# Why Are Medicare and Commercial Insurance Spending Weakly Correlated?

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**Objective:** To investigate the source of the weak correlation across geographic areas between Medicare and private insurance spending.

**Study Design:** Retrospective, descriptive analysis.

**Methods:** We obtained Medicare spending data at the hospital referral region (HRR) level for 2007 from the Dartmouth Atlas, and commercial claims from large employers for 2007 from the Truven MarketScan Database. We constructed county-level data on hospital market structure from Medicare patient flows and obtained county-level data on the Medicare wage index from the Centers for Medicare & Medicaid Services website. We aggregated these sources to the HRR level. We decomposed Medicare and private spending into 2 components: price and volume. We also decomposed Medicare and private prices into 2 components: a common measure of cost and a sector-specific markup. We computed correlations between Medicare and private prices and volumes, and the correlation of each sector's price and volume with cost and markup.

**Results:** We found that Medicare and private prices are strongly positively correlated, largely because both are keyed off of common costs. Consistent with previous work, we found that Medicare and private volumes are strongly positively correlated as well.

**Conclusions:** The weak correlation between Medicare and private spending is consistent with these 2 empirical regularities. It is mathematically due to negative correlations between each sector's price and the other sector's volume. In particular, we found that private prices have important spillover effects on Medicare volume. Future research on the effects of competition should take account of this phenomenon.

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**For author information and disclosures, see end of text.**

Area variation in Medicare fee-for-service spending has been extensively documented. However, the extent to which area variation in spending by private insurers mirrors the variation in Medicare is an open empirical issue. Numerous studies have found a significant positive correlation between Medicare and the privately insured in terms of service use, such as hospital admissions, days per admission, or days in the intensive care unit at the end of life.[1-3] In contrast, the correlation between Medicare and private spending is weakly positive or even negative, depending on the type of service and the specifics of the populations in question.[1,4]

Understanding why Medicare and private spending are so weakly correlated is important. One hypothesis for the weak correlation in spending is that the prices paid by Medicare are weakly (or even inversely) correlated with the prices paid by private insurers. If true, this could be evidence that Medicare's prices fail to reflect costs, perhaps due to political manipulation of reimbursement rates, or that private prices fail to reflect costs, perhaps due to provider market power. These explanations have very different implications for Medicare policy.



Yet no study has tested this hypothesis directly. More generally, no study has offered a unified framework in which to understand the relationships between the components of Medicare and private insurer spending.

This study sought to fill this gap. We decomposed Medicare and private insurance spending into 2 components: a price index and price-adjusted spending, which we used as a measure of quantity. We calculated the simple correlations among the components of spending and the correlations between the components, the Medicare wage index, and price-cost markups.

These correlations rejected the hypothesis that Medicare's prices are weakly or inversely correlated with those of private insurance. Rather, they are strongly positively correlated, largely reflecting differences in costs (as measured by the wage index) across areas. We provide evidence for an alternative explanation for the strong positive correlation between Medicare and private utilization and a weak correlation between Medicare and private spending.

## DECOMPOSING SPENDING

We examined how the components of inpatient spending

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among fee-for-service Medicare beneficiaries are related to the components of spending among a nonelderly, privately insured population. We wrote inpatient spending per enrollee in either Medicare or private coverage from hospital referral region (HRR) *i* as the product of a price index for HRR *i* and quantity (price-adjusted spending) per enrollee in *i*:

**Take-Away Points**

This retrospective, descriptive analysis investigated the source of the weak correlation across geographic areas between Medicare and private insurance spending.

- Medicare and private prices are strongly positively correlated, largely because both are keyed off of common costs. Medicare and private volumes also are strongly positively correlated.
- The weak correlation between Medicare and private spending is consistent with these 2 empirical regularities. It is mathematically due to negative correlations between each sector's price and the other sector's volume.
- Private prices have important spillover effects on Medicare volume. Future research on the effects of competition should consider this phenomenon.

Spending per enrollee in HRR = price index in HRR × quantity per enrollee in HRR

Strictly speaking, geographic price indices for enrollees in fee-for-service Medicare and private insurance plans measure different things. Medicare reimbursement rates are determined by a complex nationwide administered price system, so geographic variation in Medicare "prices" necessarily arises out of geographic variation in whatever factors the Medicare formula considers. In contrast, commercial rates depend on numerous unrelated negotiations between insurers and providers, so geographic variation in commercial prices depends on a much less well-specified, broader range of influences.

We adopted the formula used in the Dartmouth Atlas for our Medicare price index.[5] According to the formula, the Medicare price level in an HRR is equal to the ratio of total spending in the HRR divided by base diagnosis-related group (DRG) payments plus adjusted outlier payments. Thus, the formula captures variation across areas in the wage index and in medical education and disproportionate-share (graduate medical education, indirect medical education, and disproportionate share hospital) payments, given each HRR's DRG mix and outlier payments. Our private insurance price index is equal to total spending in an HRR divided by what spending would have been if all hospitals in the HRR charged the national average set of DRG prices. This index captures variation across areas in the prices that insurers pay, given each HRR's DRG mix.

We also decomposed the price indices into 2 factors: the part that is due to differences in costs that are common to Medicare and the private sector, and a markup, which we allowed to vary across sectors. We used the Medicare wage index to represent common costs. We defined the markup as the residual from a regression of the log of the price index on the log of the Medicare wage index. Thus, for either the Medicare or private insurer price index in HRR *i*:

Price index in HRR = f(Medicare wage index in HRR) × markup in HRR,

where f(.) is defined as exp[a + b*ln(wage index)], and a and b are coefficients from the regression described above. We provide a formal presentation of our decomposition in the **Appendix**.

## DATA

We used data from several sources. First, we used HRR-level data from the Dartmouth Atlas website for 2007. These data included total Medicare inpatient spending per admission on fee-for-service beneficiaries, total price-adjusted inpatient spending per admission, the number of elderly beneficiaries, and the number of admissions per beneficiary. All of these variables are adjusted by Dartmouth for differences in the age, sex, and racial composition of areas. From this information, we constructed the price index described above. These data cover a total of 27,978,661 individuals in all 306 HRRs.

Second, we used Truven MarketScan Commercial Claims and Encounters data on the nonelderly privately insured from 2007. We limited our sample to individuals with preferred provider organization insurance and imposed the additional selection criteria suggested by Baker and colleagues.[6] These data include information on the enrollees' county of residence, which we mapped to HRRs according to the method proposed by Chernew and coauthors.[7] We adjusted the variables for differences in age and sex across HRRs (we could not adjust for differences in race because the MarketScan data do not include race). These data cover a total of 14,902,153 beneficiaries in all 306 HRRs.

Third, we used data on the Medicare wage index by county from the Centers for Medicare & Medicaid Services website, which we mapped to HRRs using the method described above.

Fourth, we used data on hospital market structure that we constructed from individual-level 2007 data on Medicare patient flows according to the method proposed by Kessler and McClellan[8]; we provide details in the Appendix. We counted hospitals in a common system as commonly owned.

**Table 1.** Means (Standard Deviations) of Variables Used in Analysis

| | Unweighted | Weighted by Enrollees | Minimum | Maximum |
|---|---|---|---|---|
| **Medicare** | | | | |
| Total spending | 3990 (696) | 4176 (757) | 2584 | 7341 |
| Price index | 0.977 (0.118) | 1.000 (0.129) | 0.805 | 1.493 |
| Quantity (price-adjusted spending) | 4093 (630) | 4174 (562) | 2644 | 5925 |
| Price markup over wage index | 1.001 (0.050) | 1.003 (0.059) | 0.911 | 1.345 |
| **Market scan** | | | | |
| Total spending | 713 (139) | 697 (111) | 397 | 1568 |
| Price index | 1.039 (0.241) | 1.000 (0.179) | 0.689 | 2.633 |
| Quantity (price-adjusted spending) | 697 (100) | 704 (85) | 357 | 1004 |
| Price markup over wage index | 1.016 (0.189) | 0.971 (0.149) | 0.664 | 1.961 |
| **Other variables** | | | | |
| Wage index | 0.963 (0.148) | 0.991 (0.045) | 0.739 | 1.562 |
| Hospital HHI | 0.539 (0.130) | 0.494 (0.116) | 0.252 | 0.956 |

HHI indicates Herfindahl-Hirschman Index.

Table 1 presents the enrollee-weighted and unweighted means and standard deviations of the variables that we analyzed. These descriptive statistics reflect the well-known properties of Medicare and private insurance area variation. There is considerable variation across areas in Medicare spending, even after adjusting for differences in prices.[9] Spending per enrollee in the MarketScan data is much lower, reflecting the much lower hospital admissions rate in the nonelderly population. The enrollee-weighted means of the Medicare and MarketScan price indices are both 1 by construction.

Total spending per enrollee in MarketScan is slightly less variable across areas than total spending per enrollee in Medicare; the ratio of the standard deviation to the mean is 0.159, compared with 0.181 in Medicare. But the portion of this variation due to variation in prices is much greater in MarketScan than Medicare; the standard deviation of the MarketScan price index is 0.179 compared with 0.129 in Medicare, which is consistent with previous work.[10] This is reflected in the fact that the standard deviation across areas of the price markup over the wage index is 3 times greater in MarketScan.

## ANALYSIS

Table 2 presents the correlation between Medicare and MarketScan total spending, quantities, and prices (*P* values for the null hypothesis of zero correlation are in parentheses). *Total* spending is weakly positively correlated ($\rho = 0.1135$, $P = .0473$), but quantity, as measured by *price-adjusted* spending, is very strongly positively correlated ($\rho = 0.6467$, $P < .0001$). This finding is consistent with the previous literature, which finds strong positive correlations between the rates of use of particular services in the elderly and nonelderly populations. It is also consistent with the hypothesis that physicians develop a single practice style that they use for patients of different ages and insurance statuses. Medicare and MarketScan prices are also strongly positively correlated ($\rho = 0.4476$, $P < .0001$). This rejection of the hypothesis that the prices paid by Medicare are weakly (or even inversely) correlated with the prices paid by private insurers suggests that another factor is responsible for the weak correlation between Medicare and MarketScan total spending.

Instead, according to Table 2, the weak correlation between sectors' total spending is due to the negative correlation between each sector's price and the other's quantity. In other words, Medicare volume is low where private prices are high ($\rho = -0.4324$), and MarketScan volume is low where Medicare prices are high ($\rho = -0.3748$). Mathematically, this is what is causing the weak correlation between Medicare and MarketScan total spending. (If Medicare spending is the product of prices *a* and quantities *b*, and MarketScan spending is the product of prices *c* and quantities *d*, then $\text{Cov}(ab, cd) \approx w_1\text{Cov}(a,c) + w_2\text{Cov}(a,d) + w_3\text{Cov}(b,c) + w_4\text{Cov}(b,d)$, where $w_1 \ldots w_4$ are weights.[11]) This is consistent with a wide volume of literature that finds that price reductions in Medicare induce increases in private volume.[12]

Table 3 investigates this result further. It presents the correlations of the sectors' prices and quantities with the Medicare wage index and each sector's markup. According to the first column, the wage index is strongly positively correlated with both sectors' prices, although more strongly with Medicare prices ($\rho = 0.9001$) than with private prices ($\rho = 0.5262$). It is also negatively correlated with both Medicare

**Table 2.** Correlations Between Spending and Its Components (*P* values in parentheses)

| | MarketScan Total Spending | MarketScan Quantity | MarketScan Price |
|---|---|---|---|
| Medicare total spending | 0.1135 (.0473) | 0.3225 (<.0001) | –0.1094 (.0560) |
| Medicare quantity | 0.0126 (.8266) | 0.6467 (<.0001) | –0.4324 (<.0001) |
| Medicare price | 0.1853 (.0011) | –0.3748 (<.0001) | 0.4476 (<.0001) |

**Table 3.** Correlations Between Costs, Markups, and the Components of Spending (*P* values in parentheses)

| | Wage Index | MarketScan Markup | Medicare Markup |
|---|---|---|---|
| Medicare price | 0.9001 (<.0001) | 0.0360 (.5309) | 0.4431 (<.0001) |
| MarketScan price | 0.5282 (<.0001) | 0.8739 (<.0001) | –0.0209 (.7173) |
| Medicare quantity | –0.2548 (<.0001) | –0.3576 (<.0001) | 0.0036 (.9494) |
| MarketScan quantity | –0.4123 (<.0001) | –0.2958 (<.0001) | –0.0180 (.7637) |

($\rho$ = –0.2548) and MarketScan ($\rho$ = –0.4123) quantities. For example, the 3 HRRs with the lowest price-adjusted Medicare spending (Bend, Oregon, at $2644; San Luis Obispo, California, at $2677; and Santa Barbara, California, at $2763) all have relatively high wage indices (1.04, 1.12, and 1.12, respectively); by comparison, the 3 HRRs with the highest adjusted Medicare spending (Alexandria, Louisiana, at $5666; McAllen, Texas, at $5836; and Monroe, Louisiana, at $5925) all have relatively low wage indices (0.78, 0.87, and 0.79, respectively). If we assume the wage index measures costs common to both sectors, when the wage index falls, both Medicare and private patients become absolutely more profitable, but Medicare patients become relatively less profitable than private patients, because the correlation between the wage index and the Medicare price is higher. This explains why a unit decrease in the wage index leads to increases in both Medicare and private quantities, with a greater increase in the private quantity.

According to the second column, the MarketScan markup is strongly positively correlated with the MarketScan price ($\rho$ = 0.8739), and negatively correlated with both the Medicare ($\rho$ = –0.3576) and the MarketScan ($\rho$ = –0.2958) quantities. When the MarketScan markup rises, private quantity falls, and Medicare quantity falls even more. The **Figure** translates the negative correlation between MarketScan markup and Medicare quantity into dollar terms. The HRRs with the lowest MarketScan markups have average price-adjusted Medicare spending of $4426, whereas those with the highest markups have Medicare spending of $3808—a difference of almost 1 standard deviation. This is consistent with a model in which private demand slopes downward and providers respond to the declining profitability of private patients by increasing the services they deliver to Medicare patients.

According to the third column of Table 3, the Medicare markup is strongly positively correlated with the Medicare price ($\rho$ = 0.4431, $P$ <.0001), but roughly uncorrelated with the MarketScan price and the Medicare or MarketScan quantity. This is likely due to the minimal amount of variation in the Medicare markup; we discuss alternative explanations for this finding in the Discussion section.

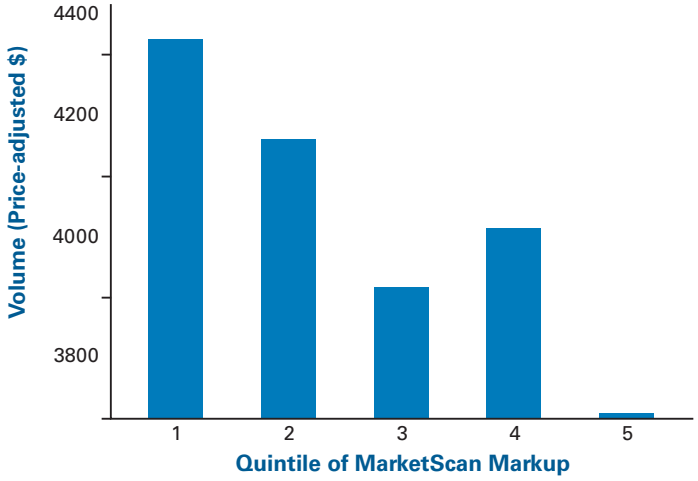
## DISCUSSION

Area variation in Medicare spending has long been viewed as evidence of inefficiency in the program.[13] At the same time, health services researchers have observed that area variation in private insurance spending is only weakly positively (or even negatively) correlated with Medicare variations. Given that physicians likely have a single practice style that they use for both elderly and nonelderly patients, this presents a puzzle: if utilization is correlated across sectors, why isn't spending?

In this study, we explain the source of this apparent anomaly. We decomposed Medicare and private insurance spending into 2 components: a price index and price-adjusted spending, which we use as a measure of quantity or volume. We showed that the weak correlation in overall spending is not due to weak or inverse correlation in Medicare and private prices. Not surprisingly, Medicare and private prices are strongly positively correlated across areas, largely because both are keyed off common costs (as measured by the Medicare wage index). Instead, the weak correlation is due to the negative correlation between each sector's price index and the other's volume.

We documented 2 channels through which this negative cross-correlation might occur. First, increases in common

**Figure.** Medicare Volume by Quintile of MarketScan Markup




costs are associated with increases in both Medicare and private insurance prices, and increases in private prices are associated with decreases in private volumes. Second, increases in private insurance markups are associated with decreases in Medicare volumes. Previous research on the sources of Medicare variation has focused on beneficiary health, socioeconomic status, and preferences. Our results point to another possibility: prices in the private, under-age-65 insurance market. In analyses not reported in the tables, we showed that hospital market concentration is a likely source of this second effect: the correlation between private markups and the hospital HHI is 0.3797 ($P$ <.0001).

To our knowledge, ours is the first study to identify this effect. The literature on the spillover effects of prices on utilization focuses on the impact of changes in public prices on private quantities rather than the impact of private prices on public quantities.[11] We provide empirical evidence for the hypothesis proposed by Chernew and colleagues: that providers respond to the declining profitability of private patients by reducing the share of time and resources they devote to them compared with public patients.[12]

Our analysis has significant limitations. It does not identify the causal relationships that are at the root of the negative association between one sector's prices and the other's volume. For example, we cannot say whether high private prices themselves cause low Medicare volumes, or whether some underlying third factor (like common costs or hospital market concentration) causes both. For purposes of policy, distinguishing between these alternatives is important. To do this would require specification of a formal model of the process through which prices and volumes are determined, which was beyond the scope of this study. In addition, our analysis was limited to inpatient acute care hospital spending. Results for outpatient services, prescription drugs, and postacute care may differ, thus complicating the explanations that we offer for the weak correlation in overall spending. Finally, our study design had only minimal independent variation in public prices. Therefore, the fact that we did not find significant spillovers from public prices to private volumes cannot be interpreted as evidence of the absence of such an effect; understanding the relative importance of private-to-public and public-to-private spillovers is an important topic for future work.

Nonetheless, our work shows that the weak correlation between spending in the 2 sectors does not, by itself, imply anything about the processes by which prices are determined, or about the relative efficiency in one sector versus the other. However, our finding that hospital market concentration is strongly positively correlated with private payer markups supports the concern voiced by other investigators that private sector purchasers are more vulnerable to provider market power.[1] Future research on the policy implications of area variations should take more careful account of this issue.

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## Appendix

We wrote inpatient spending per enrollee in either Medicare or private coverage from hospital referral region (HRR) *i* as the product of 2 factors: a price index for HRR *i*, and price-adjusted spending per enrollee in *i*:

$$\frac{\sum_d p_{id} q_{id}}{N_i} = \frac{\sum_d p_{id} q_{id}}{\sum_d p^*_{id} q_{id}} \times \frac{\sum_d p^*_{id} q_{id}}{N_i}$$

where $d$ indexes diagnosis-related groups (DRGs), $p_{id}$ is the average payment for an admission for DRG $d$ in HRR $i$, $p_{id}^*$ is the adjusted price for that admission, and $N_i$ is the number of enrollees.

$P_{id}^*$ is defined differently in the Medicare and privately insured populations. For Medicare, we used the definition of $p_{id}^*$ from the Dartmouth Atlas: the national-level base payment for DRG $d$ plus the average outlier payment for $d$ in HRR $i$, deflated by the Medicare wage index. For the privately insured, $p_{id}^*$ is the quantity-weighted (across HRRs) national average price for DRG $d$.

We defined the hospital Herfindahl-Hirschman Index (HHI) in HRR $i$ to be:

$$HHI_i = \sum_{l \in HRRi} \gamma_{li} \times \sum_{\substack{j \text{ serving} \\ \text{county } l}} \delta_{jl} \times \sum_{\substack{k \text{ admitting} \\ \text{to hospital } j}} \beta_{kj} \times \sum_{\substack{j \text{ serving} \\ \text{zipcode } k}} \alpha_{jk}^2$$

where $j$, $k$, and $l$ index hospitals, zip codes, and counties; $l$ is the share of patients who live in zip $k$ admitted to hospital $j$; $\beta_{kj}$ is the share of patients admitted to hospital $j$ who live in zip $k$; $\delta_{jl}$ is the share of patients who live in county $l$ going to hospital $j$; and $\gamma_{li}$ is the share of HRR $i$'s population who live in county $l$.