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HOW IMPORTANT IS PRICE VARIATION BETWEEN HEALTH INSURERS?

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Abstract

Prices negotiated between payers and providers affect a health insurance contract's value via enrollees' cost-sharing and self-insured employers' costs. However, price variation across payers is difficult to observe. We measure negotiated prices for hospital-payer pairs in Massachusetts and characterize price variation. Between-payer price variation is similar in magnitude to between-hospital price variation. Administrative-services-only contracts, in which insurers do not bear risk, have higher prices. We model negotiation incentives and show that contractual form and demand responsiveness to negotiated prices are important determinants of negotiated prices.

1 Introduction

High health care costs are a major public policy concern. Higher quantities and prices both contribute to the United States' uniquely high costs relative to other countries (Garber and Skinner 2008, Cutler and Ly 2011). Furthermore, price variation across settings, providers, and regions has received substantial media and policy attention. Prices for the same service vary substantially between geographic markets and between providers in a given geographic market (Cooper et al., forthcoming). While the recent literature has focused on between-provider variation, negotiated prices may vary across insurers as well. In this paper, we

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provide new descriptive evidence for the role of insurers and payers in setting negotiated prices. We explore the size of price variation between insurers, how contracting incentives affect these prices, and consequences for individuals and self-insured employers.

We document variation in prices paid to the same provider for the same service using data from the Massachusetts All-Payer Claims Database (APCD). We examine negotiated payments for five well-defined services (knee and hip replacements, vaginal and cesarean deliveries, and MRIs), in addition to overall price levels for all inpatient care. Between-payer price variation is similar in magnitude to between-provider price variation. Across our five clinical cohorts, the standard deviation in prices across hospitals, controlling for payer, ranges from 17-31 percent of the mean. In comparison, the standard deviation in prices across payers, controlling for hospitals, ranges from 16-28 percent of the mean. The most expensive major payer is about 13% more expensive on average than the cheapest major payer in our sample. For comparison, the highest-priced hospital system in our data is 27% more expensive than the average of other hospitals.

Examining variation in prices between *payers* at the same provider largely eliminates quality differences as a potential explanation. Differences in bargaining between payers may reflect underlying differences in enrollees' demand for providers across payers, the ability of payers to steer enrollees to specific hospitals, or bargaining ability. In our data, differences in underlying enrollee demand across payers are unlikely to explain price differences, as demographic characteristics (e.g., income) and distance to nearby hospitals are relatively balanced across payers. Finally, one might also be concerned that price differentials across payers could reflect differences in underlying severity and inputs used to treat patients. Examining MRI prices allows us to isolate a homogeneous procedure where even the "chargemaster" rate (list price) is the same across payers within a provider.

Variation in negotiated provider prices is important for at least two distinct reasons. First, consumers bear part of those costs in the form of out-of-pocket spending. Second, higher provider prices translate into higher costs for self-insured employers and, potentially, higher insurance premiums in the fully-insured market. While price transparency efforts have focused on helping consumers compare prices between providers before obtaining care, the earlier choice of which insurer to buy from will also have important effects on the health care prices consumers face. All else equal, consumers should prefer plans offered by insurers with lower negotiated rates. This is particularly true as the popularity of high-deductible insurance plans grows. Moreover, because self-insured employers pay medical costs directly at the prices their insurer (henceforth "payer") negotiates, they should prefer lower negotiated provider prices in administrative services only (ASO) contracts.[1]

Choosing a low price instead of a high price major payer (about a 15% difference in negotiated prices) leads to an average out-of-pocket (OOP) savings of $182 in a high-deductible plan; an individual with more knowledge about the types of service and hospitals they would use would experience greater price variation. The cost reduction for self-insured employers is larger: $750-$1,000 per enrollee.[2]

Given the importance of between-payer variation, we explore strategic payer behavior. The existing literature suggests that payers will receive lower prices if they have larger market share or greater ability to steer patients to specific providers (Sorensen 2003, Roberts, Chernew, and McWilliams 2017, and Ho and Lee 2017).[3] Our theory shows that—in addition to these forces—the response of insurance demand to negotiated prices is a crucial determinant of negotiated price levels; to our knowledge, this parameter has not been measured. Contracting incentives are also important. In a fully-insured product, the payer bears most of the costs of higher negotiated prices; in an ASO contract, the payer typically receives a fixed fee and the self-insured employer bears the costs of higher negotiated prices. All else

[1] Self-insured employers do not technically work with insurers, but with an ASO or third-party administrators who administer the plan. We use the term "payer" to refer to both these entities and to insurers.

[2] The average commercially insured individual in Massachusetts has about $5,000 in health care spending (Lassman et al. 2017). We observe prices that are 15-20% lower at the lowest price payer relative to the highest. All else equal, a medium-size enterprise with 200 insurees would save $150,000-$200,000 per year by choosing the payer with lower provider prices. While ASO contracts could offset higher provider prices with lower administrative fees, these fees are only about 5% of claims on average making it unlikely that they fully offset observed price variation (CHIA, 2016)

[3] The incentives of insurers to negotiate lower prices has been identified as way to mitigate provider pricing power (see Trish and Herring 2015 and Ho and Lee 2017).

equal, we predict that payers will negotiate less aggressively when they are not financially responsible for the claim; in the data, negotiated prices at a given hospital are higher in ASO contracts (by about 2-4%), holding payer constant. Consistent with previous studies, we also find that managed care (HMO) plans command prices that are 3-5% lower, holding payer constant.

The paper is organized as follows. Section 2 describes relevant features of the insurer market and related literature. Section 3 describes our data and estimation strategy. Section 4 discusses the magnitude of variation in negotiated provider prices. Section 5 discusses the implications of this variation for the value of an insurance plan, and provides a framework for understanding payers' negotiated provider prices. Section 6 concludes.

2 Setting and Related Literature

Negotiation between payers and providers determines most health care prices outside of Medicare fee-for-service. Rather than paying a posted price, payers typically negotiate "allowed amounts" with providers. We focus our discussion on employer-sponsored insurance, whichis the dominant form of private health insurance in the United States; however, our insights are also relevant for other insurance markets.[4]

Employers in the U.S. healthcare system often purchase insurance on their enrollees' behalf. In fully-insured plans, the insurer takes on both administrative responsibilities and financial risk. These fully-insured plans are typically purchased by small employer groups; Cebul et al. (2011) show that the fully-insured market is characterized by high search costs and loads. In the market for these fully-insured plans, the employer serves as a (potentially imperfect) agent for employees.

Alternatively, employers can self-insure through ASO contracts or third-party administrator contracts. Under these arrangements, the employer contracts with a payer to administer the benefit, but the employer remains financially responsible for claims. The contract

[4] For example, see Garthwaite and Scott Morton (2017) on prescription drug coverage.

can take the form of a fixed per-enrollee fee paid by the employer to the payer. Alternatively, the employer may pay a percentage of overall claims as a fee, or the fixed fee may depend on a prior year's claims (see Jeng 1996). In these contracts, the employer bears the marginal cost of additional healthcare costs; moreover, fees based on percentage of claims can lead payers to receive high payments as negotiated prices increase. Both features attenuate the incentive for payers to negotiate lower prices. Large employer groups typically self-insure, due in part to federal law.[5]

Our paper is related to a literature on insurer pricing. Cooper et al. (forthcoming) examine the role of price variation between providers. Clemens and Gottlieb (2017) show that changes in relative prices between services tend to follow Medicare. Clemens, Gottlieb, and Molnár (2017) show that private payers tend to deviate most from Medicare when sufficient value is at stake. Other work examines the effect of managed care on prices. Cutler, McClellan, and Newhouse (2000) find that HMOs have lower expenditures largely due to lower negotiated prices, and Wu (2009) finds similar results examining hospital prices in Massachusetts from 1993-2000 using data from a large employer.[6] More recently, Roberts, Chernew, and McWilliams (2017) examine variation in prices for outpatient office visits using data from FAIR Health (a dataset of about 60 insurers). They find that insurers with larger market share in a county negotiate lower prices in that county.

Our paper is also related to the structural bargaining literature, which has not historically modeled the impact of strategic insurer behavior. Most papers (from Town and Vistnes 2001 to Gowrisankaran, Nevo, and Town 2015) model insurers as maximizing consumer surplus, while Ho and Lee (2017) model insurers as maximizing the Nash product of their own profits (premiums net of claims) and consumer surplus. The latter formulation

[5]The Employee Retirement Income Security Act, or ERISA preempts self-insured plans from state insurance regulation. (See Dalton and Holland (2017) on tax motivations for self-insurance, Feldman (2012) for a moral hazard argument, and Jensen, Cotter, and Morrisey (1995) for the role of regulation).

[6]Wu's results show substantial variation in the discounts the HMO plans secure relative to the fee-for-service plan (ranging from 26-52%). However, Wu's results also show that hospital fixed effects explain a limited fraction of variation in prices. That is in contrast to both our results and the recent work of Cooper et al. (2015), and may be due to the method of measuring prices (per-diem rate for all admissions, as opposed to well-defined services).

nests everything from Nash Bertrand pricing to a break-even constraint for insurer, but does not explicitly consider the negotiation incentives that result from contractual form.

3 Empirical Strategy

We explore between-payer provider price variation in the private health insurance market in the state of Massachusetts. Using the Massachusetts All Payer Claims Database (APCD), we analyze prices for a representative set of services commonly provided to the privately insured. These data are ideal for our analysis for three reasons. First, the data report the actual negotiated prices between hospitals and payers ("allowed amounts"). Second, the data contain the universe of commercial claims in the state, including both ASO plans and fully-insured plans. Third, we observe payer identifiers, which allow us to estimate price differences between payers and hospitals.

3.1 Data and Price Measurement

We examine claims for 18-64 year olds at 68 acute care hospitals from 2009-2011.[7] In our analysis, we focus on the three largest payers in Massachusetts: Blue Cross Blue Shield, Tufts Health Plan, and Harvard Pilgrim. We also analyze prices for three national payers—UnitedHealth, Aetna, and Cigna—which are large organizations but make up only a small fraction of the Massachusetts market.[8] Our results are not sensitive to the inclusion or exclusion of specific payers.

We use two strategies for price measurement, one focused on precision and one focused on generalizability. To measure prices precisely, we select narrowly-defined services with limited heterogeneity, so that measured prices are driven by bargaining, rather than by differences in treatment intensity or patient severity. We use five clinical cohorts: admissions

[7] See Ericson and Starc (2015b) for discussion of hospital definitions.

[8] We observe prices for other payers, and include them in our analyses; due to small sample sizes at many hospitals we do not report their coefficients.

for hip and knee replacement (ICD 8151 and 8154), vaginal and cesarean delivery (ICD 7359 and ICD 741), and lower limb MRI (CPT code 73721). We also restrict these data on the basis of clinical codes that might indicate especially complex cases (e.g. fractures or crushing injuries in joint replacements, or twins in deliveries).[9] We exclude anyone under 18 or over 64 years, out-of-state enrollees, and those with missing provider information. We also exclude episodes whose prices are in the top or bottom one percent of the price distribution and the top one percent of length-of-stay, as these cases are likely to represent measurement error or idiosyncratically complicated admissions that may not be representative of a patient's expected price of care. To summarize across service lines, we create a "composite price," which estimates the same price index, but for all five clinical cohorts together, adding a clinical cohort fixed-effect to the regression. Additional details can be found in Appendix A.1.

In an alternative analysis focused on generalizability, we construct a dataset including all inpatient admissions. We again estimate our hospital-payer price index, now treating the primary diagnosis as the clinical cohort fixed-effect in the regression. The sample of all inpatient admissions better represents the full basket of services over which payers and hospitals negotiate, but may contain more measurement error. In both the "composite sample" and "all inpatient sample," we weight cohorts and diagnoses according to their overall contribution to spending to ensure that clinical events that occur frequently but do not make up a large portion of spending (e.g., MRIs) do not dominate the results.[10]

3.2 Regression Specification

Our estimating equation is given by:

[9] MRIs include only outpatient claims (at the hospital); to avoid potential bundling with other services, we limit our analysis to patient days with no other claims and where there is a separate professional claim for the reading of the MRI.

[10] All of our results are qualitatively similar when estimated without weights or using inverse propensity scores to balance the distribution of spending across payers.

$$ln(price_{ihpt}) = \beta X_i + \lambda Z_i + \theta_h + \theta_p + \theta_t + \epsilon_{ihpt}, \tag{1}$$

where $price_{ihpt}$ is the transaction price for a given patient i at hospital h paid by payer p in sample month t. We estimate these regressions separately on a sample for each clinical cohort, as well as on the composite sample and the sample of all inpatient admissions. Patient age (measured in 5-year age bands) and sex are included in X_i; for the composite and all-inpatient admissions samples, X_i also includes fixed-effects for each cohort or primary diagnosis code.

We control for insurance plan characteristics in Z_i, including funding type (ASO/fully-insured) and product (e.g., HMO, PPO).[11] We include hospital fixed effects θ_h, sample-month fixed effects θ_t, and, critically, payer fixed effects θ_p.

To quantify price variation across payers and hospitals, we regress raw transaction prices onto the covariates ($X_i, Z_i, \theta_h, \theta_p$, and θ_t), and analyze the distribution of payer and hospital fixed effects:

$$\hat{\theta}_p = \overline{price}_p - \overline{X}_p\beta - \overline{t}_p\hat{\theta}_t - \frac{\sum_{i\in p}\hat{\theta}_{h(i)}}{N_p}. \tag{2}$$

These fixed-effects represent payer p's average price $\overline{price}_p$, less the contribution of patient characteristics, aggregate time shocks, and the average price difference of hospital h, weighted by the fraction of payer p's patients who obtained care at hospital h. The analogous measures of $\hat{\theta}_h$ can be written the same way.[12]

[11]These plan characteristics are indexed by i to reflect the fact that they vary across consumers who purchase different plans within a payer.

[12]In separate analysis, we follow equation (2) in analyzing the variation in ln(Price) across hospitals and payers. The results of this exercise are qualitatively similar.

4 Results: Estimated Price Variation

This section documents large variation in negotiated prices across payers for the same service in the same hospital. Some payers are systematically more expensive than others on average across all hospitals, and there is meaningful variation accounted for by a hospital-payer interaction. We also find price variation within a payer-hospital pair that depends on the characteristics of the plan type (ASO or fully-insured).

Table 1 displays the number of observations and average prices for each clinical cohort. Panel A reports the standard deviation of hospital fixed-effects $\hat{\theta}_h$, and Panel B reports the standard deviation of payer fixed-effects $\hat{\theta}_p$, each estimated from equation (2). Each row corresponds to a clinical cohort or composite measure; in parentheses below each estimate, we report the standard deviation as a percent of the unconditional average price reported in Column (2).[13]

Column (3) includes no controls; these estimates are the standard deviation of unadjusted average price levels. Column (4) controls for patient characteristics and aggregate time shocks; Column (5) then adds payer (Panel A) or hospital (Panel B) fixed effects. We find that prices vary across payers nearly as much as they do across hospitals. In the most controlled specification, the standard deviation of payer fixed-effects ranges from 16 to 28 percent of the mean price for the five clinical cohorts. For hospital fixed-effects, this ranges from 17 to 31 percent. These estimates are fairly similar across the three columns, indicating that variation in payer price levels is not driven by the composition of hospitals its enrollees visit, though somewhat smaller when aggregating across a broader sample of admissions.[14]

Figure 1 shows, for each hospital-payer pair, the relationship among our price index measures: prices for narrowly-defined procedures, the composite price index of these pro-

[13] As noted by Sacarny (2018), these estimates may exhibit dispersion that is due to measurement error rather than “true" differences in levels. To limit the potential for dispersion to be driven by such noise, we limit to hospital-payer-cohort pairs of at least 10 cases. Our results are qualitatively similar for the unrestricted samples.

[14] In unreported results, we estimate alternative variance decompositions (Abowd, Kramarz, and Margolis (1999)), which confirm that there is important price variation across both payers and hospitals.

cedures, and the price index measured on all inpatient admissions. There is a positive correlation across all measures. Consistent with prior work by Cooper et al. (forthcoming), these correlations are much weaker across service lines (e.g., cesarean sections and hip replacements) than within service lines (e.g., knee replacements and hip replacements).

Table 2 shows the estimates of equation (1) for two different samples: the composite sample (capturing all five narrowly-defined services) and the sample of all inpatient admissions. We first benchmark the between-provider variation in prices by running regressions in Columns (1) and (4) that control for an indicator for whether a hospital is owned by Partners (but omit Z_i, θ_h, and θ_p). Consistent with both the academic literature (Ho, 2009) and policy reports (Coakley, 2010), Partners commands high prices relative to other hospitals in Massachusetts. Transforming our coefficients into percentage changes, Column (1), shows that Partners' prices are on average 27.3 percent ($= e^{0.241} - 1$) higher than those for other hospitals in the data. Columns (2) and (5) add hospital fixed effects θ_h and insurance plan characteristics Z_i. Consistent with previous literature exploring the impact of managed care on negotiated prices, we find that HMOs, which typically steer consumers to specific providers, pay prices that are lower relative to PPO plans. Columns (3) and (6) add payer fixed effects, showing that these differences are not the result of compositional differences in plan types across payers. In Column (3), we estimate that HMO plans pay prices that are nearly 5.4 percent lower than PPOs, even when controlling for payer and hospital.

We also find substantial differences in price levels across self-insured ASO contracts and fully-insured products. Columns (3) and (6) show that ASO prices are 2.3 to 4.0 percent higher (depending on specification) than those of fully-insured plans. Table 3 presents specifications that include hospital-by-payer fixed effects. On aggregate, we find that ASO plans pay prices that are 2.1 to 4.3 percent higher than their fully insured counterparts, even within the same hospital-payer pair. The magnitude of this effect is substantial: approximately half as large as the savings associated with HMO plans.

While we observe multiple prices for different plans at the same hospital-payer, prices are often negotiated at the product level rather than by funding type. For example, the higher priced BCBS contract in Panel (c) of Figure 2 is 100% PPO and roughly 75% ASO. The lower priced BCBS contract is roughly 86% HMO (14% other non-PPO) and only 40% ASO. However, in multiple cases, we observe two distinct prices within a hospital-payer pair for MRIs in which one price applies only to ASO plans and the other applies only to fully insured plans, suggesting that funding forms the basis for distinct negotiations in at least some bargaining settings. For example, in Panel (c) of Figure 2, Harvard Pilgrim contracts are segmented by funding type. The higher priced contract is 100% ASO, while the lower priced contract is 93% fully insured and 7% "other." As we document in Appendix Table A.6, ASO plans tend to be PPO plans. PPO prices are therefore more likely to reflect ASO incentives than other plan types. Indeed, when ASOs are a higher share of PPO enrollment, the difference between the "HMO" and "PPO" price is larger. We examine this issue at length in Appendix A.2, and show that the results in Table 3 provide a likely underestimate of pure ASO incentive differences.

Finally, we turn our attention to the average price difference across payers. Columns (3) and (6) of Table 2 show that there is substantial variation across payers: in Column (3), prices negotiated by Harvard Pilgrim are an average of 6.5 percent lower than prices negotiated by BCBS (the omitted category); Tufts' prices are 13.2 percent lower. The pattern in the data is somewhat surprising given BCBS's larger market share; one natural explanation would be that BCBS does less to steer its consumers. While this may be the case, these gaps in negotiated prices persist even when we control for plan types. Also note that the three national payers have the lowest prices, despite having relatively small market share.[15]

Variation across payers exists in each clinical cohort as well as in our broad inpatient sample. In Appendix Table A.3, we estimate analogous specifications separately procedure-

[15]In Table 2 we have aggregated the national payers into a single group. When estimated separately, coefficients for Aetna, Cigna, and United in Column 3 are -0.060, -0.315, and -0.210, respectively. Cigna and United's coefficients are not significantly different from each other.

by-procedure. Consistent with the low correlations across procedures observed in Figure 1, these specifications show that the price index hides some interesting patterns across procedures. For instance, while Tufts negotiates rates 13.2 percent lower than BCBS on average across all five services, Tufts is much "cheaper" for hip and knee replacements (about 36 percent), and actually slightly more "expensive" for MRIs. The ASO effect is broadly consistent across procedures.

Variation in negotiated price levels across hospital-payer pairs is shown in Figure 2: BCBS does not negotiate systematically higher or lower prices across all providers or procedures. Furthermore, while there is substantial variation across hospitals and payers, variation across bargaining dyads is also important. Consistent with the fact that the price ordering of hospitals in one payer is quite different than others, a joint F-test reveals that adding hospital-payer interactions to regressions of the form estimated in Table 2 always adds statistically significant explanatory power.[16]

What explains these differences between payers? Observable characteristics of enrollees are relatively balanced across payers (see Appendix Table A.2). Consumers have preferences over networks and insurers may have different network strategies, potentially leading to different negotiated prices; BCBS's network is relatively broad (Ericson and Starc 2015b), which could be a factor in BCBS's relatively high negotiated prices.[17] Moreover, brand reputation could operate as a shift in demand for a given price, leading to higher negotiated prices. Finally, search costs may lead to price variation (see Cebul et al. 2011).

[16] For hip replacements, we estimate a joint F-test of $F(45, 118) = 63,852$, $p < 0.001$. This same test is significant at $p < 0.001$ for all of our clinical cohorts.

[17] BCBS is also unique in this time period for introducing a value-based payment contract (the Alternative Quality Contract, ACQ), in which providers bear some risk. Higher payments from BCBS could partially be compensation for bearing risk, note that BCBS did not see a big cost increase when they introduced the ACQ and the effect of the ACQ on spending is relatively small compared to our results (Song et al. 2011).

5 Implications

5.1 Price Variation and Consumer Value of Insurance

The financial value of a health insurance plan to an individual is often modeled as comprising two parameters: premiums p and a cost-sharing function that translates medical expenses into OOP costs for the consumer.[18] However, the prices a plan has negotiated with providers also affect its value, as the prices determine the amount of medical expenses incurred for using a particular service—and, therefore, the cost-sharing that the individual faces. Let z be the plan's *negotiated provider price level* that scales up or down a claim L.[19] For normalization, let $z = 1$ be the average negotiated price level, so that an insurer with $z = 1.5$ has negotiated provider prices that are 50% higher than average.

For simplicity, we model cost-sharing as a constant coinsurance rate $\alpha \in [0, 1]$: if an individual has claims L, the insurer will pay αL. Because α characterizes the fraction of claims the plan covers, we refer to α as the plan's actuarial value.[20]

We can then write an insurance contract as $X = (p, \alpha, z)$. Consider an individual with a risk-averse utility function who faces probability π of needing a procedure that would cost L at average prices. Their expected utility is given by

$$\mathbb{E}U(X) = \pi U(w - p - (1 - \alpha)zL) + (1 - \pi)U(w - p)$$

for some level of wealth w.[21] First, note that the value of an insurance plan to an individual

[18] Insurance plans vary on other dimensions besides financial value, including provider networks and brand reputations. Recent work has attempted to estimate how sensitive consumers are to premiums when plans are differentiated on these dimensions, holding constant the cost-sharing function (Ericson and Starc 2015, Starc 2014).

[19] A single price level is a simplification, as a payer could be cheaper than average at one hospital and more expensive than average at another. Our empirical results show that payers differ between each other on average, but also that there is substantial idiosyncratic hospital-payer variation.

[20] In non-linear contracts (e.g., deductible and max OOP), effective actuarial value will vary with negotiated prices. Here, we think of actuarial value α as being defined for some fixed reference level of negotiated prices, so that a change in z will not affect α.

[21] More generally, an individual will face a distribution F of loss sizes $L \geq 0$. We assume that provider price level does not affect underlying medical care usage (no moral hazard).

is weakly decreasing in its negotiated provider price level z: $\frac{\partial \mathbb{E}U}{\partial z} \leq 0$. Moreover, the effect of z on individual utility depends on the degree of cost-sharing in the plan. Under full insurance ($\alpha = 1$), the individual is not affected by z; as actuarial value drops, the individual begins to be more affected by the provider price level.

5.2 Quantifying Price Variation in a High Deductible Plan

To quantify the impact of provider price variation on the effective financial generosity of an insurance plan, we select a sample of health care claims for a sample of working-age adults from Truven MarketScan (details in Appendix). We apply a high-deductible insurance plan to these claims (deductible=\$5,000, coinsurance=30%, maximum OOP=\$6,350). We then simulate the OOP spending amounts under a range of price multipliers that enable us to examine what OOP spending would be if prices were, for example, twice as high or half as large. The average OOP spending in the data at observed prices is \$1,900. In Appendix Figure A.1, we plot the average OOP spending and actuarial value for this plan from multipliers ranging from 0.5 to 2. The average OOP spending in the plan ranges from \$1,267 at prices 50% of observed, to \$2,641 at prices that were 200% of observed.

Across all our sampled services and providers, higher-cost payers were about 15% more expensive than lower-cost payers. A 15% discount relative to observed prices is an average OOP savings of \$182. Individuals likely have more information about which types of services or providers they will use (i.e., a young person might expect to have a birth at a nearby hospital, while an older person might expect to be more likely to have a hip replacement at a different hospital near them). We estimated price variation between insurers of about 50% for more specific services—such as Tufts versus BCBS for births, or the national carriers versus BCBS for MRIs. A 50% discount relative to observed prices is an average OOP savings of \$633. While we have focused on expected OOP spending, note that risk aversion will increase the disutility from spending that comes from cost-sharing as opposed from premiums.

5.3 Insurer Incentives: Fully Insured and ASO Markets

Contractual form will affect the incentives that payers have to negotiate prices, and so a payer's optimal price will typically differ between the fully-insured market and the ASO market. We lay out a brief model that identifies these incentives. We allow payers to negotiate separate provider prices z_{INS} and z_{ASO} for the two markets they operate in: the fully-insured market (INS) (e.g., health insurance exchanges, the individual market, the small group market) and the ASO market. However, in practice, there may be reputation, legal, and contractual barriers linking the prices in the two markets; in this case, the observed price in product for a given payer may reflect a combination of these two prices.

Consumer demand in the fully-insured market is given by the function $D_{INS}(p, z_{INS}, \alpha, \boldsymbol{X})$, where $\boldsymbol{X}$ is the vector of other products in the market, where demand is weakly decreasing in p and z_{INS}, and is weakly increasing in α. While the model in Section 5.1 shows that the level of z_{INS} affects consumer welfare, the way in which z_{INS} affects demand is a complex interaction between this model and a model of consumer search.

Negotiated provider price levels also affect the value of ASO contracts. ASO contracts typically consist of a fee paid to the payer in exchange for claims processing and access to the payer's negotiated provider rates. We represent an ASO contract as $Y = (\tau, z)$, where z is the payer's negotiated provider rates, and the fixed fee is τ. Thus, if spending per enrollee at average prices ($z = 1$) is $\$M$, then total cost per enrollee to the self-insured employer is $zM + \tau$. Other contractual forms—including those in which the employer pays a percentage of overall claims as a fee —will exacerbate the issues we highlight in this section. When the employer chooses an ASO provider, both τ and z are both important determinants of costs. In theory, employers could trade off τ against z to make decisions only on total cost; however, employers are unlikely to observe z as well as they observe τ, and may not value reductions in z fully.[22] Let ASO demand is given by $D_{ASO}(\tau, z_{ASO}, \alpha, \boldsymbol{X})$, with demand

[22]It is likely that z is harder to observe because there are many different prices in the market at the payer-provider level and no publicly available source of information on them.

weakly decreasing in τ and z_{ASO}.

Payers can exert costly effort e_{INS} and e_{ASO} to reduce negotiated prices (see e.g. Grennan 2014). The cost of effort for each price is given separately by a convex function c, with $c(0) = 0$, $c' > 0, c'' > 0$. We assume $\frac{dz_i}{de_i} = -1$ for each contract type i, which is without loss of generality because the cost of effort function c can be re-scaled.[23] We let the expected amount of medical care per enrollee be M at $z = 1$ prices,[24] and assume that there are no per beneficiary costs other than medical care consumed. We assume payers choose negotiation effort, premiums p, and administrative fees τ to maximize total profits,[25] which can then be written as:

$$\begin{aligned}
\Pi_{INS} &= (p - \alpha z_{INS} M)\, D_{INS}(p, z_{INS}, \alpha, \boldsymbol{X}) - c\,(e_{INS}) \\
\Pi_{ASO} &= \tau D_{ASO}(\tau, z_{ASO}, \alpha, \boldsymbol{X}) - c\,(e_{ASO})\,.
\end{aligned}$$

Note that the response of insurance demand $\frac{\partial D_{INS}}{\partial z_{INS}}$ and $\frac{\partial D_{ASO}}{\partial z_{ASO}}$ to negotiated prices is important determinants of payer negotiation effort. While a large number of papers investigate $\frac{\partial D}{\partial p}$ (the response of demand to premiums),[26] we are unaware of any papers that attempt to measure $\frac{\partial D}{\partial z}$, let alone the differences between $\frac{\partial D_{INS}}{\partial z_{INS}}$ and $\frac{\partial D_{ASO}}{\partial z_{ASO}}$. However, our next result shows that if the demand response to negotiated prices is small enough, the payer will optimally set ASO prices higher:

Result 1 *For small enough response of insurance demand to negotiated prices (e.g.* $\frac{\partial D_{INS}}{\partial z_{INS}} = \frac{\partial D_{ASO}}{\partial z_{ASO}} = 0$*),* $z_{ASO} > z_{INS}$*.*[27]

In the fully-insured market, the payer benefits from negotiating a lower price level

[23]It is possible that there is a different cost of effort function for z_{INS} and z_{ASO}. For our Result 1 below, we need only assume that if $e_{INS} = e_{ASO} = 0$, then $z_{INS} = z_{ASO}$.

[24]For simplicity, we abstract away from asymmetric information.

[25]We do not treat actuarial value as a choice variable; for instance, it is determined by regulation on the ACA's health insurance exchanges.

[26]See Auerbach and Ohri (2006), Chan and Gruber (2010), Cutler and Reber (1998), Ericson and Starc (2015a), Gruber and Poterba (1994), Ho (2006), Ho and Lee (2017), Marquis and Long (1995), and Royalty and Solomon (1998).

[27]See Appendix A.4 for proof.

because it pays the insured claims; at $\alpha = 1$, the payer is the residual claimant on negotiation effort. In the ASO market, lower negotiated prices only benefit the payer through increased demand; if that channel is shut down because $\frac{\partial D_{ASO}}{\partial z_{ASO}} = 0$, then ASO prices will be higher. However, we do not know whether and how the individual and ASO markets differ in their response to negotiated prices. Employers shopping for ASO services may (or may not) be better informed and responsive than individuals shopping for fully-insured products. As a result, it is ambiguous whether z_{INS} or z_{ASO} is higher. Moreover, outside our model, regulation differs between the ASO and fully-insured markets (for instance, medical loss ratios do not apply to ASO markets), and this may affect negotiated prices. Finally, payers may face constraints making it difficult for z_{INS} to diverge substantially from z_{ASO}, such as threat of bad publicity or regulation. Nonetheless, the observed differences in ASO prices is consistent with this prediction.

6 Conclusion

There is substantial variation in prices paid by different payers to the same hospitals for the same service. This variation affects the value of insurance products, implying substantial welfare effects for consumers. Insurer incentives are critical to understanding the variation in our data: prices paid are higher for ASO contracts holding fixed both payer and provider. Insurer size does not necessarily predict negotiated rates in our setting; however, we show that the ability to "steer" consumer demand (as proxied for by HMO contracts) is important, consistent with previous studies (Cutler, Kessler, and McClellan 2000).

Provider prices are hard to observe: the level of negotiated provider prices could be an important dimension of price transparency efforts. Consumer response (among individuals and large employers) to negotiated provider prices is a crucial determinant of insurers' negotiation effort. Yet we know little about this parameter; additional measurement of across payer price variation and consumer preferences over negotiated prices is an important direction for future work.

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8 Tables and Figures

Table 1: Quantifying Price Variation Within and Between Groups

Panel A: Analysis of Variation Across Hospitals

	(1) Observations	(2) Mean Price	(3)	(4)	(5)
			Standard Deviation of θ_h		
Hip Replacement	5,764	22,046	4,576	4,614	4,759
			(20.8)	(20.9)	(21.6)
Knee Replacement	8,205	20,955	4,250	4,332	4,255
			(20.3)	(20.7)	(20.3)
Cesarean Section	10,810	9,654	1,754	1,784	1,751
			(18.2)	(18.5)	(18.1)
Vaginal Delivery	13,142	6,147	1,045	1,004	1,059
			(17.0)	(16.3)	(17.2)
Lower Limb MRI	36,525	823	252	249	253
			(30.7)	(30.3)	(30.7)
All Inpatient	422,726	12,689	2,766	2,744	2,755
			(21.8)	(21.6)	(21.7)
Composite	74,446	11,790	1,902	1,902	1,916
			(16.1)	(16.1)	(16.2)
Patient Controls			No	Yes	Yes
θ_p			No	No	Yes

Panel B: Analysis of Variation Across Payers

	(1) Observations	(2) Mean Price	(3)	(4)	(5)
			Standard Deviation of θ_p		
Hip Replacement	5,764	22,046	3,586	3,441	3,617
			(16.3)	(15.6)	(16.4)
Knee Replacement	8,205	20,955	4,066	3,791	3,834
			(19.4)	(18.1)	(18.3)
Cesarean Section	10,810	9,654	1,604	1,582	1,500
			(16.6)	(16.4)	(15.5)
Vaginal Delivery	13,142	6,147	1,468	1,624	1,731
			(23.9)	(26.4)	(28.2)
Lower Limb MRI	36,525	823	191	167	187
			(23.3)	(20.3)	(22.7)
All Inpatient	422,726	12,689	1,882	1,643	1,635
			(14.8)	(13.0)	(12.9)
Composite	74,446	11,790	1,402	1,328	1,450
			(11.9)	(11.3)	(12.3)
Patient Controls			No	Yes	Yes
θ_h			No	No	Yes

Notes: Each cell contains the standard deviation across hospital fixed effects (Panel A) or payer fixed effects (Panel B), conditional on each sets of controls. Fixed effects are estimated as in equation (2). The standard deviation as a percent of the unconditional average price is reported in parentheses. The dependent variable in each regression is the raw individual-level transaction price. Patient controls include patient age, sex, and insurance plan type. In the all inpatient and composite samples, each regression also contains fixed effects for primary diagnosis and clinical cohorts and are weighted by the overall spending share of each procedure or cohort represents. Regressions underlying estimates for Columns (4) and (5) include a monthly fixed-effect. Data are limited to hospital-payer-cohort triads with at least 10 cases.

Table 2: Between Insurer Price Variation for Composite Price Measures

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	ln(Price)					
Partners	0.241***			0.328***		
	(0.045)			(0.047)		
HMO		-0.042**	-0.056***		-0.053***	-0.034***
		(0.014)	(0.011)		(0.012)	(0.008)
ASO		0.048***	0.023**		0.027***	0.039***
		(0.012)	(0.007)		(0.008)	(0.006)
Harvard Pilgrim			-0.067**			-0.094***
			(0.025)			(0.028)
Tufts			-0.142***			-0.117***
			(0.025)			(0.027)
Aetna/UHG/Cigna			-0.140**			-0.200***
			(0.045)			(0.039)
Hospital FE	No	Yes	Yes	No	Yes	Yes
Payer FE	No	No	Yes	No	No	Yes
Sample	Composite	Composite	Composite	All Inpatient	All Inpatient	All Inpatient
R-Squared	0.919	0.929	0.933	0.386	0.450	0.459
Observations	74,446	74,446	74,446	422,726	422,726	422,726

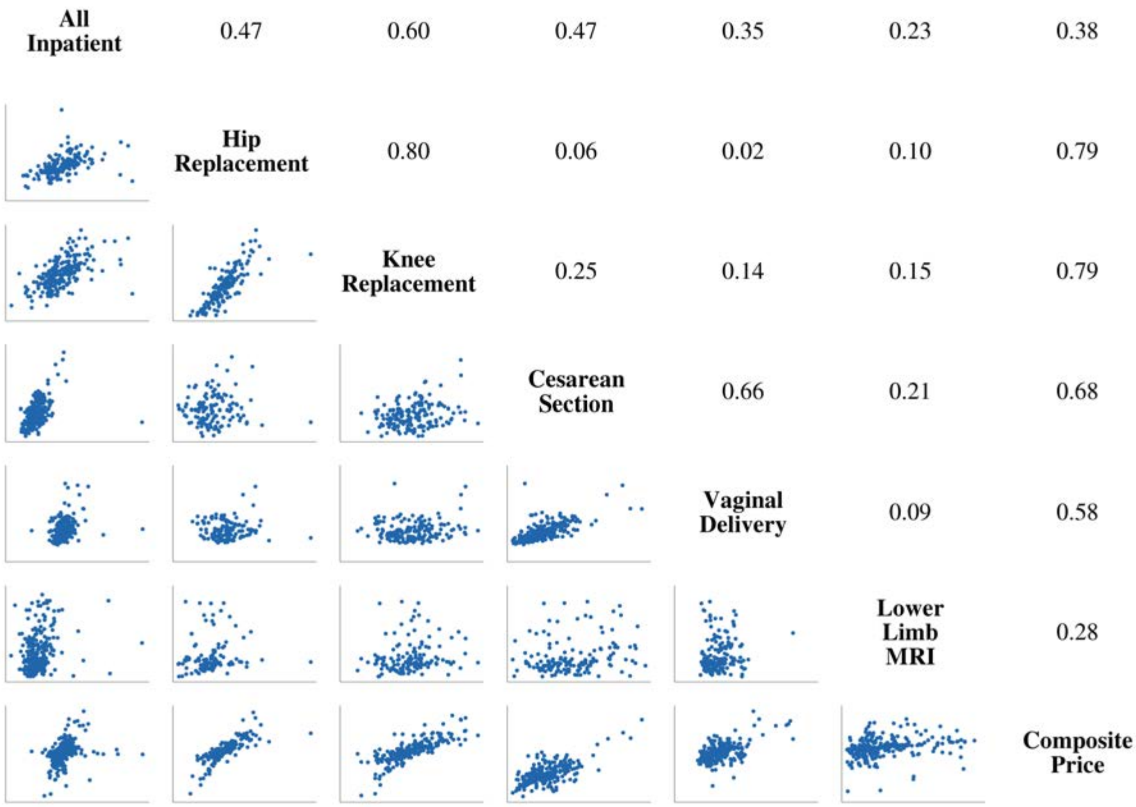
Notes: * ($p<0.05$), ** ($p<0.01$), *** ($p<0.001$). Standard errors clustered at the hospital-insurer pair in parentheses. The dependent variable is the log of individual-level transaction price. Insurer coefficients are estimated relative to BCBS. The omitted category for funding type is fully insured. The omitted category for product type is PPO. All regressions contain controls for patient patient sex and five-year age band as well as monthly fixed-effects. We also estimate price-level coefficients for all other payers in the data, which include: Fallon, Health New England, Boston Medical Center HealthNet, Celticare, ConnectiCare, Health Plans Inc., Neighborhood Health Plan, NetworkHealth, and Wellpoint. However, we omit these estimates here for the sake of simplicity.

Table 3: Between Insurer Price Variation for Composite Price Measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable:				ln(Price)			
HMO	-0.048***	-0.058***	-0.048***	-0.046***	-0.062***	-0.021**	-0.030***
	(0.009)	(0.017)	(0.012)	(0.009)	(0.013)	(0.008)	(0.008)
ASO	0.021***	0.027**	0.017	0.013*	0.011	0.022***	0.042***
	(0.006)	(0.009)	(0.010)	(0.006)	(0.007)	(0.005)	(0.005)
Clinical Cohort	Composite	Hip Replacement	Knee Replacement	Cesarean Section	Vaginal Delivery	Lower Limb MRI	All Inpatient
R-Squared	0.945	0.569	0.579	0.627	0.640	0.816	0.494
Observations	74,446	5,764	8,205	10,810	13,142	36,525	422,726

Notes: * ($p<0.05$), ** ($p<0.01$), *** ($p<0.001$). Standard errors clustered at the hospital-insurer pair in parentheses. The dependent variable is the log of individual-level transaction price. Insurer coefficients are estimated relative to BCBS. The omitted category for funding type is fully insured. The omitted category for product type is PPO. All regressions contain controls for patient patient sex and five-year age band as well as monthly fixed-effects. We also estimate price-level coefficients for all other payers in the data, which include: Fallon, Health New England, Boston Medical Center HealthNet, Celticare, ConnectiCare, Health Plans Inc., Neighborhood Health Plan, NetworkHealth, and Wellpoint. However, we omit these estimates here for the sake of simplicity.

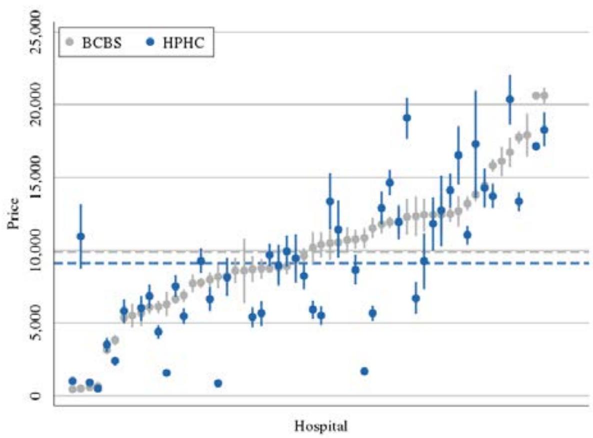
Figure 1: Correlation of Provider-Payer Price Across Procedures



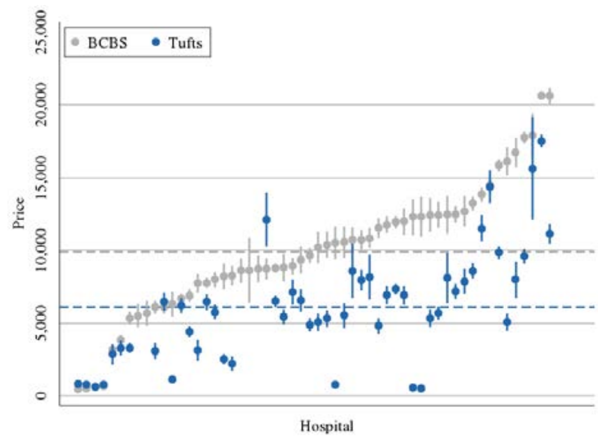
Notes: Each observation represents the regression-adjusted average price for a given hospital-insurer pair. All prices are adjusted for patient sex and five-year age band as well as a monthly fixed-effect. The method we use for risk-adjustment is detailed in Appendix A.1. The composite measure is adjusted using a fixed-effect for clinical cohort. The inpatient sample is adjusted using a fixed-effect for primary diagnosis.

Figure 2: Hospital-Specific Price Levels Relative to BCBS

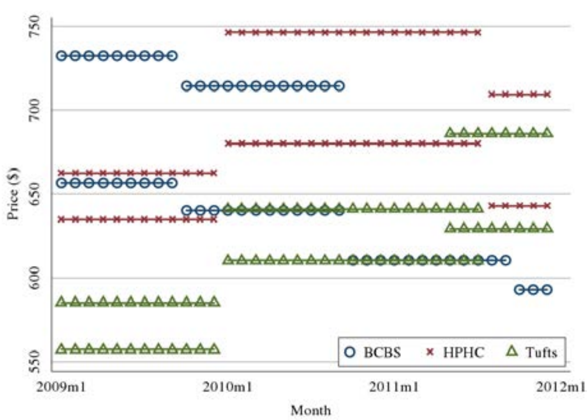
(a) HPHC



(b) Tufts



(c) Within-Hospital Prices



Notes: Each observation in Panels (a) and (b) represents the regression-adjusted average price for a given hospital-payer pair in our composite sample. All estimates represent the average residual price contribution by payer from a regression conditioning on age, sex, and clinical cohort. The method we use for risk-adjustment is detailed in Appendix A.1. Hospital-payer pairs with fewer than 10 observations have been omitted. Panel (c) displays persistent price agreements by payer at a large hospital for lower limb MRIs. The length of each line indicates the first and last day the price was observed for each hospital-payer pair.

A Appendices: For Online Publication Only

A.1 Measuring Hospital-Payer Prices

Sample Construction

We construct seven distinct samples for the purpose of analyzing price. First, in order to ensure that we are capturing variation in price, rather than differences patient complexity, we construct 5 narrowly defined clinical cohorts. We analyze prices for four commonly provided inpatient procedures—hip replacement, knee replacement, cesarean section, and vaginal delivery—and outpatient lower limb MRIs. In defining our clinical cohorts, we follow closely the approach used in Cooper et al. (2015), with the exception that our data do not contain reliable DRG codes. We therefore identify hip and knee replacements (ICD 8151 and 8154), vaginal and cesarean deliveries (ICD9 7359 and 741), and lower limb MRI (CPT code 73721) using their respective clinical codes.

Second, we construct two samples, which attempt to measure the average basket of treatments an insurer might negotiate over. In one sample create a composite containing all of the cases in each of the five narrowly defined cohorts. While this sample most credibly controls for patient heterogeneity, one might also be concerned that this does not accurately represent the complete bundle of services over which hospitals and payers negotiate. In order to address this concern, we also construct a sample of all inpatient admissions in the data. In our main analyses, we control for differences in treatment intensity by including a fixed-effect for cohort in the composite sample and primary diagnosis in the overall inpatient sample.

For all of our samples, we limit to patients age 18-64. We exclude all cases where either the patient lived- or the facility was located outside of MA, and limit to facilities which match to the American Hospital Association (AHA) Annual Survey data. We exclude cases where prices are negative, and where prices are above or below the top or bottom percentile of the price distribution. We also exclude inpatient cases where the patient had multiple discharge dates or was admitted to multiple hospitals in order to avoid pricing idiosyncrasies that may be associated with transfers.

We also perform additional sample-specific restrictions to isolate a homogeneous set of treatments. For hip and knee replacements, we include only patients age 40-64 and we exclude all admissions where a crushing injury or tumor was recorded in any of the diagnosis fields. For vaginal deliveries and cesarean sections, we focus on cases where the patient was between 18 and 40 years old, and drop all cases that would be disqualified from inclusion in a hospital's cesarean section rate.[28] For lower limb MRIs, we focus only on outpatient cases where the MRI was the only procedure recorded for the patient at any facility that day. We also restrict to cases where there was a separate professional claim for the reading of the MRI in order to

[28]See Kritechevsky et al., 1999.

avoid any potential bundling of services that may confound our estimation of the hospital's negotiated price.

Price Measurement

For most of our analysis, we use the raw patient-level transaction price. However, in some figures, we present a risk-adjusted measure of the average price for a hospital-patient pair. To do this, we follow Cooper et al. (2018) and estimate prices as:

$$price_{ihpt} = \pi X_i + \gamma_{hp} + \delta_t + \varepsilon_{ihpt}$$

where X_i denotes the characteristics (age and sex) of individual i as well as a fixed effect for the clinical cohort to which it belongs, γ_{hp} are fixed effects for hospital-payer dyad hp, and δ_t are fixed effects for each month-year in the sample t. We then generate a price index of the form

$$p_{hp}^{INDEX} = \hat{\gamma}_{hp} + \hat{\pi}\bar{X} + \hat{\delta}_t\bar{t}$$

where the main estimates of interest are $\hat{\gamma}_{hp}$, which are the estimated hospital-payer fixed effects. The other terms scale the level of these fixed effects relative to the average mix of patients characteristics and the distribution of patients over time. $\hat{\pi}\bar{X}$ is the a vector containing the average contribution of each individual characteristic ($\hat{\pi}$) multiplied by the state-wide average prevalence of that characteristic. ($\bar{X}$). $\hat{\delta}_t\bar{t}$ adds in the average contribution of over-time variation in prices by multiplying the aggregate price shock of time t ($\hat{\delta}_t$) multiplied by the state-wide share of patients in each month-year t ($\bar{t}$).

A.2 Error in Estimating ASO Price Incentives

The purpose of this appendix is to argue that our estimation of ASO price incentives in Section 4 provides a potential under-estimate of the magnitudes of such effects. Several empirical facts motivate our approach

(a) ASO and PPO plans are correlated in the data (see Table A.6)

(b) While we observe multiple distinct contracts at a given hospital-insurer pair, these are often negotiated at the product level, rather than by funding source directly. While we observe contract segmentation imperfectly, this observation is informed by conversations with industry participants. We also attempt to document the nature of this segmentation in our discussion of Figure 2, Panel (c) in Section 4 of the text.

Given these observations, we assume the following data generating process. First, each observed contracted price is the aggregation of price incentives for the patients who choose that plan-hospital combination:

$$p_{i|fjhp} = \frac{\sum_{i \in fjhp} p_{ijhp}}{N_{jhp}}$$

where each individuals' negotiation incentives are given by

$$p_{ifjhp} = \theta_{hp} + Z_{ifj}$$

where Z_i is a vector of indicators for funding (f) and product type (j). The intuition behind this formulation is that both ASO and PPO provide price shocks that are driven by patient steering and financial incentives of payers, and that the negotiated price is in fact the average contribution of characteristics across the relevant patients.

We then carry out the following simulation exercise.

1. We use the vector of hospital-payer fixed effects as estimated in Column (6) of Table 3.[29] The actual values of these "base" prices is irrelevant since we will assume for the purpose of this exercise that they are orthogonal to the product and funding characteristics.

2. We assign 1,000 patients to each hospital-payer pair, over which we draw a distribution of HMO/ASO according to the following process.

$$HMO_i = 1\{\epsilon_i > 0\}$$

$$ASO_i = 1\{\eta_i > 0\}$$

   and

$$[\epsilon, \eta] \sim N\left([0,0], \begin{bmatrix} 1 & -0.8 \\ -0.8 & 1 \end{bmatrix}\right)$$

3. We assume an individual's price contribution

$$ln(Price_{ifjhp}) = log(\theta_{hp}) - 0.05HMO_i + 0.03ASO_i$$

   That is, HMO_i provides 5% of downward pricing pressure and ASO_i softens the payers' negotiating incentives by 3%.

4. We further aggregate these price contributions by product-contract j (defined as HMO vs. PPO) such that the observed price

$$ln(Price_{if|jhp}) = \frac{\sum_{i \in jhp} (log(\theta_{hp}) - 0.05HMO_i + 0.03ASO_i)}{N_{jhp}}$$

[29] We use MRI prices for this exercise because it is easier to observe the stable contract, as in Panel (c) of Figure 2. Because we have defined MRIs as narrowly as single CPT-code, each observation will have the same chargemaster (list) price. Our observed prices will therefore not reflect any heterogeneity in price that would result from a price that is set as a share of charges.

5. We estimate OLS price effects

$$ln(Price_{if|jhp}) = \theta_{hp} + \beta_{HMO}HMO_i + \beta_{ASO}ASO_i + \varepsilon_{ijhp}$$

Column (1) of Table A.7 presents the results of this exercise, which results in an overestimate of HMO price effects (-0.068) and an underestimate of ASO incentive effects (< 0.001). The intuition behind this problem is that averaging price at the contract (HMO) level, introduces a kind of non-classical measurement error by which within hospital-payer ASO price incentives are not associated with additional price variation. However, the correlation between ASO and HMO means that the contribution of ASO price incentives are "well explained" by the HMO indicator.

To solve this problem, we can regress price onto the ASO share by contract

$$ln(Price_{if|jhp}) = \theta_{hp} + \beta_{HMO}HMO_i + \beta_{ASO}\overline{ASO}_j + \varepsilon_{ijhp}$$

where

$$\overline{ASO}_j = \frac{\sum_{i \in jhp} ASO_i}{N_{jhp}}$$

The results of this regression are reported in Column (2) of Table A.7, which yields the correct parameter values. Here, product-type still defines the contract, however identification of ASO effects is driven by relative differentials in HMO/PPO prices for contracts with more or less ASO penetration. With a clean identification of contracts (as in Panel (c) of Figure 2), this method is easily extendable to a setting in which one does not know the precise rationale for segmentation of plans into contracts. To do this, we can simply calculate average HMO and ASO (and "other") shares by identified contract. In our simulation, this is identical to the method in Column (2) of Table A.7 because, in that exercise, we have assumed HMO is either 0% or 100% throughout the contract. We apply this method to the MRI data, where it is easy to identify stable contracts that typically differ based on product type. When we apply this correction, the ASO effect as originally reported in Table A.3 moves from 2.2% to 14.9% and the HMO effect falls from -2.1% to 2.5% (though it becomes insignificant). We therefore conclude that the estimates reported in Table A.3 likely provide an underestimate of the ASO effect.

A.3 Implications: The Value of an Insurance Plan

To assess how price variation translates into expected out of pocket costs, we use data from Truven MarketScan for 2010, and select a population of working age adults aged 24-64 (inclusive). Truven MarketScan is used by HHS to calibrate the ACA Marketplace risk adjustment, and provides similar distributions as the MEPS. We limit to those with 12 months of continuous enrollment, and take a 1 percent sample of those enrollees for computational ease. We drop a small number of people for whom at some point there was a service date with a negative net payment, giving us 216,983 individuals. We then sum up their inpatient and outpatient claims for the year.[30]

We do not examine prescription drug claims in this analysis, as our work has not assessed price variation in prescription drug claims.[31] Moreover, the impact of prescription drug prices to consumers is complex: for instance, many plans use tiered copays, rather than coinsurance. Our results should be interpreted as roughly characterizing an insurance plan with a separate medical and drug deductible.

The impact of negotiated prices on consumers will depend on the insurance plan design (as well as on the distribution of underlying health care claims). We examine the effect of negotiated prices using a high-deductible health plan: a plan with a deductible of $5,000, a coinsurance rate of 30%, and a maximum out-of-pocket (maxOOP) limit of $6,350. This is similar to a bronze plan on the ACA Marketplaces. The observed spending in Marketscan comes from a mix of insurers and providers, and we cannot distinguish among them. To simulate the effect of price variation, we multiply all the observed spending by a multiplier—that is, a multiplier of 0.5 to simulate what would happen if prices were 50% of the observed prices. We take the observed and the multiplied spending levels and translate them into 1) out-of-pocket (OOP) spending and 2) actuarial value for this population.

Before applying any price multiplier, the average OOP spending in this data is $1,900, and the average actuarial value of this plan is about 44%. If this data underestimates the right tail of the claims distribution—i.e. underestimates very high spenders—then the actuarial value will be understated, since the plan covers 100% of claims beyond the maxOOP. Figure A.1 plots the average OOP spending and actuarial value for this plan from multipliers ranging from 0.5 to 2. The average OOP spending in the plan ranges from $1,267 at prices 50% of observed to $2,641 at prices that were 200% of observed. This is equivalent of moving a tier in actuarial value: AV for the 50% prices is 0.59 while for the 200% prices is only 0.31

A.4 Proof of Result 1

Result 1 *For small enough response of insurance demand to negotiated prices (e.g.* $\frac{\partial D_{INS}}{\partial z_{INS}} = \frac{\partial D_{ASO}}{\partial z_{ASO}} = 0$*),* $z_{ASO} > z_{INS}$*.*

Proof: To see that $z_{ASO} > z_{INS}$ when $\frac{\partial D_{INS}}{\partial z_{INS}} = \frac{\partial D_{ASO}}{\partial z_{ASO}} = 0$, consider the first order conditions for choice of negotiation effort:

[30] We use the same approach as in Ericson and Sydnor (2017). Note that we do not use the Massachusetts APCD here. Our analysis of the enrollment files suggested that the APCD had an unreliable measure of the fraction of enrollees with zero claims. Unreliable number of zero claim enrollees poses a challenge to using the APCD to measure the population distribution of claims (for which zero claims are important). However, it is not a problem for our measure of prices (since they are conditional on a transaction occurring), or for other work looking at demand conditional on using services

[31] For more on price variation in prescription drug spending, see Starc and Swanson (2017).

$$c'(e_{INS}) = \alpha M D_{INS} \text{ and } c'(e_{ASO}) = 0.$$

Hence, $e_{INS} > e_{ASO} = 0$. Note that we have assumed that if $e_{INS} = e_{ASO} = 0$, then $z_{INS} = z_{ASO}$, so given that z_{INS} decreases in e_{INS}, we have $z_{ASO} > z_{INS}$.

Note that the payer has an incentive to set positive negotiation effort for the fully insured market, since it pays for the insured portion of medical spending. However, the payer does not have incentive to put forth negotiation effort in the ASO market, since it does not pay these prices. The payer only cares about the level of z_{ASO} insofar is it affects the level demand, but we have $\frac{\partial D_{ASO}}{\partial z_{ASO}} = 0$ by assumption.

A.5 Tables and Figures

Table A.1: Mean Price and Sample Size by Clinical Cohort

		Number of Observations				
	Mean Price	Total	BCBS	HPHC	Tufts	National Payers
Composite	11,790	74,446	32,833	16,491	12,842	4,100
Hip Replacement	22,046	5,764	2,761	1,151	788	411
Knee Replacement	20,955	8,205	4,008	1,661	1,057	404
Cesarean Section	9,654	10,810	5,312	2,439	1,327	770
Vaginal Delivery	6,147	13,142	5,778	2,171	1,333	1,016
Lower Limb MRI	823	36,525	14,974	9,069	8,337	1,499
All Inpatient	12,689	422,726	171,553	76,548	57,232	39,413

Notes: This table displays observation counts for our clinical cohorts across the three dominant local payers (BCBS, HPHC, and Tufts) as well as the three national payers (UnitedHealth Group, Aetna, and Cigna).

Table A.2: Patient Characteristics and Hospital Choice Across Payers in Boston HRR, All Inpatient, 2009-2011

	BCBS	Harvard-Pilgrim	Tufts	National Payers	Other
Age	44.17	44.55	45.08*	43.10	43.65
	(12.52)	(12.56)	(12.55)	(12.60)	(13.26)
County Median Income	68,724	68,121	68,983	68,740	65,888
	(10,339)	(11,196)	(10,284)	(10,420)	(11,326)
Distance Traveled (Miles)	10.70	10.17	10.01	10.10	9.06
	(12.17)	(11.58)	(11.00)	(11.33)	(11.88)
Distance to Closest (Miles)	3.24	3.20	3.18	3.18	2.81
	(3.31)	(3.43)	(3.14)	(3.16)	(3.40)
Admitted to Closest Hospital	0.35	0.35	0.36	0.38	0.45*
	(0.48)	(0.48)	(0.48)	(0.48)	(0.50)
Distance to MGH (Miles	30.20	27.58	28.43	29.76	29.01
	(24.01)	(23.99)	(22.45)	(22.00)	(24.99)
Observations	135,184	67,327	47,075	30,209	48,086

Notes: This table presents each payers mean (first-row) and standard-deviation (second-row) for each characteristic, estimated over the sample of inpatient admissions in the Boston HRR for 2009-2011. Stars indicate significance levels from a t-test against the overall mean: * (p<0.10), ** (p<0.05), *** (p<0.01), and standard errors are clustered at the hospital-payer pair. County level median income data come from the Census Bureau's Small Area Income and Poverty Estimates (SAIPE). Distances are measured from the centroid of each patient's zip code to the hospital's longitude and latitute using a geodetic distance measure. "National Payers" represents the combined average of UnitedHealth Group, Aetna, and Cigna. "Other" contains all other insurers in the data: Fallon, Health New England, Boston Medical Center HealthNet, Celticare, ConnectiCare, Health Plans Inc., Neighborhood Health Plan, NetworkHealth, and Wellpoint.

Table A.3: All Inpatient Prices, All Payers

	(1)	(2)	(3)	(4) ln(Price)	(5)	(6)	(7)
HMO	-0.056***	-0.050**	-0.058***	-0.052***	-0.059***	-0.021*	-0.034***
	(0.011)	(0.018)	(0.014)	(0.009)	(0.014)	(0.009)	(0.008)
ASO	0.023**	0.022*	0.004	0.018*	0.010	0.033***	0.039***
	(0.007)	(0.010)	(0.011)	(0.008)	(0.010)	(0.009)	(0.006)
Harvard Pilgrim	-0.067**	0.038	0.143	-0.298***	-0.230***	0.029	-0.094***
	(0.025)	(0.103)	(0.077)	(0.037)	(0.036)	(0.041)	(0.028)
Tufts	-0.142***	-0.402***	-0.445***	-0.084*	0.083*	0.100**	-0.117***
	(0.025)	(0.110)	(0.108)	(0.035)	(0.039)	(0.036)	(0.027)
Aetna/UHG/Cigna	-0.140**	-0.258**	-0.255***	-0.253***	-0.159**	0.416***	-0.200***
	(0.045)	(0.079)	(0.053)	(0.057)	(0.055)	(0.077)	(0.039)
Hospital FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Payer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clinical Cohort	Composite	Hip Replacement	Knee Replacement	Cesarean Section	Vaginal Delivery	Lower Limb MRI	All Inpatient
r2	0.933	0.384	0.408	0.499	0.461	0.513	0.459
Observations	74,446	5,764	8,205	10,810	13,142	36,525	422,726

Notes: * ($p<0.05$), ** ($p<0.01$), *** ($p<0.001$). Standard errors clustered at the hospital-insurer pair in parentheses. The dependent variable is the log of individual-level transaction price. Insurer coefficients are estimated relative to BCBS. The omitted category for funding type is fully insured. The omitted category for product type is PPO. All regressions contain controls for patient patient sex and five-year age band as well as monthly fixed-effects. We also estimate price-level coefficients for all other payers in the data, which include: Fallon, Health New England, Boston Medical Center HealthNet, Celticare, ConnectiCare, Health Plans Inc., Neighborhood Health Plan, NetworkHealth, and Wellpoint. However, we omit these estimates here for the sake of simplicity.

Table A.4: All Inpatient Prices, All Payers, with Zip Code Fixed-Effects

	(1)	(2)	(3)	(4) ln(Price)	(5)	(6)	(7)
HMO	-0.056***	-0.048*	-0.057***	-0.053***	-0.062***	-0.021*	-0.035***
	(0.010)	(0.018)	(0.013)	(0.009)	(0.014)	(0.009)	(0.008)
ASO	0.023**	0.021*	0.002	0.020*	0.010	0.032***	0.039***
	(0.007)	(0.011)	(0.011)	(0.009)	(0.011)	(0.008)	(0.006)
Harvard Pilgrim	-0.067**	0.035	0.145	-0.299***	-0.234***	0.030	-0.093***
	(0.025)	(0.101)	(0.074)	(0.037)	(0.035)	(0.040)	(0.027)
Tufts	-0.141***	-0.405***	-0.447***	-0.085*	0.083*	0.097**	-0.117***
	(0.025)	(0.106)	(0.107)	(0.035)	(0.039)	(0.035)	(0.027)
Aetna/UHG/Cigna	-0.139**	-0.266***	-0.255***	-0.252***	-0.161**	0.421***	-0.202***
	(0.044)	(0.072)	(0.052)	(0.058)	(0.054)	(0.077)	(0.039)
Hospital FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Payer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clinical Cohort	Composite	Hip Replacement	Knee Replacement	Cesarean Section	Vaginal Delivery	Lower Limb MRI	All Inpatient
R-Squared	0.934	0.436	0.450	0.520	0.483	0.527	0.463
Observations	74,446	5,764	8,205	10,810	13,142	36,525	422,726

Notes: * ($p<0.05$), ** ($p<0.01$), *** ($p<0.001$). Standard errors clustered at the hospital-insurer pair in parentheses. The dependent variable is the log of individual-level transaction price. Insurer coefficients are estimated relative to BCBS. The omitted category for funding type is fully insured. The omitted category for product type is PPO. All regressions contain controls for patient patient sex and five-year age band as well as monthly fixed-effects. We also estimate price-level coefficients for all other payers in the data, which include: Fallon, Health New England, Boston Medical Center HealthNet, Celticare, ConnectiCare, Health Plans Inc., Neighborhood Health Plan, NetworkHealth, and Wellpoint. However, we omit these estimates here for the sake of simplicity.

Table A.5: Between Insurer Price Variation for Composite Price Measures Under Multiple Weighting Schemes

	(1)	(2)	(3)	(4)	(5)	(6)
	ln(Price)					
HMO	-0.056***	-0.051***	-0.041***	-0.034***	-0.033***	-0.026***
	(0.011)	(0.010)	(0.009)	(0.008)	(0.009)	(0.007)
ASO	0.023**	0.018*	0.031***	0.039***	0.043***	0.055***
	(0.007)	(0.007)	(0.008)	(0.006)	(0.007)	(0.006)
Harvard Pilgrim	-0.067**	-0.064*	-0.060*	-0.094***	-0.079**	-0.044
	(0.025)	(0.025)	(0.028)	(0.028)	(0.029)	(0.026)
Tufts	-0.142***	-0.149***	-0.015	-0.117***	-0.100***	-0.102***
	(0.025)	(0.026)	(0.025)	(0.027)	(0.028)	(0.026)
Aetna/UHG/Cigna	-0.140**	-0.143**	0.012	-0.200***	-0.196***	-0.173***
	(0.045)	(0.054)	(0.055)	(0.039)	(0.037)	(0.037)
Hospital FE	Yes	Yes	Yes	Yes	Yes	Yes
Payer FE	Yes	Yes	Yes	Yes	Yes	Yes
Weights	Spending Share	Average Basket	No Weights	Spending Share	Average Basket	No Weights
Sample	Composite	Composite	Composite	All Inpatient	All Inpatient	All Inpatient
R-Squared	0.921	0.920	0.948	0.457	0.449	0.403
Observations	74,446	74,446	74,446	422,726	422,726	422,726

Notes: * ($p<0.05$), ** ($p<0.01$), *** ($p<0.001$). Standard errors clustered at the hospital-payer pair in parentheses. The dependent variable is the log of individual-level transaction price. Insurer coefficients are estimated relative to BCBS. The omitted category for funding type is fully insured. The omitted category for product type is PPO. All regressions contain controls for patient patient sex and five-year age band as well as monthly fixed-effects. We also estimate price-level coefficients for all other payers in the data, which include: Fallon, Health New England, Boston Medical Center HealthNet, Celticare, ConnectiCare, Health Plans Inc., Neighborhood Health Plan, NetworkHealth, and Wellpoint. However, we omit these estimates here for the sake of simplicity. "Spending Share" weights weight each observation by the fraction of spending (across payers) each clinical cohort or diagnosis code represents. "Average Basket" weights balance the observation shares by clinical cohort across payers using inverse propensity scores; these weights are then multiplied by the "Spending Share" weights.

Table A.6: Patient Characteristics and Hospital Choice Across Funding Type in Boston HRR, All Inpatient, 2009-2011

	(1) ASO	(2) Fully Insured	(3) Other
Age	44.79***	43.72***	43.95
	(12.50)	(12.61)	(13.27)
County Median Income	68,809***	68,144	66,591**
	(10,566)	(10,569)	(11,483)
Distance Traveled (Miles)	10.23	10.42**	9.33*
	(11.45)	(12.09)	(11.72)
Distance to Closest (Miles)	3.15	3.25***	2.89**
	(3.21)	(3.41)	(3.29)
Admitted to Closest Hospital	0.35***	0.37	0.42
	(0.48)	(0.48)	(0.49)
Distance to MGH (Miles)	28.62	30.07***	28.10
	(23.21)	(24.22)	(23.97)
Share PPO	0.35***	0.10***	0.14***
	(0.48)	(0.30)	(0.35)
Share HMO	0.31***	0.81***	0.14***
	(0.46)	(0.40)	(0.34)
Share Other	0.34***	0.10***	0.72***
	(0.47)	(0.30)	(0.45)
Observations	139,128	145,795	42,958

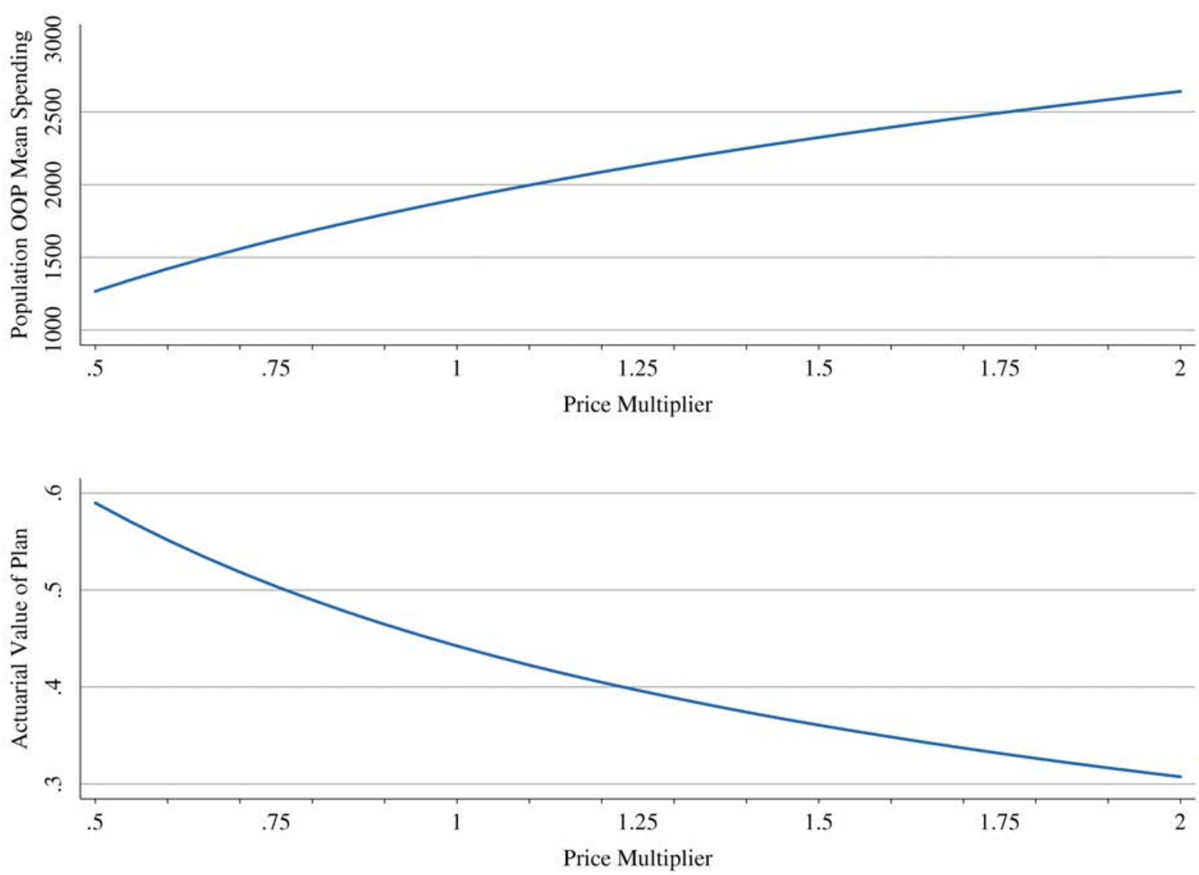
Notes: This table presents each payers mean (first-row) and standard-deviation (second-row) for each characteristic, estimated over the sample of inpatient admissions in the Boston HRR for 2009-2011. Stars indicate significance levels from a t-test against the overall mean: * (p<0.10), ** (p<0.05), *** (p<0.01), and standard errors are clustered at the hospital-payer pair. County level median income data come from the Census Bureau's Small Area Income and Poverty Estimates (SAIPE). Distances are measured from the centroid of each patient's zip code to the hospital's longitude and latitute using a geodetic distance measure. Shares of product characteristics do not always sum to 1 because of rounding.

Table A.7: ASO and HMO Effects Under Assumed DGP

	(1)	(2)
Dependent Variable:	$ln(Price_{if\|jhp})$	
HMO_i	-0.068***	-0.050***
	(0.000)	(0.000)
ASO_i	0.000***	
	(0.000)	
$\overline{ASO}_j$		0.030***
		(0.000)
R-Squared	1.000	1.000
Observations	36,525	36,525

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors clustered at the hospital-payer pair parentheses. Table presents the results of the simulation described in Appendix A.2.

Figure A.1: Consequences of Price Variation for Enrollee Out-of-Pocket Spending and Plan Actuarial Value



Notes: Results of simulations using MarketScan Data, as described in text.