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ABSTRACT

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. To address this, we obtain separate transaction prices for hospital episodes (treatment) and for the narrowly defined surgical procedure, using the example of heart bypass surgery. Both sets of prices were drawn from a database of insurance claims of self-insured firms that offer a menu of insurance options. We use a Nash-Bargaining framework to obtain price discounts by type of insurance. Adjusting for product and patient heterogeneity, the per-procedure prices yield the anticipated pattern of discounts: Relative to traditional fee for service, point-of-service HMOs exhibited the largest discounts followed by Preferred-Provider-Organizations (18 and 12 percent, respectively). While reductions in intensity of services are not directly observable from the data, combining the results from the per-procedure and per-episode analysis yields a range of intensity reduction of 20-6 percent, with a corresponding per-unit price discount of 4-18 percent for the entire episode. We conclude that a large share cost savings by managed care organizations are due to per-unit price reductions.

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I. Background

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., Melnick et al., 1992; Keeler and Melnick, 1999). Dranove and Ludwick, (1999) caution that these methods provide approximations of actual prices, and are subject to measurement error due to unobservable service mix differences. Examining treatment episodes for acute myocardial infarctions (heart attacks), Cutler, McClellan and Newhouse (2000) infer that discounts are attained by managed care plans are only partly due to reductions in intensity. Here, we employ data that enables 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 theirs 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 Brooks, Dor and Wong (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 CABGs were performed in the U.S., with expenditures exceeding $21 billion. Other economists have focused on these procedures to examine market phenomena such as the hospital's entry decision (Chernew et al., 2002) or information diffusion (Dranove et al., 2003), yet the pricing decision was not treated fully.

II. Bargaining Model for Pricing

Hospitals have been willing to grant procedure-specific discounts to various insurers in return for guaranteed referrals (Anders, 1996, Hilzenrath, 1994). 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 Watson (1995) use this framework to draw welfare implications in hypothetical hospital-physician bargaining over joint payments. Binmore, Rubinstein, and Wolinsky (1984) and Svejnar (1985) proposed a generalized Nash-bargaining model of the form $\Omega = U^{\tau(Z)} \cdot V^{1-\tau(Z)}$, where τ denotes relative bargaining power, and U and V are the respective payoff functions of the two players, which the players maximize jointly. This model is particularly adaptable to analyses of actual market phenomenon 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.

For "per-procedure" prices, Brooks, Dor and Wong (1997) have shown that under the assumption of profit maximization and constant economies of the scale the payoff function of the hospital reduces to $U = N(P-P_l)$, while the payoff function 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_l and P_m are the disagreement prices of each of the players: P_l 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 Ω and solving for P yields the solution

$$P - P_l = \tau \cdot (P_m - P_l)$$

Further parameterization of τ can be summarized as $\tau = \tau$ (**Z**: H, I, F), where H is vector of hospital characteristics and its market, I denotes the type of insurance plan and market structure for the insurer-firm, and 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

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

where **D** is a vector of state fixed-effects, ε is the disturbance term and β , γ, and φ are equivalent to coefficients obtained from a restricted least-squares regression. With additional restrictive assumptions precisely the same price equation can be written when bargaining occurs over payment per-episode of inpatient care (per hospitalization, or per 'treatment' a Cutler et al. refer to it) rather than over the more narrowly defined procedure price[1]. Thus, both regressions shown in Table 2 are specified using the same functional form.

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[1] Using E to denote per-episode payment, we can describe the hospital's payoff as $U = E - E_m$, where, and E_I = the hospital's disagreement outcome, i.e., the minimum revenue that the hospital would be willing to accept to treat such a patient. Let the self-insured firm's payoff function is $V = E_m - E$, where E_m is the maximum expenditure the firm would incur to pay for an *episode* of hospitalization for a privately insured patient the relevant market. Players must jointly select E which maximizes **Ω**, noting that E is found on the interval $E_m < E < E_m$. With the additional assumption that revenues E_I exactly covers the hospital's average or marginal costs we

III. Data and Definitions of Transaction Prices for Hospitals

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, and post-operation recovery. 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., disagreement prices were obtained from an external database, which was available for the analysis herein. Therefore Disagreement prices were defined as the lowest price and highest price in the MSA conditional on a given severity for observations from the MSA with >80 observations. Over two-thirds of the sample came from such MSAs. For observations from smaller MSAs disagreement 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]

IV. Data and Definitions of Managed Care

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can rewrite Ω as: $E - E_l = \tau(E_m - E)$. Optimizing with respect to E yields the analogous specification as for the per-procedure equation in the text.

[2] California was excluded from the source data.

About 60% of all insured individuals in the U.S. receive coverage through employer-sponsored plans. The rate of self-insurance among employers is surprisingly high: in 1997, 55% 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% (Marquis and Long, 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 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 (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 plan. A small number of individuals (about 5%) 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 a third of all cases in the data. This includes a rare 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 copayments.

About 6% of individuals were enrolled in point-of-service HMOs (POS-HMO). POS-HMOs resemble traditional HMOs as long as consumers stay within the network: cost-sharing by patients is minimal, but the ability to choose among providers is also minimal; in addition patients are assigned a 'gatekeeper', usually a family physician or nurse case manager, and are not able to access specialists directly without the gatekeeper's referral. However, like PPOs, POS-HMOs give their members the option of choosing physicians and hospitals outside the network, in exchange for higher out-of-pocket participation. 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% compared with 22% for HMOs and only 26% for fee-for-service plans. POS-HMOs comprised about 3% of the national market, but their market share has grown to 7 percent in recent years. (HIAA, 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 metropolitan statistical areas[3], and the percent 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

[3] The authors are grateful to Douglas Wholey for providing a mapping of ARF counties to MSAs. See Wholey et al., 1995.

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 high concentration of 0.75 (mean=0.34) implies a 12% increase procedure-price and a 15 increase in treatment-price. 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: semi-log, linear (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 fee-for-service and were therefore excluded from Table 3. However, HMO discounts are higher on a per-treatment basis than on a per-procedure basis (24% and 18% 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, we are able to place bounds on the intensity factor by making the alternate assumption that the observed per-treatment discount applied either to the main procedure exclusively or to all other related services equally. If the observed per-treatment discount applied to the main procedure exclusively, then the average per unit discount would be 4% and the reduction in intensity would be 20%. On the other hand if the price applied equally to all procedures, then point of service HMOs would reap a price cut of 18% and a service reduction of only 6%.[4]

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 an earlier related study by Cutler et al., our

[4] To illustrate it, suppose there are two procedures (1 and 2) associated with the full treatment. Let e be expenditures on the treatment. Then $e = p_1q_1 + p_2q_2$, where p_1 and p_2 are prices and q_1 and q_2 are quantities. Let x represent the insurance variable (for convenience, we assume it is continuous; the use of dummy variables to estimate plan effects will not alter the following point). Differentiate e with respect to x to get

$$\tilde{e} = k(\tilde{p}_1 + \tilde{q}_1) + (1-k)(\tilde{p}_2 + \tilde{q}_2).$$

Here

$k = p_1q_1/e$, and $\tilde{e} = \frac{de}{dx}\frac{1}{e}$, etcetera

We have data on e and p_1. Based on the bargaining model results in Table 3 for HMOs, $\tilde{e} = 24$ percent and $\tilde{p}_1 = 18$ percent. We assume $\tilde{q}_1 = 0$. Based on Table 1 for the fee-for-service group, k = 6704/28903 = .23. If $\tilde{p}_2 = 0$, the price discount on the treatment is $k\tilde{p}_1 =$ .23*18 percent = 4 percent. But if $\tilde{q}_2 = 0$, the price discount on the treatment is 24 percent.

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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Table 1: Hospital Transaction Prices for Bypass Surgery: Means and Distribution*

	Treatment Price	Procedure Price
Major Medical , μ	27987.4	9646.7
σ	11836.3	9441.9
N	190	168
Fee-for-service, μ	28903.4	6740.4
σ	10900.8	3901.4
N	1948	1802
PP0	27598.0	5390.4
σ	11489.2	3025.1
N	1208	1143
HMO (point-of-service), μ	26177.7	6239.4
σ	14716.4	4920.8
N	211	184
Low End Procedure[1], μ	28212.4	6137.5
σ	11223.9	3847.6
N	2366	2202
High End Procedure[1], μ	28233.9	6507.1
σ	11764.4	4464.6
N	1155	1062

1. Low-end procedure: single artery, with or without catheterization;
   High-end procedure: multiple arteries.

Table 2: Regressions on Hospital Transaction Prices ($P-P_l$) [1,2]

(Variable) * (P_m-P_l)	Treatment	Procedure
Patient-Product Characteristics		
Trait 2	0.002 (0.007)	0.003 (0.007)
Trait 3	0.003 (0.007)	0.003 (0.007)
Trait 4	0.003 (0.008)	0.004 (0.002)[b]
Trait 5	0.001 (0.001)	-0.003 (0.005)
Urgent	-0.003 (0.006)	-0.003 (0.006)
No. Comorbidities	0.004 (0.002)[b]	0.004 (0.002)[b]
Insurance Type		
Fee-for-service (ref)	----	----
Major-Medical	-0.003 (0.028)	0.014 (0.028)
PPO	-0.035 (0.007)[a]	-0.042 (0.007)[a]
HMO	-0.092 (0.013)[a]	-0.063 (0.009)[a]
Hospital Characteristics		
Minor Teaching	0.023 (0.007)[a]	-0.007 (0.008)
Major Teaching	0.051 (0.008)[a]	0.011 (0.019)
For-Profit	0.129 (0.021)[a]	0.011 (0.024)
Market Structure		
Cardiac Herfindahl Index	0.057 (0.018)[b]	0.042 (0.021)[b]
HMO penetration	-0.056 (0.004)	-0.014 (0.044)
% employees in large firms	-0.126 (0.183)	-0.101 (0.242)
β	0.157 (0.031)[a]	0.558 (0.040)[a]
Intercepts		
Year (1996)	-1457.5 (412.52)[a]	254.412 (84.52)[a]
State fixed effects	yes	yes)
R^2	0.853	0.848

Notes: Huber-White standard errors are used to correct for heteroscedasticity due to hospital clusters; b: $0.01< p < 0.05$, a: $p < 0.01$

Trait 1 – 5: single arterial bypass; double bypass; triple bypass; quadruple+ bypasses; with cardiac catheterization.

Table 3: Managed Care Discounts, Relative to Fee-For-Service

	Per Treatment[+, ++]		
	Bargaining	Linear	Semi-log
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
	Per Procedure		
	Bargaining	Linear	Semi-log
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

Notes: [+] Includes surgery, room and board, lab, anesthesiology, radiology, ancillary services, post op, other). **:** [+ +] All results are statistically significant at the 1 percent level.