of costs that are sensitive to wage differences (the labor-related share) than the 71 percent now applied in the payment formula. If so, some of the margin variation could be reduced by lowering the labor-related share of the national base payment rate. It is not yet clear, however, whether this difference in the labor-related share is primarily associated with high wage markets or with large hospitals, which are more likely than small- and medium-sized facilities to be located in high wage markets. The Commission plans to pursue this issue further.

Although the findings indicate that the current case-mix adjustment in the PPS tends to overcompensate high case mix hospitals, the mechanism (and the appropriate solution) is not clear. Adopting a patient classification system that is more sensitive to differences in severity of illness than the current DRGs might eliminate the unintended case mix contributions to margin variation across hospitals. It is also possible, however, that a portion of the problem arises from limitations in the data and methods used to calculate the national DRG relative weights. The DRG weights may be biased because they are based on hospitals' service charges, and thus reflect the systematic differences in mark-ups across services that are built into hospitals' charge structures (MedPAC 2000). Our model cannot tell us whether the problem lies in the patient classification system, DRG relative weights, or both. Rather, we would have to construct alternative case-mix measures and test their effects in the model.

The case for addressing these errors in the wage and case-mix indexes is strengthened since each tends to increase the distributional impact of the IME and DSH adjustments (which are applied to case-mix and wage-adjusted payments). This compounding effect occurs because the wage and case-mix adjustments are correlated with hospitals' teaching intensity and low-income patient shares, with high values on all four variables tending to benefit the same providers.

We have not found any specific market characteristics associated with differences in margins that suggest the need for additional adjustments within the PPS formulas. However, regional variations persist in the PPS margins that are not related to length of stay or local health care supply measures, and further investigation of these differences may identify other issues. The greater unpredictability that we find among small hospitals (and the impact on the model results from removing CAHs from the sample) also may focus attention on market conditions associated with weak demand.

Finally, we found that hospital operating characteristics generally thought to be at least partially under managements' control account for 20 percent of the variation in Medicare inpatient margins. But much of the impact of management effectiveness is probably unmeasured, and likely represents a substantial portion of the half of PPS margin variation that remains unexplained. Nearly three-quarters of the variation in hospitals' performance under the inpatient PPS is either unrelated to the payment factors or unexplained. While modifications to the payment system could reduce total variation, providers still have a great deal of control over their relative performance. ■

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