

## Alternative geographic adjustments in Medicare payment to health maintenance organizations

by W. Pete Welch

*The payment received by a health maintenance organization (HMO) for its Medicare enrollees is proportionate to the average cost of Medicare beneficiaries in that county. However, HMO market share in an area appears to decrease costs in the fee-for-service sector, so that HMOs are paid less. For this and other reasons, alternative payment formulas may be desirable and several are developed in this article. The conceptually simplest location factor would be an input price index. An alternative strategy would also recognize systematic variation in utilization. Utilization rate is regressed on variables such as county population density and physicians per 1,000 persons. The predicted utilization rate times an input price index could serve as a location factor. The value of alternative location factors are presented for specific counties.*

### Introduction

The payment received by a health maintenance organization (HMO) for its Medicare enrollees is determined by the Medicare adjusted average per capita cost (AAPCC) in the fee-for-service (FFS) sector. The AAPCC is 95 percent of the U.S. average Medicare per capita cost (USPCC) in the FFS sector, adjusted for the demographic characteristics of the enrollees in the HMO (the demographic factor) and for local cost differences as measured by the ratio of Medicare costs in the county to costs nationally (the location factor). That is, the payment rate is the product of the USPCC, the demographic factor, and the location factor. This formula was designed in the 1970s and has remained basically unchanged since then. This article develops alternatives to the location factor, alternatives that are tied to national average FFS expenditures (i.e., USPCC).

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### Framework and general approaches

A two-equation framework facilitates understanding the major ways Medicare might geographically vary payments to HMOs. The first equation is

$$E = P * Q \quad (1)$$

where

$E$  is Medicare FFS expenditures per beneficiary in an area,  $P$  is the input price (e.g., hospital wage), and  $Q$  is the quantity of services or the utilization rate (e.g., admission rate). A second equation elaborates on the utilization rate:

$$Q = f(X) + e \quad (2)$$

where

$X$  is a vector of variables and  $e$  is a stochastic term. Some but not all of the variation in utilization rates can be explained by factors such as physician supply. More formally, the variation in utilization has two components: systematic ( $f(X)$ ) and area-specific ( $e$ ). To understand these components, consider an urban area in which the utilization rate is 115 percent above the national average, whereas for all urban areas it is, say, only 105 percent above average. The systematic component is 5 percent and the area-specific component is 10 percent.

This framework enables one to delineate three ways that Medicare payments to HMOs could be tied to variations in local Medicare FFS expenditures. Variation in payment rates might reflect:

- Only input price variation.
- Input price variation and systematic variation in utilization.
- Input price variation and all variation in utilization.

At present, Medicare payment to HMOs is proportionate to local FFS expenditures and, as such, reflects input prices and both components of utilization. The other two approaches are elaborated on later.

There is likely to be consensus that payments to HMOs should reflect, at a minimum, local input prices (e.g., Anderson et al., 1989). For instance, in an area where input prices are 10 percent above the national average, HMOs would be paid 10 percent above the average. An analog to this is physician payment, which is proportionate to the Geographic Practice Cost Index (GPCI).

The case for an input-price approach is strongest if HMO utilization rates are uniform nationally, that is, not influenced by the utilization rates in the local FFS

sector. However, because HMO and FFS providers constitute two sectors of local health care markets, theoretically it is unlikely that these sectors are independent of each other. High HMO market share appears to lower costs in the FFS sector (Welch, 1991b). Plausibly, above average (below average) costs in the FFS sector cause above average (below average) costs in the HMO sector. The impact of one sector on the other is termed a spillover effect.

HMOs compete with the FFS sector in both output and input markets. In the output market, the sectors compete for enrollees. The more FFS physicians practice a profligate style of medicine—perhaps hospitalizing frequently or ordering many tests—the higher the expectation is of potential HMO enrollees in terms of hospitalization and tests. This increases the difficulty for HMOs in practicing conservatively while maintaining their market share.

In the input market, the sectors compete for physicians. The relationship between the two sectors is clearest for individual practice associations (IPAs), whose physicians are partially in the FFS sector. Unless those physicians can have two different and independent styles of practice, which is unlikely, their style of practice in the FFS sector will have an impact on their style of practice in the HMO sector and vice versa. Even prepaid group practices (PGPs) such as Kaiser Permanente may be affected by the local physician market if they hire some of their physicians locally.<sup>1</sup> Two-thirds of HMO enrollees (including non-Medicare enrollees) are in IPAs. This suggests that payment rates might reflect, at least in part, local utilization rates.

A location factor reflecting input prices (i.e., a market basket of inputs) and only the systematic component could be devised by regressing Medicare FFS expenditures on input prices and determinants of utilization (e.g., urban-rural status or physicians per capita). Predicted expenditures would reflect the systematic, but not the area-specific, component of utilization. Payment in each county would be proportionate to predicted expenditures instead of actual expenditures.

Note that possible changes in the location factor would be consistent with many possible changes in the geographic payment areas. For instance, Rossiter, Adamache, and Faulkner (1990) proposed that counties be replaced by metropolitan statistical areas (MSAs) and rural areas of States, which are the geographic units that Medicare uses to pay hospitals. As MSAs are aggregations of counties, a location factor designed for a county-based payment system could be transformed for an MSA-based payment system. This would involve summing the location factors of the counties within each MSA, weighting by Medicare enrollment.

## Goals and their implications

Which of these three approaches is most appropriate for Medicare depends, in part, on one's goals for the Medicare HMO program. One possible goal is to save Medicare dollars in the short run and to "guarantee" savings in each county. A second goal is to increase HMO market share in Medicare, whether savings are immediately realized or not. Increased market share might be deemed desirable, either because HMOs produce a higher quality of health care through managed care or because HMOs result in the FFS sector lowering its expenditures through a spillover effect. A final goal is equity of access (or at least out-of-pocket premiums) for Medicare beneficiaries; that is, beneficiaries in areas with low FFS expenditures should have, the argument goes, the same opportunities to enroll in HMOs as beneficiaries in areas with high FFS expenditures.<sup>2</sup>

The case for the status quo—recognizing area-specific utilization rates—is strongest if shortrun savings is the primary goal, because this approach appears to guarantee the same percentage savings in each county. Under this approach, payment would be greatest where FFS expenditures are highest, the rationale being that HMO enrollment growth is most needed there because the savings to Medicare are greatest there. This is strictly a budgetary rationale.

Even with that goal, the case for the status quo has a serious weakness. It ignores the possibility that local FFS expenditures are influenced by HMO market share, through either selection bias or a spillover effect. Actual savings from the enrollment of Medicare beneficiaries in HMOs would be greater than 5 percent to the extent there is spillover and less than 5 percent (even negative) to the extent there is selection bias. Welch's (1991b) finding of a substantial spillover effect weakens the case for using local FFS expenditures. HMOs could be treated as an investment, because they appear to save more than the statutory 5 percent in the long run. This suggests pursuing the second goal, increasing HMO market share regardless of whether there are any immediate savings.

To increase HMO enrollment, one could obviously increase payment levels to HMOs in all areas. But Medicare could easily end up paying more in the pursuit of saving money. Of more policy relevancy are ways to raise payment levels in some areas and lower them in others, within the constraint of average payment levels that are unchanged. This probably would involve dampening the variation in location factors. Ignoring area-specific variation in utilization rates would dampen variation, and ignoring all variation in utilization rates would further dampen variation.

The general point can be made concretely with reference to Dade County (Miami) and rural Minnesota. As detailed later, FFS expenditures in Dade County are 159 percent of the national average, giving it the highest location factor in the country.

<sup>1</sup>Both PGP and IPA physicians are likely to be affected by community standards of medicine.

<sup>2</sup>For instance, proposals to raise payments to HMOs in rural areas have been justified as increasing access for rural beneficiaries.

Expenditures in rural Minnesota are 69 percent of the national average, giving it one of the lowest location factors. HMO market share is high in both Dade County and urban Minnesota and might be high in rural Minnesota except for the low location factor. Most alternatives to the present location factor would dampen variation; that is, these alternatives would move the location factors in Dade County and rural Minnesota toward the national average. The location factor in Dade County would fall and the location factor in rural Minnesota would rise.

The extent to which dampening the variation would increase or decrease HMO enrollment depends, in part, on the relationship between local FFS expenditures and HMO costs. HMO costs appear to have less geographic variation than FFS expenditures. One piece of evidence is Adamache and Rossiter's (1986) finding that HMOs were most likely to contract with Medicare in areas with high expenditure and hence payment. This finding has been confirmed by Porell and Wallack (1990). If HMO costs have less variance, dampening variation in payment to HMOs may align HMO payment more closely to HMO costs, and could increase HMO enrollment. But dampening variation could, in principle, result in payment levels being too low everywhere to attract HMOs. This would suggest that HMOs are not much more cost effective than FFS Medicare.

Dampening variation would help achieve the third goal, that of making HMO enrollment a viable option for beneficiaries in areas with low FFS expenditures as well as elsewhere. The high location factor in Dade County under the status quo allows HMOs there to charge beneficiaries no out-of-pocket premiums, whereas HMOs in Minneapolis-St. Paul charge substantial out-of-pocket premiums (Health Care Financing Administration, 1991). HMOs in rural Minnesota apparently could not find any viable level of out-of-pocket premiums, and a number of them withdrew from that market. The goal of equity could be pursued by dampening the variation in the location factor.

### **Other approaches not developed**

Several other approaches to paying HMOs require discussion. The most radical option is to uncouple HMO payment from even the national average FFS expenditures (i.e., USPCC). This option is periodically suggested by members of the HMO industry as a means of solving the perceived problem of low HMO payment rates. Even among proponents of this approach, however, there is no consensus on the alternative method of determining payment levels. Competitive bidding is one possible means (Dowd et al., 1990). Minnesota and Wisconsin use it for their State employees, but they accept bids only at or below local FFS expenditures. Hence, competitive bidding in this form would not raise HMO payment but would place greater administrative demands on the Health Care Financing Administration (HCFA). A concrete

proposal reflecting this approach might lower payment levels, alienating the proponents of the approach in its general form.<sup>3</sup>

A second approach worthy of mention is Enthoven's (1987) proposal that the location factor be based on HMO costs in areas with similar characteristics. (HMO payment could still be coupled to average national FFS expenditures.) If HMOs were the dominant form of health care providers, it would make sense for payment to HMOs to reflect the determinants of their costs, just as payment to hospitals reflects the determinants of their costs. But only 3 percent of Medicare beneficiaries are enrolled in HMOs. Beyond the philosophical issue of whether payment should reflect HMO costs, there are serious practical problems in the short term. HCFA lacks information on HMO costs, and obtaining that information could be quite costly. (Competitive bidding would be one such way.) Rather than doing so, this article takes a more incremental approach of using existing data. This approach can be seen as a first step toward Enthoven's proposal.

Milliman and Robertson (1987) proposed that, in areas with high HMO penetration, the location factor be frozen rather than annually updated. Then as HMO market share increased in an area, its future impact on local FFS expenditures would not be reflected in future payment rates. The key issue here is the choice of base years. A recent set of years would tend to incorporate HMOs' initial impact on FFS expenditures. An early set of years would ignore recent changes in the geographic distribution of expenditures.

It may be possible to actuarially adjust location factors for policy changes. Prominent among these policy changes are changes in the hospital wage index, the standardized amount under the prospective payment system (PPS), and the Medicare fee schedule for physicians. However, over time the corrections would become more complex, and the relationship between the frozen location factor and the location factor if there were truly no HMO enrollment would become more tenuous. Over the long term, the freezing of the location factor is not a promising option.

Rossiter and Adamache (1990) offered a similar proposal. The location factor in some year 2 would be "blended": It would be the weighted average of the status quo location factor and factor in year 1. The weight for the factor in year 2 would be the HMO market share and the weight for the status quo factor would be the FFS market share. In year 3, the location factor appears to be a weighted average of the status quo factors and the factor in year 2, which is the new "blended" factor. Because the status quo factor enters twice in the factor in year 3, the formula does little more than delay the impact of changes in the FFS sector.

<sup>3</sup>Under the bidding proposal of Dowd et al. (1990), Medicare Part B premiums for FFS beneficiaries would vary by county according to HMO premiums in the county. Although many of the ideas in the proposal are part of Minnesota's health insurance program for State employees, the proposal is inappropriate for Medicare. Basing beneficiary premiums, in part, on HMO premiums would be strange in a program in which HMOs have only a 3-percent market share.

Strategically, the proposal developed here is intended to be less radical than the first two proposals— involving competitive bidding or HMO costs—but more radical than the second two—freezing the status quo or delaying FFS impacts. The aim is to develop a proposal that involves fundamental change but that is still a feasible next step.

## Input prices and systematic utilization

This section develops the methodology for calculating a location factor that reflects input prices and the systematic component of utilization variation. It is done by using input prices to deflate local FFS expenditures per beneficiary, which is then regressed on determinants of utilization. The predicted values could constitute the location factor.

## Dependent variable

The dependent variable is the county average Medicare expenditures for the period 1983-87. This variable is adjusted for demographic characteristics and deflated by input prices.

In principle, the present location factor could be calculated by summing Medicare FFS expenditures in a county, summing the number of beneficiaries not enrolled in HMOs in a county, and dividing the first sum by the second. Unfortunately, Medicare data systems cannot always distinguish bills for FFS beneficiaries and bills for HMO beneficiaries. For this reason, the Office of the Actuary at HCFA first sums all Medicare expenditures—for both FFS and HMO beneficiaries—in a county and sums all beneficiaries in a county. It then subtracts out the number of HMO beneficiaries and its estimate of HMO expenditures (Palsbo, 1989). The approach is algebraically complex.

Instead of analyzing the location factor in its present form, this article starts with figures from earlier in the actuarial process. It analyzes the 5-year average Medicare expenditures per beneficiary; that is, it does not attempt to distinguish the expenditures of HMO and FFS beneficiaries.<sup>4</sup> If payment to HMOs were based on national patterns of expenditures, the actual FFS expenditures in a local area would have less impact on the payment in the area. I take this opportunity to simplify the payment formula by not subtracting out HMO expenditures.<sup>5</sup>

The average expenditure per beneficiary is adjusted by the demographic factors of age, sex, and welfare status, as in the computation of the AAPCC. This is

done by summing the number of beneficiaries in a county, weighting each beneficiary by the demographic factor of his or her age-sex-welfare status rate cell. The sum of expenditures is divided by this sum of beneficiaries. This expenditure variable is then normalized to the national average in order to make regression coefficients immediately understandable.

Expenditures can be thought of as the product of price and quantity (or utilization rates). The next section develops an input price index, which is used here to deflate the expenditure variable. By moving the price variable in equation (1) from the right-hand side to the left-hand side, the regression is specified as

$$E/P = Q = f(X) + e \quad (3)$$

The computer-generated *R*-square will represent the percentage of variation in deflated expenditures (*E/P*) that is explained. Conceptually more appropriate, however, is the percentage of the variation in expenditures (*E*) that is explained, which is easily computed. Both *R*-squares are presented later.

## Criteria for independent variables

In considering which variables should be used to predict Medicare expenditures, several factors should be kept in mind.

The more variation explained, the better.

The fewer the variables, the better. Simplicity facilitates understanding by policymakers, HMOs, and the general public. Medicare payment to hospitals, which is based in part on regression analyses, is an instructive precedent. PPS payment to a hospital primarily reflects its case mix, the local wage, its teaching status, and the share of its patients who are poor. Academic regressions of hospital costs include other variables, such as the number of beds, outpatient visits (to capture economics of scope), for-profit status, region, and characteristics of the medical staff (e.g., Custer and Willke, 1991). In the interest of simplicity, not every significant variable is incorporated in the payment formula.

The variables should be measured without controversy. Preferably, they should be administratively generated variables that policymakers and providers are familiar with, such as the HCFA hospital wage index.

The variables' coefficients should not have the "wrong" sign in one of two senses. A sign may be wrong because it is inconsistent with economic theory, for instance, an input price having a negative sign. Or, a sign may be "wrong" because it hurts a group considered to be deserving; for instance, a coefficient that implies lower payment in areas with high poverty rates might be considered wrong.<sup>6</sup>

<sup>4</sup>The expenditure data have been "modeled" to capture changes in PPS on, for instance, wages.

<sup>5</sup>Regression analysis of Medicare expenditure (which follows) controls for HMO effects, both the accounting effect due to paying 95 percent of FFS expenditures and any behavioral effect (for instance, competitive or spillover effects). Were HMO market share significant and negative, one would use the estimated coefficient to subtract out the effect of HMO market share on expenditures. Distinguishing between the expenditures of HMO and FFS beneficiaries would then be superfluous. In the following regressions, HMO market share has a positive coefficient and hence is dropped.

<sup>6</sup>Because of these four criteria, the specification that follows differs from that in Welch (1991b) in a number of ways. For instance, the prevailing charge index is replaced by the GPCI. Also, the specification has been simplified to facilitate understanding by non-econometricians.

## Population-related variables

In seeking to explain differences in utilization rates, this article emphasizes population-related variables: population density, population size of the metropolitan area, and rural location. These three variables alone can explain more than 60 percent of the variance in Medicare expenditures (Welch, 1991a), making them promising as payment variables. In addition, they can be measured without controversy and have reasonable signs in the regressions. Hence, these variables meet the criteria outlined previously.

Utilization increases with density and population size. (As shown later in the regressions, these variables are significant predictors of expenditure when prices are controlled for.) A likely explanation is that urbanization lowers the average distance between patient and physician (and hospital). Conceptually, the quantity of medical care demanded may be as sensitive to the time price as to the monetary price. In support of this notion, Acton (1975) found that travel time is a significant predictor of utilization in New York City. Several univariate studies in Great Britain have the same finding (Wagstaff, 1989; and Shannon, Bashshur, and Metzner, 1969.) Population-related variables appear to capture travel-time barriers to access that are not easily measured directly.

As a concept, density is a good variable; as it is commonly measured, density is subject to a problem illustrated by San Bernardino County, which is east of Los Angeles. Most of San Bernardino's population is in its southwest corner, but most of its land area is in the Mohave Desert. Thus, the virtually uninhabited desert inflates the county's area, resulting in a very low population density for the county even though most of its population lives in urban areas.

To capture the distribution of people over areas with varying density, density is first calculated at the ZIP Code level. Average density for a county is then calculated, weighting by the ZIP Code's population. This measure may be thought of as the density for the average person (Welch, 1991a). Exploratory regressions showed that expenditure is not a linear function of density or even of the log of density.<sup>7</sup> Rather, a segmented linear or piecewise regression is used because it is a flexible functional form. This form allows the density coefficient to vary over ranges of the variable. Three density thresholds were chosen, resulting in four ranges. The U.S. Bureau of the Census uses 1,000 persons per square mile to define urbanized areas. A density of 100 persons per square mile is often used to delineate rural areas (Hewitt, 1989). To subdivide urbanized areas, which have a majority of the population, I choose a density threshold of 5,000 persons per square mile. This results in more equal population size within ranges than, say, a threshold of

10,000.<sup>8</sup> In sum, very low, low, medium, and high density areas are delineated by densities of 100, 1,000, and 5,000. These areas have 18, 30, 32, and 20 percent of the population, respectively.

More mechanically, the four variables are defined in terms of density ( $D$ ) as follows:

$$\begin{aligned} X_1 &= D \text{ if } D < 100 \\ &= 100 \text{ otherwise} \\ X_2 &= 0 \text{ if } D < 100 \\ &= D - 100 \text{ if } 100 < D < 1,000 \\ &= 900 \text{ otherwise} \\ X_3 &= 0 \text{ if } D < 1,000 \\ &= D - 1,000 \text{ if } 1,000 < D < 5,000 \\ &= 4,000 \text{ otherwise} \\ X_4 &= 0 \text{ if } D < 5,000 \\ &= D - 5,000 \text{ if } 5,000 < D < 15,000 \\ &= 10,000 \text{ otherwise} \end{aligned}$$

The variables are defined such that

$$D = X_1 + X_2 + X_3 + X_4$$

(below the truncation point of 15,000), and the segments form a continuous function.

Finally, metropolitan area population size is entered in log form. Because this variable is undefined for rural areas, a dummy variable for rural location is added. The metropolitan areas population (log of population in thousands) is set equal to 250 for rural areas. Hence, the rural dummy variable tests the difference between metropolitan areas with populations of 250,000 and rural areas.

## Provider variables

Discussions of the impact of providers on utilization typically focus on two variables: hospital beds and physicians per 1,000 persons. The presumption is that large numbers of providers increase utilization rates. Because familiarity is an advantage for a variable that might be part of a payment formula, both of these variables are used. The second variable, however, is elaborated on by distinguishing between primary care physicians and specialists. Specialists per 1,000 persons are more likely to be associated with high utilization rates, whereas primary care physicians may be associated with lower utilization rates if they serve as substitutes for hospitalization. In sum, three provider variables are entered, all defined in terms of providers per 1,000 persons.

<sup>8</sup>The only counties with densities substantially above 15,000 are San Francisco County and several counties in or near New York City. To avoid having counties such as San Francisco and Manhattan (with densities of 23,600 and 86,100, respectively) dominate the coefficient for the high density range, densities are truncated at 15,000. Otherwise the expenditure level is likely to be overestimated for these extreme values. This technical problem would be manifested as an overpayment under a regression-based payment system. There are several precedents of caps on payment variables. For instance, when PPS originally recognized disproportionate share of the poor as a payment variable, that variable was capped at .15.

<sup>7</sup>More attention is paid to the functional form of this variable than others, in part, because it is the only variable specific to the county. (The needy elderly rate is defined later but it is entered in only one regression.)

## Other potential payment variables

Three other independent variables that do not fit into the aforementioned categories are entered. The proportion of beneficiaries who are poor (by some measure) may predict Medicare expenditures in a county. Even after those expenditures are deflated for variables such as welfare status, counties with a high proportion of needy beneficiaries may have high expenditures. Supplemental Security Income (SSI) beneficiaries as a percentage of Medicare beneficiaries is calculated.<sup>9</sup>

According to economic theory, utilization rates are a decreasing function of the out-of-pocket prices paid by patients. In addition to the deductible and the 20-percent coinsurance, Medicare beneficiaries are liable for the balance of any physician bill. The extent of balance billing varies geographically. Holahan, Dor, and Zuckerman (1990) found that the utilization of physician services was negatively related to the extent of balance billing. Medicare administrative files do not contain information on the size of the balance billing but do have information on the percentage of the bills that are "assigned," that is, for which there is no balance billing. This variable is entered later.

Finally, Welch (1991b) found that Medicare expenditures are a decreasing function of HMO market share. For completeness, this variable is entered later.

## Units of observation for independent variables

Although the dependent variable (expenditures) is defined at the county level, the independent variables are defined at different levels, which involve the concept of metropolitan areas. Effective April 1, 1990, the U.S. Bureau of the Census uses metropolitan areas (MAs) as the term representing the fundamental unit of metropolitan areas (*Federal Register*, 1990). First an MA is defined. Then if the MA has a population in excess of 1 million, it may be subdivided, in which case it is termed a consolidated metropolitan statistical area (CMSA) and its subdivision is termed a primary metropolitan statistical area (PMSA). If an MA is not subdivided, it is termed a metropolitan statistical area (MSA). Medicare uses these concepts only for paying hospitals. In the new terminology, a hospital's wage index is specific to its PMSAs as well as (freestanding) MSAs.

Because the U.S. Bureau of the Census considers the MA to be the fundamental unit of metropolitan areas, population size is defined at the MA level to capture the size of the entire metropolitan area. It is the only variable defined at the MA level. (Whereas the delineation of an MA is economic, the delineation of PMSAs tends to have more political input.)

Most of the other variables, such as input prices and provider rates, capture market characteristics. For these

variables there is no ideal unit of observation, with the county being too small and the MA probably being too large. The county is a political unit. Its inadequacy as an economic unit is manifested in border crossing: Patients may live in one county but see providers in another, and workers may live in one county but work in another. The county is too small a unit for market characteristics.

The choice between MA and PMSA involves only metropolitan areas with at least 1 million people, as smaller MAs are never subdivided into PMSAs. Defining markets geographically is often difficult. There is presumably less border crossing between PMSAs within an MA than between counties within the same MSA; for instance, between Trenton and Philadelphia, both of which are in the Philadelphia MA, versus between counties within the Philadelphia PMSA. This pattern is reflected in the PPS's use of MSAs and rural areas of States to define the hospital wage index. In part because of its familiarity, I use the PMSA (and MSAs) and rural areas of States to define the market variables: input prices, providers per 1,000 persons, assignment rate, and HMO market share.

Two variables are defined at the county level. The needy elderly rate could capture either the characteristics of the beneficiaries themselves or of the neighborhood in which they live. Density is the other variable defined at the county level. Its primary purpose is to capture where a county is located within a metropolitan area, either in the urban core or the suburban ring.

## Data

The expenditure data, which pertain to the period 1984-87 and have been adjusted to conform with current PPS payment rates, were supplied by the Bureau of Data Management and Strategy at HCFA. The hospital wage index is published in U.S. Congress (1989) and the GPCI was developed by the author and colleagues (discussed later). The population density variable was developed by Welch (1991a). The needy elderly rate was calculated with data from the Social Security Administration (1989). Holahan, Dor, and Zuckerman (1990) is the source for the variables on providers per 1,000 persons and assignment rate.

## Methodology: Input price index

As noted in the introduction, this article develops two types of location factors, one of which reflects only variation in input prices and the other of which reflects input prices and the systematic component of utilization. Whereas regression analysis is necessary to construct the second type of location factor, an input price index is easier to construct.

Medicare already has two input price indexes—hospital wage index and the GPCI—which are defined for each county. Together these indexes are applicable to virtually all of Medicare expenditures. The construction of this input price index involves selecting weights for the two component indexes. These weights

<sup>9</sup>This measure of needy elderly holds promise as a policy variable because it is already used to calculate the disproportionate share percentage in PPS. The SSI figures pertain to the aged who received federally administered SSI payments in 1988. Note that 13 percent of these persons received only State supplements (U.S. Congress, 1989).

should represent the proportion of Medicare expenditures to which the indexes apply and should sum to 1. This section develops those weights.

Of Medicare expenditures, 53.7 percent are for inpatient hospital services under PPS (U.S. Congress, 1989), which uses the wage index. Another 4.1 percent (the remaining Part A expenditures) are for skilled nursing facilities and home health agencies. The payment limits for these providers are calculated using the hospital wage index in a manner similar to the calculations of the basic payment under PPS. Another 13.6 percent (the non-physician proportion of Part B) are made to ambulatory surgery centers and hospital outpatient departments, for which payment of both is a function of the hospital wage index. In sum, 71.4 percent of Medicare expenditures are a function of the hospital wage index.

Only part of the wage index, however, is applied to these expenditures. For PPS payment purposes, Medicare calculates the average costs for labor and non-labor (called standardized amounts).<sup>10</sup> The basic payment for an admission is the sum of the labor-related standardized amount times the wage index for the area, and the non-labor-related standardized amount. Because the labor-related standardized amount is 74 percent of the combined standardized amount, the location factor should reflect only 74 percent of the variation in the hospital wage index. More precisely, the wage part of the location factor would be

$$.714 * [((\text{Wage} - 1) * .74) + 1]$$

where

.714 is the proportion of Medicare expenditures that is a function of the wage index, and Wage is the normalized wage index. This can be simplified to

$$.186 + .528 * \text{Wage}$$

which is the hospital wage component of the input price index.

The remaining 28.6 percent of Medicare expenditures are for physicians (U.S. Congress, 1989). Starting in 1992, Medicare will use the GPCI to pay physicians. The GPCI is part of physician payment reform enacted in 1989. An input price index, it has price proxies for four inputs: physicians' own time, employee wages, rent, and malpractice insurance. The index is a weighted sum of these proxies, where each weight is the proportion of a physicians' expense associated with that input. The index is defined for each MSA and the rural area of each State (Zuckerman, Welch, and Pope, 1990). Congress modified the original index by recognizing only one-quarter of the variation in physicians' own time. This change compresses index values toward 1. The original form and the enacted form are highly correlated ( $r = .99$  when weighted by

the number of Medicare beneficiaries). As the enacted form of the GPCI will be administratively generated, it is used here. The weight for the GPCI is 28.6 percent. Whereas the hospital wage index is applied to only part of the standardized amount, the GPCI is applied to its entire base. Put differently, 100 percent of the GPCI should be reflected in this input price index.

In sum, the input price index is

$$.186 + (.528 * \text{Wage}) + (.286 * \text{GPCI})$$

This constitutes one possible location factor as well as the deflator for expenditures as the dependent variable in the regression analysis.

## Regression results

Table 1 presents the summary statistics for the variables used in the regressions, and Table 2 presents several alternative specifications.

### Population-related variables only

Because the use of density-related variables is unusual, I start by showing the explanatory power of those variables by entering only them in regression 1. What is noteworthy is that two-thirds of the variance of expenditures is explained by these variables and one-third of the variance in utilization or deflated expenditures is explained. (Deflated expenditures are calculated as expenditures divided by the input price index.)

A county's expenditures are a function of both the MA population size and where in the MA the county is located. Most MAs have one county with a density well above that of the remaining counties. These high-density counties are usefully defined as the core of these MAs. For instance, Cook County in the Chicago MA has a density of 11,400, whereas contiguous DuPage County has a density of 3,200. Predicted expenditures are 10.4 percentage points higher in Cook than in DuPage (i.e.,  $(3.3 * (5 - 3.2)) + (.7 * (11.4 - 5)) = 10.4$ , where 5 represents the threshold of 5,000 persons per square mile).

The segmented linear form shows that the marginal impact of density varies by density range. An increase in density from about 0 to 100 persons per square mile would increase deflated expenditures 2.02 percent, but an increase of from 5,000 to 5,100 persons per square mile would increase expenditures by .07 percent.<sup>11</sup> The marginal impact of density falls with increasing density.<sup>12</sup>

Medicare expenditures also increase with the population size of the metropolitan area. A doubling of

<sup>11</sup>Note that the density variables are defined in terms of 1,000 persons per square mile, whereas this statement pertains to increases of 100 persons per square mile.

<sup>12</sup>Given these results, one might replace the four density variables with the log of density. This less flexible functional form yields a somewhat lower R-square. The more flexible form is kept until the impact of additional payment variables is investigated. It is simplified in regression 4.

<sup>10</sup>Although the standardized amounts are different for rural, small urban, and large urban areas, the distinction between rural and small urban areas is being phased out.

**Table 1**  
**Summary statistics, weighted by Medicare Part A enrollment**

Variable	Mean	Standard deviation	Minimum	Maximum
<b>Dependent variable</b>				
Expenditures per beneficiary <sup>1</sup>	100.00	21.41	43.57	153.40
Deflated expenditures per beneficiary <sup>1</sup>	99.43	15.06	35.44	162.53
<b>Population-related variables</b>				
Population-weighted density (1,000 persons per square mile):				
0-100	.01	.01	0.00	.10
101-1,000	.63	.38	0.00	.90
1,001-5,000	1.46	1.58	0.00	4.00
5,001-15,000	.87	2.42	0.00	10.00
MA population (log) <sup>2</sup>	6.93	1.54	4.16	9.79
Rural	.27	.44	0.00	1.00
<b>Input prices</b>				
Hospital wage index	.98	.16	.69	1.47
Geographic Practice Cost Index (enacted)	1.00	.08	.87	1.18
Composite index	1.00	.11	.82	1.31
<b>Providers per 1,000 persons</b>				
Hospital beds	5.16	1.51	1.33	21.29
Specialty physicians	.71	.31	.17	5.33
Primary care physicians	.62	.17	.27	2.80
<b>Other variables</b>				
Needy elderly rate	4.72	4.40	0.00	48.84
Assignment rate	63.95	15.75	17.29	98.34
HMO market share (1984-86)	1.34	3.39	0.00	24.76

<sup>1</sup>Expenditures per beneficiary are adjusted for age, sex, and welfare status and normalized to 100 percent of the national mean. Expenditures are then divided by the input price index.

<sup>2</sup>MA population (log of population in thousands) is set equal to 250 for rural areas.

NOTES: MA is metropolitan area. HMO is health maintenance organization. PPS is prospective payment system.

SOURCES: Expenditure data for the period 1984-87 supplied by the Bureau of Data Management and Strategy, Health Care Financing Administration, and adjusted to conform to current PPS payment rates; the population density variable is from Welch (1991a); the hospital wage index is from the U.S. Congress (1989); the Geographic Practice Cost Index is from Zuckerman, Welch, and Pope (1990); variables on providers per 1,000 persons and assignment rate are from Holahan, Dor, and Zuckerman (1990); and the needy elderly rate was calculated with data from Social Security Administration (1989).

MA population size increases expenditures by .6 percentage points (i.e.,  $.91 * \ln(2) = .63$ ). Specifically, predicted expenditures for Boston are 1.3 percentage points higher than for Providence, because the Boston MA has four times the population (4 million versus 1 million). Rural areas, controlling for their density, have .7 percentage points lower expenditures than metropolitan areas with populations of 250,000.

In sum, county population density has a major impact on expenditures, whereas MA population size has a minor impact.

### Specifications for payment

This subsection presents alternative specifications that yield formulas for the location factor. The subsection starts with a regression (2) that includes all the potential payment variables of this article. Because simplicity is a major virtue for public policies, variables are dropped from the regression in two steps. In each case, rationales for dropping variables are given. This process results in a range of options, from the complex to the simple.

In regression 2, four of the population-related variables have the correct sign and are significant. The three provider variables are highly significant and have correct signs. Deflated expenditures increase with the

number of hospitals per 1,000 persons. They increase with the number of specialty physicians per 1,000 persons but decrease with the number of primary care physicians. Primary care physicians may serve to keep patients out of the hospital, thereby lowering expenditures, whereas specialists may increase expenditures through more diagnostic tests and procedures.

The assignment rate has a positive sign. As the assignment rate increases, the out-of-pocket costs to beneficiaries decrease. Not surprisingly, this increases utilization and Medicare expenditures.

The needy elderly rate has a negative sign, suggesting that areas with high poverty rates have low expenditures. Part of the explanation for this result is that the dependent variable of expenditures has been adjusted for welfare status. In addition, poor Medicare beneficiaries, if they lack Medicaid coverage, are less likely than non-poor beneficiaries to have medigap coverage. Without supplemental coverage of some nature, they must pay Medicare's copayments out of pocket. However, paying HMOs less in areas with high proportions of needy elderly may conflict with notions of vertical equity. In this sense, this variable may have the "wrong" sign and is a candidate for exclusion from other regressions.

**Table 2**  
**Determinants of Medicare expenditures<sup>1</sup>**

Independent variable	Regression 1	Regression 2	Regression 3	Regression 4
<b>Population-related variables</b>				
Population-weighted density (1,000 persons per square mile):				
0-100	20.2 (1.46)	-18.3 (1.46)	-13.7 (1.06)	—
101-1,000	*2.8 (2.24)	1.6 (1.42)	1.8 (1.60)	—
1,001-5,000	*3.3 (12.90)	*3.2 (13.28)	*3.6 (14.92)	<sup>3</sup> *2.2 (18.42)
5,001-15,000	*.7 (6.03)	*.9 (7.99)	*.6 (5.17)	—
MA population <sup>2</sup>	*.91 (3.88)	*1.37 (6.31)	*1.36 (6.15)	*1.13 (4.86)
Rural <sup>2</sup>	-.71 (.76)	*2.38 (2.49)	1.44 (1.47)	*-4.05 (6.67)
<b>Providers per 1,000 persons</b>				
Hospital beds	—	*.68 (4.83)	*.74 (5.19)	—
Specialty physicians	—	*27.6 (13.17)	*23.8 (11.15)	—
Primary care physicians	—	*-59.2 (17.78)	*-51.0 (15.13)	—
<b>Other variables</b>				
Needy elderly rate	—	-.19 (3.92)	—	—
Assignment rate	—	*.26 (18.41)	*.25 (17.91)	—
HMO market share	—	.80 (12.99)	—	—
Intercept	84.22	87.70	79.14	88.19
R-square (expenditures)	.659	.743	.724	.657
R-square (deflated expenditures)	.325	.473	.441	.317
F statistic	*249	*230	*243	*483
N (number of observations)	3,119	3,096	3,097	3,119

\*Significant at .05 with the expected sign.

<sup>1</sup>The dependent variable is expenditures per beneficiary, which is adjusted for age, sex, and welfare status and normalized to 100 percent of the national mean. Expenditures are then divided by the input price index. Regressions are weighted by Medicare Part A enrollment.

<sup>2</sup>MA population (log of population in thousands) is set equal to 250 for rural areas. Hence, the rural dummy variable tests the difference between MAs with populations of 250,000 and rural areas.

<sup>3</sup>Defined over the range of 1,000 to 10,000 persons per square mile.

NOTES: *t*-values shown in parentheses. MA is metropolitan area. HMO is health maintenance organization. PPS is prospective payment system.

SOURCES: Expenditure data for the period 1984-87 supplied by the Bureau of Data Management and Strategy, Health Care Financing Administration, and adjusted to conform to current PPS payment rates; the population density variable is from Welch (1991a); the hospital wage index is from the U.S. Congress (1989); the Geographic Practice Cost Index is from Zuckerman, Welch, and Pope (1990); variables on providers per 1,000 persons and assignment rate are from Holahan, Dor, and Zuckerman (1990); and the needy elderly rate was calculated with data from Social Security Administration (1989).

HMO market share has a positive impact on expenditures in this regression, whereas it had a negative impact in Welch (1991b). As demonstrated by Adamache and Rossiter (1986), HMOs are most likely to enroll Medicare beneficiaries in areas with high Medicare expenditures, because those areas have high payment rates. My earlier work used a partial adjustment model to sort out the effect of HMO market share on expenditures and the effect of expenditures on HMO market share. That work estimated the impact of HMO market share in 1986 and 1987 on expenditures in 1986 and 1987, controlling for expenditures 2 years earlier. The present regression merely attempts to predict expenditure levels and hence uses a simpler functional form. Because an appropriate specification

would greatly add to the econometric complexity, HMO market share is dropped from future regressions.<sup>13</sup>

In the first step to simplify the regression, needy elderly rate and HMO market share are excluded because of their signs. The result is regression 3. Except for the first two density variables and the rural variable, the remaining variables are each highly significant and have the correct sign. With simplification of the population-related variables, regression 3 could serve as a payment formula. It adjusts for population-related factors, input prices, provider rates, and assignment rates.

<sup>13</sup>Were the coefficient negative, it could be retained. Then the expenditure level would be predicted using national HMO market share and local values for other variables. This estimated value would represent the expenditure level, controlling for HMO market share.

The simplest regression-based option would have only two sets of variables: population-related variables and input prices. Input prices would be retained because of the consensus that payment should reflect them. (HCFA already computes those prices.) The provider variables and the assignment rate would be dropped, either because these variables are of secondary importance or because paying more to oversupplied areas is judged to be inappropriate public policy.<sup>14</sup> The population-related variables would be retained as a way to explain much variance in expenditures with few variables.

At this point I simplify density by creating a single variable and defining it over the range of 1,000 to 10,000 persons per square mile. This incorporates three changes:

- Because in regression 3 density is insignificant over the two low-density ranges, those two density ranges are dropped.
- The truncation point is lowered from 15,000 to 10,000 persons per square mile. This directly affects 12 counties, 3 with densities from 10,000 to 15,000 and 9 with densities above 15,000.
- The coefficient is specified to be constant over the entire range of 1,000 to 10,000 persons per square mile.

As noted, the U.S. Bureau of the Census uses 1,000 persons per square mile to delineate urbanized areas.

The simplified specification is labeled regression 4. The *R*-square falls a moderate amount—from .724 to .657. The three remaining population-related variables are highly significant. If simplicity is a major concern, regression 4 is a plausible option.

Table 2 explicitly presents two viable options—regressions 3 and 4. Needless to say, other combinations of these specifications are plausible.

## Simulations

This section calculates the location factor developed previously. To elaborate on equation (3), the regressions were estimated in the following form:

$$(E/P) = \beta_0 + \beta_1 X_1 + \dots + \beta_n X_n + e \quad (4)$$

where

$\beta_i$  represents the coefficient of the *i*th variable. A regression-based location factor is calculated as follows:

$$E' = P(\beta'_0 + \beta'_1 X_1 + \dots + \beta'_n X_n) \quad (5)$$

where

$\beta'_i$  represents an estimated coefficient.

<sup>14</sup>Physician payment reform, passed in 1989, will gradually lower the limits on balance billing. This could affect the national average assignment rate and the ability of the local assignment rate to predict expenditure levels.

**Table 3**  
Summary statistics for alternative location factors

Statistic <sup>2</sup>	Factor <sup>1</sup> used in 1991	Proposed factors <sup>1</sup> based on		
		Regression		Input prices
		3	4	
Mean	100.0	100.0	100.0	100.0
Standard deviation	22.5	19.0	18.7	11.0
Correlation with factor used in 1991	1.000	.848	.804	.735
Maximum	158.6	146.7	152.4	131.5
Minimum	41.4	66.5	73.7	81.7

<sup>1</sup>Normalized using Medicare Part A enrollment.

<sup>2</sup>Weighted using Medicare Part A enrollment.

SOURCE: Welch, W. P., The Urban Institute, Washington, D.C., 1991.

## Choice of counties

Only a few of the 3,000 counties can be usefully presented in a table. Of particular interest are counties in which many Medicare beneficiaries are enrolled in HMOs, because HMOs would be more affected by changes in the location factors there. Also of interest are counties with many non-Medicare HMO enrollees. Such counties may have little Medicare enrollment in HMOs because of low Medicare payment rates, but have the potential for Medicare enrollment in HMOs. Finally, having a diverse set of counties is useful.

More concretely, the five MAs with the most HMO enrollment (absolute numbers, including non-Medicare enrollment) are included. In declining order, these are Los Angeles, San Francisco, New York City, Washington, D.C., and Chicago (Palsbo, 1990). The five MAs with the most Medicare HMO enrollment are also included. In declining order, these are Los Angeles, Miami, Minneapolis-St. Paul, Chicago, and Portland.<sup>15</sup> Four other metropolitan areas are also included: Milwaukee, because general HMO market share is high; and Honolulu, Worcester, and Albuquerque, because Medicare HMO market share is high and because they are medium-sized MSAs.

To ensure diversity of county types, within each MA an urban and a suburban county were selected. The most densely populated county was selected as the urban core. Among suburban counties, the county with the highest Medicare HMO enrollment was selected.<sup>16</sup> In addition, a rural county was selected, usually one contiguous to the suburban county.

## Results

Table 3 presents the summary statistics for two regression-based location factors and the input price index, and Table 4 presents these factors for selected

<sup>15</sup>The Medicare HMO enrollment, calculated from HCFA's Beneficiary Denominator File, pertains only to HMOs with risk contracts. Both sets of enrollment figures are as of 1989.

<sup>16</sup>Only counties with densities below 3,500 persons per square mile are considered suburban here.

**Table 4**  
**Alternative location factors for selected counties**

Metropolitan area and county	County type	Factor <sup>1</sup> used in 1991	Proposed factors <sup>1</sup> based on				
			Regression		Input prices	Hospital wage index <sup>1</sup>	GPCI <sup>1</sup>
			3	4			
<b>Los Angeles, California</b>							
Los Angeles	Core	144.6	133.2	137.0	118.2	127.1	113.7
Riverside	Ring	120.5	111.1	109.5	110.3	115.6	107.2
Imperial	Rural	108.7	92.4	92.5	102.5	103.8	101.8
<b>San Francisco, California</b>							
San Francisco	Core	126.2	145.5	152.4	129.6	146.9	116.9
Marin	Ring	107.6	123.4	129.2	129.6	146.9	116.9
Mendocino	Rural	93.0	92.4	92.5	102.5	103.8	101.8
<b>Washington, District of Columbia</b>							
The District	Core	134.1	122.6	127.1	108.6	110.8	110.0
Prince Georges, Maryland	Ring	141.2	109.3	110.6	108.6	110.8	110.0
Talbot, Maryland	Rural	77.0	85.9	80.4	89.1	81.5	95.9
<b>Miami, Florida</b>							
Dade	Core	158.6	116.0	114.0	104.6	104.7	107.5
Broward	Ring	142.1	116.7	108.9	103.8	105.0	104.0
Hendry	Rural	115.6	85.5	80.4	89.1	83.4	92.7
<b>Honolulu, Hawaii</b>							
Honolulu	MSA	94.6	108.3	113.5	110.1	116.3	105.0
Maui	Rural	83.7	77.9	86.5	95.8	90.5	103.0
<b>Chicago, Illinois</b>							
Cook	Core	121.8	119.2	128.8	109.2	111.0	111.8
Du Page	Ring	103.3	107.9	112.4	109.2	111.0	111.8
De Kalb	Rural	77.9	76.2	80.4	89.2	81.8	95.6
<b>Worcester, Massachusetts</b>							
Worcester	MSA	109.4	96.8	95.3	98.2	96.4	100.2
<b>Minneapolis-St. Paul, Minnesota</b>							
Hennepin	Core	106.2	105.3	113.5	108.9	116.1	101.5
Dakota	Ring	96.5	92.8	105.9	108.9	116.1	101.5
Goodhue	Rural	75.7	80.7	84.3	93.5	91.4	93.0
<b>Albuquerque, New Mexico</b>							
Bernalillo	MSA	97.1	105.7	101.2	100.3	101.8	97.5
<b>New York City, New York</b>							
New York	Core	147.4	146.7	147.2	123.8	134.9	118.9
Suffolk	Ring	111.7	114.9	121.5	117.6	123.9	117.5
Ulster	Rural	89.4	84.5	80.8	89.6	82.6	95.6
<b>Portland, Oregon</b>							
Multnomah	Core	99.9	107.1	111.2	108.1	114.8	101.1
Washington	Ring	98.8	100.6	107.2	108.1	114.8	101.1
Columbia	Rural	102.4	79.5	90.3	100.1	101.4	97.7
<b>Milwaukee, Wisconsin</b>							
Milwaukee	Core	103.6	113.5	109.4	101.7	103.7	99.2
Waukesha	Ring	88.7	97.8	98.0	101.7	103.7	99.2
Wood	Rural	72.8	74.4	81.7	90.5	86.5	91.8

<sup>1</sup>Normalized using Medicare Part A enrollment.

NOTES: GPCI is Geographic Practice Cost Index. MSA is metropolitan statistical area.

SOURCE: Welch, W. P., The Urban Institute, Washington, D.C., 1991.

counties.<sup>17</sup> Also presented is the location factor used in 1991. Recent drops in expenditures (relative to the United States) in several areas with high HMO

penetration (Welch, 1991b) will not be fully incorporated in the location factor for several years. Hence, the present location factor may overestimate the future factor in areas with high HMO market share.

The alternative location factors are ordered in terms of the amount of change from the status quo, starting

<sup>17</sup>All factors have been normalized using Part A enrollment, so that each national mean is 100.0.

with the factor involving the least change. First are the two regression-based factors, which recognize the systematic component of utilization. Last is the input price index, which recognizes variance in terms of prices, but not utilization.

The change in location factors is measured using standard deviation and correlation. Unless a regression explains all of the variance, its predicted value has a lower standard deviation than the dependent variable—in this case, roughly the status quo factor. The extent to which a new factor has a lower standard deviation than the status quo factor indicates the extent to which the new factor would dampen variation across counties. Besides dampening variation, a new factor is likely to change the relative rankings of counties, which are measured by the correlation between the status quo and a new factor. A new factor that would move each county, say, halfway to the national mean would have a correlation of 1.0 with the status quo factor but would have one-half its standard deviation.

The first location factor (other than the status quo) is the predicted value from regression 3, which includes population-related variables, input prices, providers per 1,000 persons, and the assignment rate. The standard deviation of the location factor falls from 22.5 (status quo) to 19.0 (regression 3). Prediction is likely to raise the minimum and lower the maximum. Both of these occur, with the minimum rising from 41.4 to 66.5 (Table 3) and the maximum falling from 158.6 (Dade) to 146.6 (New York County, i.e., Manhattan) (Table 4).

Even though regression 3 and the status quo have a correlation of .85, there would be considerable redistribution if it became the location factor. The three Florida counties in Table 4, for example, would experience sharp drops, with Dade's factor falling sharply from 158.6 to 116.0. The three counties in southern California would fall, and two of the three counties in northern California would rise. Among counties that would experience an increase are Honolulu, Bernalillo (Albuquerque), and Milwaukee.

If one moves from a factor based on regression 3 to one based on regression 4, the incremental impact is small. The standard deviation falls slightly, from 19.0 to 18.7. The correlation between the two factors is .96 (not shown in the table), and the correlation between the status quo and the factor based on regression 4 is .804. However, several of the selected counties would experience substantial changes: Cook (Chicago) would increase from 119.2 to 128.8, and Dakota (suburban Minneapolis-St. Paul) would increase from 92.8 to 105.9.

The movement to the input price index, whether from the status quo or from one of the regression-based factors, would have dramatic impacts. This is not surprising given that the regression-based factors reflect price and some utilization differences, whereas the input price index disregards all utilization differences. The standard deviation would fall from 18.7 (regression 4) to 11.0 (input price index); the maximum would fall from 152.4 to 131.5, and the minimum would increase from 73.7 to 81.7. The input price index would cause the location factor to fall dramatically in several core

counties. In Manhattan (New York), for instance, the location factor would drop from 147.4 (status quo) and 147.2 (regression 4) to 123.8. Using the index would cause the location factor to increase dramatically in several rural counties. In Wood (Wisconsin), for instance, where the Marshfield HMO is located, the location factor would increase from 72.8 (status quo) and 81.7 (regression 4) to 90.5. This HMO participated in the early HMO demonstration, but dropped its risk contract because it considered its payment rate too low (Nycz et al., 1987). Because utilization is systematically higher in urban cores than in rural areas, an input price index would systematically lower payment in cores and raise payment in rural areas.

Having discussed the input price index, one is in a better position to consider why certain counties would experience substantial drops with a regression-based factor whereas other counties would experience substantial increases. Specifically, I focus on counties with at least a 15-percentage-point change under regression 4. Because the input index plays a major role in these alternative factors, its two components are also presented in Table 4.

The largest increase is experienced by San Francisco, in part because it has one of the highest input price index values. Its utilization rate is slightly below the national average, as calculated by dividing the location factor (126.2) by the input price index (129.6). This average utilization rate contrasts with San Francisco being the most densely populated county outside of the New York City MA, density being a major predictor of utilization. (This surprisingly low utilization rate may reflect the fact that San Francisco is the MA with the highest HMO market share [Palsbo, 1990].) When the input price index is multiplied by utilization predicted by density, population size, and urban-rural location, San Francisco has a factor of 152.4, well above its present factor of 126.2.

Outside of the San Francisco MA, the largest increase in the location factor is Honolulu. Honolulu has utilization 14 percent below the national average (i.e.,  $94.6/110.1 = .86$ ), whereas its utilization predicted by population-related variables is slightly above average. The net effect is to increase the factor from 94.6 to 113.5.

The largest drops are experienced by counties in south Florida. Dade, Broward, and Hendry would experience drops of about 35 percentage points. Dade has a utilization rate 52 percent above average, whereas its utilization predicted by population-related variables is 9 percent above average (i.e.,  $114.0/104.6 = 1.09$ ). This large difference causes the large drop from the status quo.

The other two counties with large drops are Imperial in rural, southern California and Prince Georges in suburban Washington, D.C. Imperial has above average utilization even though rural counties typically have below average utilization. Prince Georges has utilization 30 percent above average, even though its utilization predicted by population-related variables is about average.

## Conclusion

Overall, Tables 3 and 4 help to illuminate the policy options. Within the options developed here, the most fundamental issue is whether to use an input price index or to recognize some differences in utilization.

Whatever the economic arguments for an input price index, such an index would involve more redistribution among HMOs in various counties than any regression-based factor. In particular, the factor in Dade would fall from 158.6 to 104.6. Even a regression-based factor would lower this to 116.0 or 114.0, a substantial drop for the HMOs operating there. As noted, the input price index would represent the most radical change.

If any change from the status quo had an acceptable level of redistribution, it would most likely be one of the regression-based factors. Among these, regression 4 relies only on population-related variables and input prices, whereas regression 3 also incorporates providers per 1,000 persons and assignment rate. The correlation with the status quo is slightly higher for regression 3 (.848) than regression 4 (.804). Simplicity is the relative strength of regression 4, whereas less redistribution is the relative strength of regression 3.<sup>18</sup>

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<sup>18</sup>To make the transition less abrupt, any change in the location factor probably should be phased in over a number of years, just as the Medicare fee schedule for physicians will be phased in.

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