# Hospital Transaction Prices and Managed-Care Discounting for Selected Medical Technologies

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It is generally assumed that managed care has been successful at capturing discounts from medical providers, but the implications have been a matter of debate. Critics argue that managed-care organizations attain savings by reducing intensity of services, while others have argued that savings are "real" and are a consequence of discounts per unit of care rather than reduced intensity. Because medical services tend to be bundled together into episodes of care, separating out prices and quantities can be difficult. Given available data, past studies focused on an "average" price for the aggregate hospital, calculated from total revenue divided by the number of inpatient days or cases (e.g., Glenn A. Melnick et al., 1992; Emmett B. Keeler and Melnick, 1999). David Dranove and Richard Ludwick, (1999) caution that these methods provide approximations of actual prices and are subject to measurement error due to unobservable differences in service mix. Examining treatment episode for acute myocardial infarctions (heart attacks), David Cutler et al. (2000) infer that discounts attained by managed-care plans are only partly due to reductions in intensity.

Here, we employ data that enable us to observe *transaction prices* (i.e., actual payments borne by the payer and received by the hospital) for major procedures on an "unbundled" basis. Our analysis differs from previous studies in several important dimensions. Among these is the focus on pricing differences *between* various insurers and employers rather than differences within a single large insurer; as a consequence, we derive an empirical specification based on the bargaining framework due to John M. Brooks et al. (1997), rather than their insurer-based model. Moreover, to identify pure unit discounts we focus on the narrowly defined procedure. Like Cutler et al., we focus on coronary heart disease, a leading cause of death. We examine a major procedure used to treat this disease, one that is costly and relatively common. In bypass surgery (more fully, coronary arterial bypass graft, or CABG) healthy segments of artery are surgically inserted around the diseased arteries. In 2002 about 344,000 CABG's were performed in the United States, with expenditures exceeding $21 billion. Other economists have focused on these procedures to examine market phenomena such as the hospital's entry decision (Michael Chernew et al., 2002) or information diffusion (Dranove et al., 2003), yet the pricing decision was not treated fully.

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## 1. Bargaining Model for Pricing

Hospitals have been willing to grant procedure-specific discounts to various insurers in return for guaranteed referrals (David S. Hilzenrath, 1994; George Anders, 1996). Price negotiations are conveniently captured in the Nash-bargaining process, in which two players are shown to maximize a joint objective function defined simply as the product of their net benefit functions. The resulting outcome is defined by a set of special properties, including symmetry of the two players. Dor and Harry Watson (1995) use this framework to draw welfare implications in hypothetical hospital–physician bargaining over joint payments. Kenneth Binmore et al. (1986) and Jan Svejnar (1986) proposed a generalized Nash-bargaining model of the form $\Omega = U^{\tau(Z)}V^{1-\tau(Z)}$, where $\tau$ denotes relative bargaining power. This model is particularly adaptable to analyses of actual market phenomena such as wage or price negotiations since it relaxes the

symmetry assumption of the original model and allows for an empirical representation of relative bargaining power. Brooks et al. (1997) have shown that under the assumption of profit maximization the net benefit function of the hospital reduces to $U = N(P - P_\ell)$, while the net gain to the self-insured firm from bargaining is given as $V = N(P_m - P)$, where $N$ = number of insured all of whom are assumed to require medical care, and $P_\ell$ and $P_m$ are the disagreement prices of each of the players: $P_\ell$ is the lowest price the hospital is willing to accept and $P_m$ is the maximum price the insurer is willing to pay. Substituting into $\Omega$ and solving for $P$ yields the following solution:

$$P - P_\ell = \tau(P_m - P_\ell).$$

Further parameterization of $\tau$ can be summarized as $\tau = \tau(\mathbf{Z}: \mathbf{H}, \mathbf{I}, \mathbf{F})$, where $\mathbf{H}$ is a vector of hospital characteristics and its market, $\mathbf{I}$ denotes the type of insurance plan and market structure for the insurer-firm, and $\mathbf{F}$ reflects patient heterogeneity. The latter is required since the medical procedures are complex and cannot be delivered in a uniform fashion. Substituting into the above and slightly rearranging yields the estimating equation

$$P - P_\ell = \beta(P_m - P_\ell) + \mathbf{Z}'\boldsymbol{\gamma}(P_m - P_\ell) + \mathbf{D}'\boldsymbol{\varphi} + \varepsilon$$

where $\mathbf{D}$ is a vector of state fixed effects, $\varepsilon$ is the disturbance term, and $\beta$, $\boldsymbol{\gamma}$, and $\boldsymbol{\varphi}$ are equivalent to coefficients obtained from a restricted least-squares regression.

### II. Data and Definitions of Transaction Prices

To obtain transaction prices we turn to the 1995–1996 MarketScan "service-level" files that assemble insurance claims from about 80 large U.S. employers that self-insure. We extracted claims data for hospital admissions for which bypass surgery was the only invasive procedure performed (see Table 1). We obtained prices under two definitions: for the narrowly defined procedure (procedure price) and for the complete hospital case (treatment price), which includes services performed in conjunction with the main procedure, such as diagnostic tests, laboratory work, and post-operation recovery.[1] For a small subset of cases, price negotiations may have centered on "treatment." The data also allow us to control for heterogeneity of patients and procedures. Sample sizes and mean prices are summarized in Table 1. Values for both types of prices are comparable to values reported in the industry sources. In Brooks et al. (1997) disagreement prices were obtained from an external database, which was not available for the analysis herein. Therefore disagreement prices were defined as the lowest price and highest price in the metropolitan statistical area (MSA) conditional on a given severity for observations from the MSA with more than 80 observations. Over two-thirds of the sample came from such MSA's. For observations from smaller MSA's disagreement

TABLE 1—TRANSACTION PRICES FOR BYPASS SURGERY: MEANS AND DISTRIBUTION

| Claim type | Treatment price | Procedure price |
|---|---|---|
| Major medical | | |
| Mean | 27,987.4 | 9,646.7 |
| SD | 11,836.3 | 9,441.9 |
| *N* | 190 | 168 |
| Fee-for-service | | |
| Mean | 28,903.4 | 6,740.4 |
| SD | 10,900.8 | 3,901.4 |
| *N* | 1,948 | 1,802 |
| PPO | | |
| Mean | 27,598.0 | 5,390.4 |
| SD | 11,489.2 | 3,025.1 |
| *N* | 1,208 | 1,143 |
| HMO (point-of-service) | | |
| Mean | 26,177.7 | 6,239.4 |
| SD | 14,716.4 | 4,920.8 |
| *N* | 211 | 184 |
| Low-end procedure[a] | | |
| Mean | 28,212.4 | 6,137.5 |
| SD | 11,223.9 | 3,847.6 |
| *N* | 2,366 | 2,202 |
| High-end procedure[b] | | |
| Mean | 28,233.9 | 6,507.1 |
| SD | 11,764.4 | 4,464.6 |
| *N* | 1,155 | 1,062 |

[a] Single artery, with or without catheterization.
[b] Multiple arteries.

[1] Applying the Nash price equation to per-treatment payment requires the additional assumptions that the hospital exhibits constant returns to scale and that its disagreement payoff is formed under perfect competition. A proof is available from the authors upon request.

prices were based on the minimum or maximum for the entire state. To assure sufficient sample sizes, only the ten largest states were included.[2]

### III. Data and Definitions of Managed Care

About 60 percent of all insured individuals in the United States receive coverage through employer-sponsored plans. The rate of self-insurance among employers is surprisingly high: in 1997, 55 percent of all insured employees who received employer-sponsored health insurance were enrolled in self-insured plans. In large firms of 500 or more employees the proportion of insured employees in self-insured plans was even higher, at 63 percent (Stephen H. Long and Susan Marquis, 1999). Most self-insured firms tend to offer only one basic plan to their employees. Under a typical self-insured plan, the firm provides at-risk coverage to its employees and assumes responsibility for reimbursing providers directly. A private insurer may be contracted for the limited purpose of processing claims, receiving compensation for administrative expenses only.

Rapid increases in health maintenance organization (HMO) premiums coupled with concerns over bureaucratic controls have led large employers to shun traditional HMOs in favor of newer forms of managed care that allow employees greater flexibility and choice of providers (Milt Freudenheim, 2000). This is reflected in the MarketScan data: although "closed-form" HMOs were listed as an option, in practice no such cases occurred. About half of employees in the data enrolled in traditional fee-for-services plans. A small number of individuals (about 5 percent) enrolled in fee-based major medical plans that provide limited coverage for serious illness and high-end medical services only. The dominant form for managed care is the preferred-provider organization (PPO), a type of insurance plan whereby a selected network of providers is contracted to provide medical services at discounted fees, accounting for one-third of all cases in the data. This includes a small number of cases (7), which belonged to exclusive-provider organizations (EPOs). EPOs operate similar networks, but unlike PPOs they do not provide consumers with the option of going outside the network of providers under a higher co-payment. About 6 percent of individuals were enrolled in point-of-service HMOs (POS-HMO). As with traditional HMOs, POS subscribers prepay and are fully covered within the confines of the HMOs, but they are not given the option of choosing out-of-network providers at higher out-of-pocket cost. Hospitals may assume some of the insurance risk, but this varies across plans. The distribution of cases by type of insurer can be gleaned from Table 1. For comparison, nationwide PPOs were the dominant form of private insurance in 1995 with a market share of 49 percent compared with 23 percent for closed-panel HMOs and only 26 percent for fee-for-service plans. EPOs comprised about 2 percent of the national market (Health Insurance Association of America, 2000).

### IV. Supplementary Data Sources

MarketScan data were augmented with variables describing market structure as predictors of bargaining power. These included the Herfindahl index for hospitals with cardiac services and the HMO penetration rate calculated over MSA's,[3] and the percentage of employees in the county in large firms of 100 employees or more, all with a one-year lag. They were drawn from the American Hospital Association Annual Surveys, the Area Resource file, and the County Business Practice Pattern file respectively. A supplemental MarketScan file contained additional variables on hospital teaching and for-profit status. The combined analysis files mapped to 472 hospitals.

### V. Bargaining Results and Price Discounts

Table 2 reports regressions on procedure and treatment prices. Models are qualitatively similar, although hospital characteristics are significant only in the treatment model. The significant coefficients of the Herfindahl index for hospitals performing heart surgery indicates that increased concentration in hospital markets leads to higher prices: an increase of this index from a "low" level of concentration of 0.25 to a

[2] California was excluded from the source data.

[3] We are grateful to Douglas Wholey for providing a mapping of ARF counties to MSA's (see Wholey et al., 1995).

TABLE 2—REGRESSIONS OF TRANSACTION PRICES ($P - P_\ell$)

| Variable × ($P_m - P_\ell$) | Treatment | Procedure |
|---|---|---|
| Patient-product characteristics[a] | | |
| Trait 2 | 0.002 | 0.003 |
| | (0.007) | (0.007) |
| Trait 3 | 0.003 | 0.003 |
| | (0.007) | (0.007) |
| Trait 4 | 0.003 | 0.004* |
| | (0.008) | (0.002) |
| Trait 5 | 0.001 | −0.003 |
| | (0.001) | (0.005) |
| Urgent | −0.003 | −0.003 |
| | (0.006) | (0.006) |
| No. co-morbidities | 0.004* | 0.004* |
| | (0.002) | (0.002) |
| Insurance type | | |
| Fee-for-service (reference) | — | — |
| Major-medical | −0.003 | 0.014 |
| | (0.028) | (0.028) |
| PPO | −0.035** | −0.042** |
| | (0.007) | (0.007) |
| HMO | −0.092** | −0.063** |
| | (0.013) | (0.009) |
| Hospital characteristics | | |
| Minor teaching | 0.023** | −0.007 |
| | (0.007) | (0.008) |
| Major teaching | 0.051** | 0.011 |
| | (0.008) | (0.019) |
| For-profit | 0.129** | 0.011 |
| | (0.021) | (0.024) |
| Market structure | | |
| Cardiac Herfindahl index | 0.057* | 0.042* |
| | (0.018) | (0.021) |
| HMO penetration | −0.056 | −0.014 |
| | (0.004) | (0.044) |
| Percentage employees in large firms | −0.126 | −0.101 |
| | (0.183) | (0.242) |
| $\beta$ | 0.157 | 0.558 |
| | (0.031) | (0.040) |
| Intercepts | | |
| Year (1996) | −1457.5** | 254.412** |
| | (412.52) | (84.52) |
| State fixed effects | yes | yes |
| $R^2$: | 0.853 | 0.848 |

*Note:* Huber-White standard errors (reported in parentheses) are used to correct for heteroscedasticity due to hospital clusters.

[a] Traits 1, single arterial bypass; trait 2, double bypass; trait 3, triple bypass; trait 4, quadruple + bypasses; trait 5, with cardiac catheterization.

* Statistically significant at the 5-percent level.

** Statistically significant at the 1-percent level.

high concentration of 0.75 (mean = 0.34) implies a 12-percent increase in procedure price and a 15-percent increase in treatment price.

TABLE 3—MANAGED-CARE DISCOUNTS RELATIVE TO FEE-FOR-SERVICE

| | A) Discount per treatment[a] (percent) | | |
|---|---|---|---|
| Plan type | Bargaining | Linear | Semilog |
| PPOs | 9.28 | 6.11 | 9.13 |
| HMOs | 24.40 | 23.02 | 27.91 |
| *F* tests for HMO-PPO ($p < 0.0001$) | yes | yes | yes |
| | B) Discount per procedure (percent) | | |
| Plan type | Bargaining | Linear | Semilog |
| PPOs | 12.25 | 13.09 | 13.01 |
| HMOs | 18.33 | 21.16 | 23.11 |
| *F* tests for HMO-PPO ($p < 0.0001$) | yes | yes | yes |

*Note:* All results are statistically significant at the 1-percent level.

[a] Includes surgery, room and board, lab, anesthesiology, radiology, ancillary services, post-operation recovery, and other costs.

The results of greatest interest are the levels of price discounting associated with the various forms of insurance, as summarized in Table 3. For comparison, results of three main functional forms are presented: semilog, linear (ordinary least squares [OLS]) and restricted OLS for the Nash-bargaining model. While all models yield qualitatively similar results, our main interest lies with the bargaining model where transaction-level costs are implicitly differenced out (Brooks et al., 1997).

The per-treatment and per-procedure cases yield the same expected pattern: HMOs exhibit the deepest discounts, followed by PPOs. Prices for major-medical plans are not significantly different from those of fee-for-service plans and were therefore excluded from Table 3. However, HMO discounts are higher on a per-treatment basis than on a per-procedure basis (by 24 percent and 18 percent, respectively). Since the data would not allow us to separate out prices and quantities for every additional service delivered in conjunction with the main surgical procedure, it is not possible to determine the share of the per-treatment discounts attributable to reductions in service intensity. However, making the alternate assumption that the observed per-treatment discount applied

either to the main procedure exclusively or to all other related services equally yields an average per-unit discount of at least 4 percent, and a reduction of intensity in the range of 6–20 percent for point-of-service HMOs.

## VI. Summary and Conclusion

It is anecdotally known that managed-care organizations attempt to lower their costs internally by providing lower payments to providers. Our analysis suggests that these payments represent discounts that persist even after adjusting for the underlying patient heterogeneity and the characteristics of the medical procedure in a given case, for managed-care plans offered by employers. We further find that greater market concentration in hospitals tends to raise prices. Together these results are consistent with the predictions of the bargaining model. Rather than focusing solely on the entire episode of care as in the earlier related study by Cutler et al. (2000), our analysis focused on transaction prices for the narrowly defined medical procedure. Both studies conclude that a large share of cost savings by managed care organizations are due to per-unit price reductions. Our results are especially relevant to the current marketplace, as purchasers transition out of closed-model HMOs into the types of flexible managed-care plans that are observed in our data. However, the extent to which these discounts are passed on to consumers remains an open question. This limits our ability to comment on the welfare implications of these price discounts.

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