## Six Stylized Facts from Ten Years of Contract Data

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#### Abstract

This paper describes new stylized facts about business-to-business contracts based on a novel panel dataset describing one decade of hospital-insurer contracts in West Virginia. Typically, hospital-insurer and other business-to-business agreements are closely guarded trade secrets. The state made hospital-insurer contracts public records, allowing me to provide stylized facts and identify specific firms. The largest insurer, Highmark BCBS, would typically form three- and five-year agreements with relatively low prices. In contrast, smaller insurers — which in this context included Cigna, Aetna, and United — generally generally formed auto-renew contracts, which only committed to one year but which typically renewed for a a decade or longer, generally accompanied by rapid price growth. The work points to open questions around the drivers of contract dynamics. By documenting this unique dataset and stark dynamic implications, this research contributes to a larger understanding of vertical market dynamics and helps set the stage for future work.

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## 1 Introduction

Hospital-insurer contracts in the United States are important both independently and as examples of business-to-business contracts. More than \$400 billion is spent annually under contracts negotiated between hospitals and private insurers, making the terms of these agreements important. The setting also provides unusually good data on the trillions of dollars spent under business-to-business agreements. Firms generally protect the confidentiality of their agreements, even going to court to prevent disclosure.

There is limited data business-to-business contracts. The confidential nature of these contracts has generally limited empirical analysis to data on outcomes such as payments. American healthcare has offered unusually good disclosures of contract outcomes: data on claims by state or by insurer, and recent reports on negotiated prices by hospital and by insurer. However, these sources have generally been short-term and unable to speak to dynamics like contract expiration, age, and timing.

This paper leverages a novel panel dataset on hospital–insurer contracts to enrich our understanding of vertical market contract dynamics. West Virginia made hospital–insurer contracts public records as a byproduct of a system regulating list prices. Although the contracts themselves were destroyed when the regulation ended in 2016, the state retained scans of hospital contract reports beginning in 2005 and ending in 2015.

The data includes valuable information on payment rates, contract formation, and scale. The reports are public records, enabling any researcher to identify individual hospitals and insurers. This work leverages the dataset to shed light on contract dynamics that were previously secret.

I document several stylized facts based on the contract data. In particular:

- 1) Correlation of payments and size. West Virginia's largest insurer, Highmark BCBS, generally paid less than other insurers.
- 2) Multiyear fixed lengths. Highmark BCBS generally formed contracts that would expire

after three or five years.

- 3) Contract length variation. Highmark BCBS formed three-year contracts with some hospitals and five-year contracts with other hospitals, and the contract lengths sometimes shifted in either direction.
- 4) Auto-renew agreements. For West Virginia's other, smaller, insurers, auto-renew contracts were a pervasive feature of contracting.
- 5) Long-lived renewal. Auto-renew contracts would consistently renew in more than 90% of years, generating realized durations of a decade or longer for even sophisticated insurers like Aetna, Cigna, and United.
- 6) *Relative price growth*. The smaller insurers' auto-renew contracts generally calculated prices as a fixed percentage of fast-growing hospital list prices.

Some of these stylized facts are consistent with previous work: it is known that larger insurers generally pay less, smaller insurers are more likely to pay based on list prices, and smaller contracts are more likely to be auto-renew. Yet, this data reveals patterns that are not explained by any mechanisms discussed in the empirical literature. It is unsurprising that some contracts are multiyear, but what drives variation in contract length, and who prefers longer or shorter agreements? It is known that smaller insurers accept auto-renew contracts, but what drives the long realized lengths, and when are these contracts revised? These features are likely to be found in other markets, suggesting important exciting avenues for future work.

The West Virginia setting represents an unusual opportunity. In many settings, it is rare to even see data on the outcomes of contracting (Yürükoğlu, 2022), much less data on a whole market. Two notable exceptions are Sorensen (2003)'s analysis of four years of contract data from 32 hospitals after the introduction of hospital-insurer negotiations in Connecticut in 1994 and Hermo (2024) work on multiunit collective bargaining using administrative data from Argentina. In healthcare, researchers increasingly use insurer claims data to infer contract outcomes (Gowrisankaran et al., 2015, Cooper et al., 2019, Weber et al., 2019, Craig et al., 2021, Ho and Lee, 2017, 2019, Liebman, 2022, Ghili et al., 2023, Prager and Tilipman, 2022, Liu, 2021, Whaley et al., 2022). In recent years, hospitals and insurers have been subject to price disclosure rules that should enable inference of contract structure. Other examples of data on negotiated outcomes include hospital supply purchases (Grennan and Swanson, 2020), NFL broadcasting agreements (Blochowicz, 2023), and accounting data from illicit drug suppliers (Leong et al., 2022). Some work focused on the analysis of which agreements exist (Crawford et al., 2018).

West Virginia's data emerged from a list price regulation system. The United States has a history of hospital price regulations that, with the exception of Maryland and West Virginia, ended by 1997 (McDonough, 1997, Murray and Berenson, 2015). Maryland has a price-setting system, and much of the literature on rate review centers on changes to Maryland's system in 2014 (Pauly and Town, 2012, Cromwell, 1987, Atkinson, 2009, Diebel and Diebel, 2017, Sharfstein et al., 2018a,b, Roberts et al., 2018a,b,c, Clemens and Ippolito, 2019). West Virginia had a price-constraining system that is often either omitted or misunderstood, which Sommers et al. (2012) attributes to the state's "later adoption." The state's system was historically unusual, and provides public records on vertical market contract data that can be replicated in future healthcare price disclosures.

I document that smaller insurers' agreements were linked to fast-growing hospital list prices, which is a topic of regulatory interest (Brown, 2014, Liu et al., 2021, Chernew et al., 2020, Berenson and Murray, 2022). The contract data emerged out of a system capping list price increases. Nevertheless, West Virginia list prices grew roughly three percentage points faster than reported costs. Work on the effects of West Virginia's system is limited, but Atkinson (2009) finds that the state's spending per admission increased three-tenths of a percentage point more slowly per year than the national average in the period running through 2007. Murray and Berenson (2015) argue that in the later era that I study, the state's system failed to constrain per-capita hospital spending or charge-to-cost ratios.

I find larger firms have more favorable payment rates (Sorensen, 2003), which is consistent with work studying the associations of market concentration (Cooper et al., 2019, Whaley et al., 2022); franchising contracts are consistently multiyear (Brickley et al., 2006, Gorovaia and Windsperger, 2018, Perdreau and Fréchet, 2022); and smaller insurers are more likely to pay share of charges contracts (Abbey, 2012, Cooper et al., 2019, Bogart, 2020, Reinhardt, 2006, Brown, 2014), all of which are consistent with prior work. There is some academic work on auto-renew contracts with "evergreen" clauses (Dutta, 2021). Trade publications suggest these contracts are common for smaller firms and can be long-lived in practice (Abbey, 2012, Prives, 2013). These contracts link to a far broader literature on contracts; summarizing this literature is too broad a task for this work.

The remainder of this paper is as follows. The rest of Section 1 discusses key related work. Section 2 describes the West Virginia setting, the public record contract data I leverage, and key variable definitions. Section 3 presents stylized facts based on the West Virginia contract data. Section 4 concludes.

### 2 Setting and Definitions

West Virginia made hospital–insurer contracts public records as a byproduct of "corridor" system regulating hospital list prices.

In the United States, health care providers and insurers (also called managed care organizations) engage in bilateral bargaining to determine payment rates. A provider like a hospital agrees to accept payments below the list prices that they would charge to patients without an agreement. In return for the more favorable payment rate, the insurer commits to steer its consumers toward the provider.

Insurers leverage their network of agreements when selling insurance plans to consumers. The insurers offer access to their negotiated discounts with providers and favorable costsharing in exchange for premiums. Insurers with more hospital agreements are able to sell more insurance for a given premium, and insurers with more favorable hospital agreements are able to charge lower premiums. Insurers also provide these discounts to self-insuring employers in a self-funded market (Craig et al., 2021).

Hospital-insurer contracts generally express prices as fixed multiples of quantities that I call benchmarks (Cooper et al., 2019). It would be impractical to negotiate a separate price for each of the thousands of services a hospital offers (Brill, 2013). Instead, the firms generally split care into aggregate categories (in West Virginia, most commonly outpatient and inpatient care) and negotiate prices as fixed multiples of benchmark prices that already calculate payments for each instance of care. The most common benchmark prices in contracts are *share of charges* prices that are a fixed discount off list prices and *prospective* prices that are fixed payments based on the diagnosis code Medicare would use in payments. There are also outlier payments for expensive care and some older *per diem* contracts (Cooper et al., 2019).

Commercially insured patients are a key component of hospital care and profits. In 2019, 36% of hospital expenditures came through private health insurance (CMS, 2022). The next-largest segment was Medicare (27%). Medicare makes take-it-or-leave-it offers based on Diagnosis-Related Group (DRG) codes that attempt to track the costs that an efficient hospital would incur to provide care. Commercial insurers generally pay far more than Medicare (Whaley et al., 2022) and far less than list prices (Brown, 2014). A small share of care is received by patients that do not have access to a discount at the hospital they visit. The list prices that are billed to patients without such a discount contract are referred to as *charges*.

From 1993 to 2016, West Virginia had a "corridor" regulation system on payments from private insurers to hospitals. Starting in 2000, small rural hospitals designated as Critical Access Hospitals (CAHs) were exempted from this system, and so not incorporated in this paper's analysis of data generated by the system.<sup>1</sup> I provide a quick overview of some key

 $<sup>^1{\</sup>rm CAHs}$  made up as much as 40% of West Virginia hospitals but only a small fraction of care (Appendix Figure 13).

characteristics of the system. Murray and Berenson (2015) provide further background.

The ceiling of the corridor system was a hospital-specific cap on list price increases. Hospitals with lower list prices and lower costs could obtain larger approved list price increases. Excessive list prices that could not be justified by a hospital's patient mix resulting in reductions of future approved list prices. Until 2015, the system included an abeyance process for hospitals that exceeded their approved increase. The list price ceiling was viewed by advocates as constraining hospital payments (Eyre, 2016) but by anonymous participants as having a limited effect (Murray and Berenson, 2015).

The floor of West Virginia's corridor system led to the dataset that I use. The state required that all private insurer contracts pay more than the hospital's average costs. The profitability floor was essentially nonbinding: private insurers consistently paid far more than hospital average costs. However, the state required its Health Care Authority (HCA) to approve all regulated contracts before the contract could be used (Murray and Berenson, 2015). The HCA made those contracts public records. The data that I analyze in this work comes from summary reports the hospitals sent to the regulator.

The West Virginia corridor system made the state unrepresentative along a few dimensions. The list price capping system was associated with lower list prices and incentivized a shift to outpatient costs (Murray and Berenson, 2015). It is not clear the West Virginia system reduced hospital costs (Atkinson, 2009). I find that list price contracts were more common in West Virginia than Weber et al. (2019) find in Colorado. The public record nature of contracting was historically unusual. In most vertical markets, contracts are explicit or implicit trade secrets (Reinhardt, 2006, Gudiksen et al., 2019). In West Virginia, market participants actively looked at competitors' payment rates (Murray and Berenson, 2015). More recent hospital and insurer price disclosure requirements make West Virginia a useful proof of concept for modern American healthcare markets and a rare chance to see vertical market contracts over time.

When the state's system ended in 2016, the state destroyed the actual contracts. As

a result, I see summary statistics from annual hospital reports rather than the contracts themselves.

#### 2.1 The West Virginia Contract Data

This paper leverages a novel panel dataset on hospital—insurer contracts. The data includes ten years of annual payment rates as a function of list prices and five years of more detailed data on larger contracts.



Figure 1: Discount Contract List scan for Charleston Surgical Hospital in fiscal year 2016. The top panel of contracts lists smaller contracts that do not fall in any of a set of special exceptions. I omit white space and a handwritten note reading, "New contract is Highmark, not Mt State," which reflects the 2011 renaming of Mountain State Blue Cross Blue Shield to Highmark Blue Cross Blue Shield West Virginia to reflect an ongoing affiliation with Pittsburgh-based Highmark.

The core contract data consists Discount Contract Lists (DCLs): annual hospital reports

on the projected discount off list prices by contract. Figure 1 gives one example. The calculations were verified by state analysts. These reports are available for 2006 through 2015. The reports exclude Medicare Advantage contracts. Medicare Advantage is a large and ostensibly commercial insurance product that is funded by Medicare and often included with traditional Medicare (CMS, 2022).

The top rows of a DCL calculate a cost-to-charge ratio and utilization threshold. These rows report the budgeted total gross patient revenues (incurred list prices, also known as charges) and the budgeted operating expenses across all payors (including government programs) to yield a cost-to-charge ratio; the budgeted (next fiscal year) or projected (year to date plus projections for remaining fiscal year) nongovernmental utilization (inpatient discharges and outpatient visits) including self-pay patients; and a volume threshold of 5% of the count of nongovernmental utilization. The hospitals had to report more detailed information on contracts that exceeded 5% utilization.<sup>2</sup> On average, 75% of reported nongovernmental utilization floor on average corresponded to 6.7% of a given hospital's reported usage.

The unusual information in the DCLs are two panels of annual discount rates by contract. Hospitals reported each commercial insurer's projected percentage discount of list prices based on the current contracts and previous year's claims. For example, if an insurer agreed to pay 80% of a hospital's list price, the associated contract would have a reported discount of 20.00%. If an insurer agreed to pay 150% of Medicare payments and Medicare would pay 57% of list prices for the hospital's patients, then the reported discount would be 14.50%.

The DCLs split contracts into two panels. The top panel of discounts corresponds to standard contracts with small payors. These smaller contracts would be aggregated in more detailed supplementary reports. The bottom panel of discounts correspond to contracts that either had projected utilization above the volume threshold or which fell into certain rare exceptions. Hospitals reported more detailed information for contracts in the bottom panel

<sup>&</sup>lt;sup>2</sup>Definitions are adapted from HCA (2004) and correspondence with regulators.

#### in separate scans.

Summary Infor	mation of Discount Contracts							
Total - FY 2016	6 Budget							
Hospital Name	Charleston Surgical Hospital							
Fiscal Year Ending	12/31/2016							
Submission Date	11/2/2015							
outinission bate	11/2/2013							
1	Name of Purchaser or Third Party Payor	Total	=	Combined Contracts	+	Mt State-PPO	Mt State-Indemnity	Aetna
2	Date of Contract					8/1/2015	8/1/2015	11/1/1994
3	Date Contract Expires					12/31/2018	12/31/2018	Auto Renewal
4	Projected Inpatient Discharges	92	_	16		50	2	17
5	Projected Gross Inpatient Revenue	2 878 926		417 403		1 627 278	65 091	567 464
6	Inpatient Discount Percent	31 54%		12 00%		43 38%	43 38%	18 00%
7	Projected Amount of Inpatient Discount	908 049		50 088		705 865	28 235	102 144
8	Projected Net Inpatient Revenue	1 970 877		367 315		/ 921 413	/ 36 857	/ 465 320
9	Projected Inpatient Cost	1 079 592		156 525		-610 226	24 409	L 212 798
10	Projected Inpatient Charge per Discharge					32 545 55	32 545 55	33 380 24
11	Projected Inpatient Cost per Discharge	and a restor suprover the second second second second second		ne consequent consequences as processions of		12 204 52	12 204 52	12 517 53
12	Projected Cost to Charge Ratio	37 50%		A search and a second second		37 50%	37 50%	37 50%
pages and y second even a sec								
13	Projected Outpatient Visits	3 985		619		2 594	136	388
14	Projected Gross Outpatient Revenue	12 312 629		1 276 012		8 755 454	459 037	1 162 818
15	Outpatient Discount Percent	34 27%		12 00%		41 58%	38 45%	15 00%
16	Projected Amount of Outpatient Discount	4 219 778		153 121		3 640 518	176 500	174 423
17	Projected Net Outpatient Revenue	8 092 852		1 122 890		(5 114 936	282 537	988 395
18	Projected Outpatient Cost	- 4617213		478 502		3 283 279	· 172 138	- 436 055
19	Projected Outpatient Charge Per Visit	Sand The second se				3 375 27	3 375 27	2 996 95
20	Projected Outpatient Cost Per Visit	a section and a section of the secti				1 265 72	1 265 72	1 123 85
21	Projected Cost to Charge Ratio	37 50%		K. Say an at some state databases of the second se Second second sec		37 50%	37 50%	37 50%
22	Uncompensated Care Percent of Gross Patient Revenue							
23	Will Contract(s) Provide a Quantifiable Economic Benefit to the Hospital? Circle			Yes		Yes	Yes	Yes
24	Is the Discount Amount Below Actual Cost of Service? Circle			No		No	No	No
25	Will Cost Be Shifted to Any Other Purchaser of Third Party Payor as a Result of this Contract? Circle			No		Να	No	Νο
26	Date contract submitted to HCA			and a subsection of the state of the state of the subsection of th		7/8/2015	7/8/2015	10/31/2014
27	the Authority? (If yes please submit revised contracts )			No		No	No	No
	Cilcie	have a more as a manager of a		NU.		NO	NO NO	110

NOTE This page should include only the total combined and 3 (three) separate contract columns Use this form in its current version only Any modifications will be returned



Starting in 2010, the retained scans also include Discount Contract (DC) forms: detailed information for contracts reported in the lower panel of the DCLs. Figure 2 presents the first page of Charleston Surgical Hospital's DC report for fiscal year 2016. The "Total" column summarizes all third-party contracts. The "Combined Contracts" column combines all contracts from the top panel of the DCL. For the contracts from the bottom panel of the DCL, the later scans include the date the HCA accepted the contract, contract expiration (or renewable) date, and sometimes contract submission date.<sup>3</sup> The DC forms also report measures of scale: projected utilization, gross revenue (charges), discount percent (as a percentage of charges), discount amount (the difference between charges and real payments),

 $<sup>^{3}</sup>$ In this paper, I use contract approval date as a measure of contract start date because approval was generally quick, while contract submission date is sometimes used to refer to a recent resubmission of an extant contract.

net revenue (real payments), cost, charge per discharge, and cost per discharge separately for inpatient and outpatient care. The DC scans also typically include the fiscal year end date and the report's submission date.

I leverage implied totals across columns and ratios across rows to verify and clean the data. For an example of a check across columns, the "Total" revenue must be the sum of revenue across third-party contracts. For two examples of checks across rows, the projected inpatient discount must be both the difference between gross (list price) and net (real) revenue and the inpatient discount rate multiplied by gross revenue. After correction of likely typos identified through this process, I am left with only 11 (of 259) hospital-year pairs for which I cannot fully verify the discount data.

#### 2.2 Definitions and Other Data Sources

I often refer to six relatively large "modeled" insurers: the largest insurer, Highmark BCBS; a regional insurer, HPUOV; and the four largest for-profit firms, Aetna, Carelink, Cigna, and UnitedHealth. I refer to these insurers as "modeled" because they are included in model estimation in Dorn (2025). Carelink was a regional subsidiary of Coventry during most of the period I study. Aetna acquired Coventry at the end of 2014, but many hospitals continued to report separate Carelink contracts after 2014. I group the other, smaller, insurers into a category of "other" insurers.

I rely on substantial manual data cleaning to standardize insurer names and identify hospital systems. Hospitals reported payors in different ways. For example, Charleston Surgical Hospital reported separate contracts with Highmark BCBS for "Mt State-PPO" and "Mt State-Indemnity" (Figure 1), while Pleasant Valley Hospital reported a single contract with "BCBS." I refer to a name as a "payor" and aggregate these payors into insurers (which I sometimes call "MCOs") by manual cleaning. To align with Dorn (2025)'s analysis of networks, I include First Health contracts as HPUOV contracts based on HPUOV's description of First Health as a "strategic partner" (Wayback Machine, 2021). I refer to hospitals by a single name in this text, even though some hospitals were renamed during their history. I aggregate hospitals into hospital bargaining systems by year based on contract report availability and qualitative research.

I mainly describe contract expiration starting in fiscal year 2011, when the DC forms become available. I aggregate the data by fiscal year, so this generally corresponds to calendar year 2010, when detailed scans begin being available. This measure loses the first detailed report for Ohio Valley Medical Center. I differentiate between "fixed-length" contracts with a reported expiration date and "auto-renew" contracts that explicitly or implicitly were auto-renew. The auto-renew category includes some contracts that had language indicating the contract would remain in place until a party fulfilled some nonstandard termination requirement (Skeen, 2021).

Most contract statistics presented here include only contracts starting in fiscal year 2011, which enable data cleaning based on the detailed contract scans. Figure 4, Figure 8, Figure 9, Figure 10, Table 1, Table 12, Table 9, and Table 11 include earlier contract data as well. In many statistics in this paper, I present payment shares. These payment shares are estimated using DC projected revenue, splitting revenue evenly among combined contracts. This calculation slightly underrates the size of medium-sized insurers, because I do not differentiate between spending among contracts below the 5% utilization threshold. The statistics I report here do not account for inflation.

I infer contract benchmarks based on the contract data. I infer that a payor with the same reported discount of list prices (or a difference of 0.01% after rounding) in consecutive hospital reports was a share of charges (list-price-benchmarked) contract that paid as a fixed discount of list prices. For the first observation of a hospital–payor pair, I infer that a round-number discount followed by a change of payor or a new share of charges contract was the final year of an expiring share of charges contract. I infer all other contracts were prospective and used Medicare as the benchmark.<sup>4</sup>

 $<sup>{}^{4}</sup>I$  discuss some limitations of this calculation in Dorn (2025).

The contract lengths summarized here reflect only moderate cleaning. Contract formation and expiration dates are generally taken from the contract reports where available. The reported dates can shift between annual reports, generating the potential for superfluous contract counts. For example, a hospital that revises their payment rate with an insurer could report new discounts but the same formation date, which would result in one reported contract length; or could incorrectly report a different contract start date in one year, which would result in two reported contract lengths. Auto-renew share of charges renewal decisions are inferred from changes in contract terms, and so are more reliable. In Dorn (2025), I model contract formation based on hand-collected start and end dates that allow me to infer pre-2010 contract changes. I refer to the contracts used in estimation there due to available reliable start and end dates as "Estimation Bargains." A cleaned version of the West Virginia contract data is available at https://jacobdorn.info/ files/ContractData.zip.

The contract reports only identify hospital list prices per case beginning in 2010. To identify earlier list prices in Tables 12 and 11, I leverage scans of annual rate review decisions. The state's annual decisions on each hospital's list price ceiling included a report of projected list prices per inpatient discharge or outpatient discharge. I use the Tesseract OCR engine in R to obtain a panel of projected list prices. Some reports are missing, so I infer missing values from a regression of log list prices per case on fiscal year by hospital.

Table 1: Count statistics for all hospital–insurer years (All Contracts), hospital-insurer-years with modeled insurers (Modeled Contracts), and hospital-insure-years used in bargaining estimation (Estimation Bargains).

Data	Hospitals	Hosp. Systems	MCOs	System-MCO Pairs	System-MCO Years	Bargain Count
All Contracts	38	33	168	613	5108	
Modeled Contracts	35	30	6	159	1482	
Estimation Bargains	32	27	6	53	289	63

I present some contract count statistics in Table 1. There are 5,108 hospital systeminsurer-year tuples after cleaning, including an estimated 168 insurers. Only 5.7% of the insurers are modeled,<sup>5</sup> but those insurers represent 29% of hospital system-insurer-year observations, and an estimated 77% of net revenue in fiscal years 2011 through 2016 data. The modeled contracts analyzed in Dorn (2025) also drops three hospitals: CAMC Teays Valley (which was in the process of integrating with Charleston Area Medical Center, which I abbreviate to CAMC, during the era I study), Saint Joseph's Hospital of Parkersburg (which closed in 2014 before the start of the inpatient data used in Dorn (2025)), and Saint Luke's Hospital (which closed in 2007).

I present further contract descriptive statistics in Appendix Tables 5, 6, and 7. Appendix Table 5 presents summary statistics on the reported fractions of list prices paid. The average contract paid around 88% of list prices for inpatient care and around 89% for outpatient care, and the distribution was right-tailed. Modeled insurers, as I find later, generally obtained more favorable discounts. As Appendix Table 6 shows, contract date information is sporadic but more available for the modeled (larger) insurers. Appendix Table 7 presents data on reported and estimated scale beginning in fiscal year 2011. I estimate the average contract involved \$1.4 million in inpatient payments and \$2.7 million in outpatient payments, but there was significant heterogeneity.

## 3 Six Stylized Facts About Hospital–Insurer Contracts

In this section, I present stylized facts from the contract data.

#### 3.1 The Largest Insurer Generally Paid Lower Prices

I find that the largest insurer generally paid the lowest prices, and larger insurers generally paid lower prices.

Table 2 presents insurer sizes. Highmark BCBS was the largest insurer at the state level, accounting for 58.5% of payments. The other insurers modeled in Dorn (2025) accounted for

<sup>&</sup>lt;sup>5</sup>Some UnitedHealth contracts are treated as separate insurers in this exercise.

	Highmark BCBS	Aetna	HPUOV	Carelink	UnitedHealth	Cigna	Nonmodeled
Inpatient	58.4%	6.1%	3.2%	3%	3.3%	2.5%	23.5%
Outpatient	58.5%	6.2%	4%	3.2%	2.6%	2.8%	22.8%
Total	58.5%	6.1%	3.8%	3.1%	2.9%	2.7%	23%

Table 2: Estimated hospital-insurer payment market shares for fiscal year 2011 and later.

between 2.7% (Cigna) and 6.1% (Aetna) of spending. HPUOV was quite regional, accounting for only 3.8% of state spending but more than 10% of spending at Wetzel County Hospital, Reynolds Memorial Hospital, Wheeling Hospital, and Ohio Valley Medical Center, all of which are in or near the state's northern panhandle.



Figure 3: Histogram of negotiated payments as a fraction of list prices for inpatient care under contracts beginning in fiscal year 2011, weighted by estimated payments. Higher rows correspond to larger insurers and, typically, lower rates. Appendix Figure 14 shows that similar patterns hold for outpatient care.

Figure 3 presents the frequency of contract payment rates, as a fraction of list prices. Each point within a bar represents a single estimated hospital system-insurer-year dollar paid. Points to the right correspond to contracts that paid a higher fraction of the hospital's list prices on average. There are three panels for three groups of insurers: Highmark BCBS, the largest insurer; the other medium-sized insurers modeled in Dorn (2025); and the small insurers not modeled in Dorn (2025). Highmark BCBS generally paid substantially lower rates than the other insurers. The other modeled insurers paid larger shares of list prices, but generally slightly lower shares than the smaller nonmodeled insurers. There is also variation between the non-Highmark modeled insurers: HPUOV, the regional insurer, had a substantial mass of payments far below list prices, mostly payments to hospitals in the state's northern panhandle where HPUOV was a larger player. While Figure 3 suggests larger insurers paid lower prices, it does not control for hospital mix. Perhaps Highmark BCBS simply does more business with hospitals with excessive list prices. I therefore present regression results that adjust for hospital mix by controlling for hospital fixed effects.

I regress payment rates on insurer, hospital, and year fixed effects. The regression model for hospital i and insurer j in fiscal year t is:

$$Y_{ijt} = \delta_j^{Insurer} + \delta_i^{Hosp} + \delta_t^{FY} + \varepsilon_{ijt},\tag{1}$$

where  $Y_{ijt} = \frac{Pay_{ijt}}{ListPrice_{ijt}}$  for payment-to-list-price regressions and  $Y_{ijt} = \frac{Pay_{ijt}}{ListPrice_{ijt}} * ChargeToCost_{it}$  for payment-to-cost regressions, where  $ChargeToCost_{it}$  is hospital *i*'s reported aggregate list price-to-cost ratio for the fiscal year. The payment-to-cost regressions make units roughly comparable across hospitals, but leverage Medicare and Medicaid reported costs in calculating the private insurer outcome. The hospital fixed effects control for general variation in hospital markups or cost reporting. I present both unweighted and payment size-weighted regression results. Standard errors are clustered by hospital.

Table 3 presents the regression results. Highmark BCBS consistently paid less than the other modeled insurers. HPUOV paid less than Cigna and United, and paid less than Aetna and Carelink when weighting contracts by payments. This reflects HPUOV's regional na-

Dependent Variables:	Payment as	a % of List Price	Payment a	s a % of Cost
Weight:	None	Payments	None	Payments
Model:	(1)	(2)	(3)	(4)
Variables				
Highmark BCBS	$-21.39^{***}$	$-17.32^{***}$	-46.04***	-38.33***
	(2.063)	(3.552)	(6.176)	(7.798)
HPUOV	$-10.70^{***}$	$-14.37^{**}$	$-16.99^{***}$	$-24.73^{*}$
	(2.370)	(6.292)	(5.432)	(12.91)
Aetna	-7.299***	-4.002**	$-14.52^{***}$	-4.625
	(2.421)	(1.882)	(4.842)	(4.143)
Carelink	-9.639***	-5.631**	-12.83*	-6.303*
	(2.575)	(2.349)	(6.354)	(3.625)
Cigna	-3.338	-2.723	-5.562	-0.1479
	(2.612)	(2.647)	(5.139)	(4.777)
Fixed-effects				
Hospital	Yes	Yes	Yes	Yes
FY	Yes	Yes	Yes	Yes
Fit statistics				
Observations	2,434	2,396	2,396	2,396
$\mathbb{R}^2$	0.57937	0.77396	0.69120	0.80935
Within $\mathbb{R}^2$	0.47903	0.63007	0.24474	0.54058

Clustered (Hospital) standard-errors in parentheses Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

Table 3: Coefficients on modeled insurers in the payment regressions represented in Equation (1) below for inpatient care for payment rates as a fraction of list prices (left) and reported cost (right). Coefficients are expressed relative to UnitedHealth. Coefficients on nonmodeled insurers are omitted for space. Appendix Table 8 presents the analogous table for outpatient care.

ture: it obtained favorable payment rates in the regions in which it was larger. Cigna and UnitedHealth (the latter is the omitted category) paid more than other modeled insurers. Appendix Table 8 shows that similar patterns held for outpatient care.

Highmark BCBS consistently obtained highly favorable rates within a hospital. Figure 4 presents a scatterplot of Highmark BCBS's payment ranking across insurers (y axis) and the number of insurers each hospital contracted with (x axis). Hospitals that contract with more insurers have more opportunities to reach even more favorable payment rates. The



Figure 4: Relative positioning of Highmark BCBS's best contract by hospital-year across fiscal years. A dot indicates the number of insurers the hospital contracted with (x-axis) and Highmark BCBS's relative positioning within payment rates (y-axis). The dashed line indicates median performance (y = (1+x)/2). Highmark BCBS obtained favorable payment rates.

scatterplot shows that Highmark BCBS often obtained one of the top two most favorable rates, and almost never paid more than the median insurer.

#### 3.2 The Largest Insurer Generally Formed Multiyear Contracts

The largest insurer in West Virginia, Highmark Blue Cross, generally formed contracts with fixed expiration dates. Those contracts would most commonly expire after three years or five years.

The simplest measure of contract length is reported length. Figure 5 presents retrospective contract length for fixed-length BCBS contracts. A given observation is a hospital-payor-start-end tuple. Large spikes are visible at three years and five years, indicating that these were standard Highmark BCBS contract lengths. There is a right tail of extreme lengths, which reflect either expired contracts that were extended or data reporting issues.

Highmark BCBS formed sufficiently few auto-renew contracts that the auto-renew contracts can be studied individually. A fair number of the auto-renew contracts were contracts specifically for Highmark BCBS indemnity plans, which were relatively unpopular in the era I



Figure 5: Distribution of reported contract term lengths (hospital-insurer-start-end tuples) for contracts with fixed expiration dates for Highmark BCBS. Ten hospitals' auto-renew contracts with reported formation dates are not contained in this figure.

study. Some contracts were auto-renew share of charges contracts at the relatively small Davis Medical Center, Fairmont Regional Medical Center, and Summersville Memorial Hospital. Many Highmark BCBS auto-renew contracts appear to have been short-term extensions of nominally expired contracts with Beckley ARH Hospital, Camden Clark Medical Center, Jackson General Hospital, Princeton Community Hospital, Saint Joseph's Hospital of Buckhannon, and Wheeling Hospital. The ability to extend expired contracts while negotiations continue is a feature of bargaining that represents an interesting direction for future work.

It is not clear why contracts are multiyear. Contracts may emerge to enable coordination, commitment, or investment incentives (MacLeod and Malcomson, 1993, Hermalin et al., 2007). However, once a contract exists, it is not so clear when the contract should end. Longlived contracts can introduce dynamic inefficiencies, but it is not obvious what inefficiencies are generated in this market, or why it should be so common to tolerate three- or fiveyear inefficiencies and almost never two- or six-year inefficiencies. The variation in contract lengths across hospitals does not offer any obvious guidance.

# 3.3 It Is Not Clear What Drove Variation in Contract Length Across Hospitals

I do not find that Highmark BCBS's contract lengths were consistently associated with hospital size. There is some indication that contract length is sticky, but only imperfectly so.



Figure 6: Distribution of projected BCBS spending in fiscal year 2011 at the 14 hospitals that always reported three-year or five-year contracts with Highmark BCBS. Five-year contracts were associated with larger hospitals for BCBS, with the exception of the West Virginia University (WVU) Health System.

Some hospitals always had the same contract length. In Figure 6, I present the size of hospitals that reported three- or five-year contracts and not the other. (It is possible for other lengths to reflect short-term renewal or other rare circumstances.) I plot the hospitals by fiscal-year-2011 Highmark BCBS spending. Both the largest (WVU Hospitals) and smallest (Charleston Surgical) hospitals reported three-year agreements. Five-year agreements were rare for the smallest hospitals; a story of dynamic inefficiency and transaction costs would if anything point towards smaller hospitals forming longer-lived agreements to diffuse ne-

All	UnitedHealth	Highmark BCBS	Aetna	Carelink	HPUOV	Cigna	Nonmodeled
43.3%	100%	5.6%	89.2%	74.5%	100%	100%	99.8%

Table 4: Estimated percentage of inpatient payments accounted for by auto-renew contracts by insurer. Auto-renew contracts were rare for Highmark BCBS, the largest insurer, and more common for smaller insurers.

gotiation costs. The largest hospital, CAMC, is not on the graph. In early years, CAMC reported a five-year share of charges contract with Highmark BCBS, but in later years, changes to reported expiration with the same reported payment rates suggest the Highmark BCBS-CAMC contract was extended by three years and then five years.

Figure 6 misses substantial heterogeneity in the data. Many of the hospitals in the figure also reported contracts with unusual start dates, or failed to update start dates. In Appendix Table 9, I describe the sequence of likely contract lengths based on manual summary of reported dates, including pre-2010 contracts. There is some indication that smaller hospitals shifted towards five-year contracts during this era, perhaps reflecting a change in strategy. Other, larger, hospitals shifted towards shorter agreements. It is clear that there was variation in contract lengths across hospitals, and it is not clear what drove that variation.

The other three stylized facts focus on the other half of the market: smaller insurers.

#### 3.4 Smaller Insurers Generally Formed Auto-Renew Contracts

Smaller insurers generally formed auto-renew contracts.

Table 4 presents the frequency of auto-renew contracts for different groups of insurers. Auto-renew contracts were used for an estimated 43% of inpatient payments. However, Highmark BCBS only used such contracts for an estimated 6% of payments. Aetna and Carelink used some fixed-length contracts but more commonly paid under auto-renew contracts. I find essentially no other fixed-length contracts.

The fixed-length contracts formed by the non-BCBS modeled insurers were rare enough to be studied individually. One was Carelink's earliest reported contract with Beckley ARH Hospital, which expired on June 30, 2007. The others were a contract formed between Aetna and Camden Clark Medical Center, a medium-sized hospital in Parkersburg, which expired September 30, 2014, and CAMC contracts with Carelink and Aetna which expired in 2012. Both the Carelink and Aetna contracts shifted to auto-renew after the expiration date, with Aetna's contracted discount increasing from one percentage point to two percentage points one year later. (Carelink was acquired by Aetna in 2014, but CAMC continued to report a Carelink contract with a two-percentage-point discount.)

The existence of auto-renew contracts is less surprising than the contracts' renewal behavior.

#### 3.5 Auto-Renew Contracts Generally Renewed

Smaller insurers' auto-renew contracts renewed in more than 90% of years. I find some suggestion that non-renewal decisions were associated with extreme changes to list prices, though the association explains only a small amount of variation.



Figure 7: Reported elapsed contract length as of report submission date for fiscal year 2015 auto-renew contracts with modeled insurers with reported formation date, including the small number of prospective auto-renew contracts (see Figure 11). Only a few contracts were formed by Blue Cross (blue) rather than the other insurers (red). Many contracts had remained in place for a decade or more. A cluster around 15 years partially reflects contracts with January 1, 2000, reported start dates.

I present retrospective contract length data for auto-renew contracts in Figure 7. The graph presents the reported amassed duration of auto-renew contracts that had detailed data

reported in fiscal year 2015. A few auto-renew contracts had been in place less than one year. The median reported auto-renew contract had been in place for a decade or longer.



Figure 8: Percentage of auto-renew share of charges contract-years that remained in place (green), were renegotiated (red), or were dropped (blue) for each insurer. The insurers all generally allowed auto-renew contracts to renew, with the average renewal probability of 93.4% indicated by dashed line.

As Figure 8 shows, the reported auto-renew lengths if anything underestimate the contracts' realized durations. The figure shows the one-year-ahead probability of contract changes by insurer for auto-renew share of charges contracts. The probability of an auto-renew contract being renewed in the contract panel data was 91.7% for the modeled insurers and 93.9% for the nonmodeled insurers that were unlikely to report retrospective lengths. Under a Bernoulli trial model, these would correspond to expected lengths of roughly 12 and 16 years, respectively. When a non-BCBS modeled insurer's contract did not renew, the new contract was generally also an auto-renew share of charges contract, but with a new payment rates. When a nonmodeled insurer contract did not renew, the contract was generally dropped, likely reflecting cleaning of dormant contracts.

I find that auto-renew contracts consistently renewed at all times. Figure 9 graphs the one-year-ahead change in status for auto-renew contracts by fiscal year. The bar for modeled insurers is tallest around 2011, when detailed contract scans were retained and I can reliably differentiate between auto-renew and fixed-length contracts for larger contracts. In all years, most auto-renew contracts were renewed. In essentially all years, the most common result



Figure 9: The number of hospital-insurer auto-renew share of charges contracts being renewed (green), dropped (blue), changed to fixed length (purple), renegotiated with a small change to discount (light red), or renegotiated with a large change to discount (dark red) by fiscal year for modeled (left) and nonmodeled (right) insurers.

of a non-renewed auto-renew contract among the modeled insurers was a new auto-renew contract with different payment rates.



Figure 10: Probability of a new auto-renew share of charges contract remaining in place after a given number of fiscal years of contract data elapsed by insurer. The smaller insurers in the "Other" category were more likely to see contracts renew than the larger insurers, especially Highmark BCBS which rarely used auto-renew contracts in this era.

There is some indication of variation in renewal strategies across insurers and hospitals. Figure 10 presents a Kaplan-Meier survival plot for new auto-renew contracts. The nonrenewal rates are higher than the average rates in Figure 9, because these pairs are selected on negotiating at least once. Highmark BCBS had few auto-renew contracts, and its auto-renew contracts generally ended quickly. (As mentioned in Section 3.2, many Highmark BCBS auto-renew contracts were likely fixed-length contracts that were allowed to remain in place after expiration.) Carelink and the smallest insurers generally allowed contracts to renew. The other modeled insurers had higher renegotiation rates, often negotiating contracts with these hospitals after a few years.

The consistent use of the same list price benchmark by multiple small and mediumsized insurers over time is consistent with substantial bargaining frictions. Imagine a stylized model wherein insurer A and insurer B have auto-renew contracts in place with the same hospital. In period t, hospital i or insurer j can allow the ij contract to renew at price  $\alpha_{j,t_0}p_{b,t}$  or give notice and renegotiate to a perfectly foreseeable new starting price of  $p_{j,t}^*$ . For simplicity, suppose all pairs allow contracts to renew if and only if  $|\alpha_{j,t_0}p_{b,t} - p_{j,t}^*| \leq u$ . If, as typically happens in practice, both contracts renew, then  $|p_{A,t}^* - p_{B,t}^*| \leq 2u$ . The common renewal of share of charges contracts means either the disparate insurers must remain in the small region that enables the hospital to avoid renegotiating with any insurer  $(|p_{A,t}^* - p_{B,t}^*|$  is small) or the range of acceptable prices must be large (u is large). The median renegotiation changed payment rates by 2% of charges, and the median auto-renew contract paid \$1,928,247 annually in fiscal year 2011, suggesting that \$38,565 could have been available by renegotiating just one year earlier. I take the rare renegotiation as suggestive evidence that perceived bargaining frictions are high.

In Appendix A.1, I use a regression strategy to assess the drivers of nonrenewal decisions. I find some evidence that list price changes are associated with nonrenewal, but the associated is small and only explains a small amount of the nonrenewal decisions.

# 3.6 Smaller Insurers Experienced Faster Price Growth Between Negotiations

At any given moment, most contracts in place were a mix of Highmark BCBS's recent Medicare-linked contracts and smaller insurers' old list price-linked contracts. As a result, smaller insurers' payments would increase more quickly between negotiations.



Figure 11: Estimated percentage of inpatient payments accounted for by imputed contract structure by insurer. Color indicates inferred payment benchmark. Transparency indicates contract expiration type. Highmark Blue Cross, the largest insurer, generally used prospective ("Medicare") diagnosis weights in contracts with fixed expiration dates. Smaller insurers generally used list price-based formulas under auto-renew contracts.

Most insurers formed auto-renew contracts benchmarked to list prices, while Highmark BCBS generally formed fixed-length contracts benchmarked to something else. Figure 11 presents the usage rates of different contract types by insurer. Highmark BCBS had some list price-benchmarked contracts with fixed expiration dates, but was more likely to use prospective payment structures.<sup>6</sup> Conversely, the other modeled insurers and nonmodeled insurers generally used auto-renew share of charges contracts that were benchmarked to list prices.

The leading exceptions to this pattern were rare enough to describe individually. The regional HPUOV was small at the state level (3.8% to 11.7% of estimated sales), relatively

<sup>&</sup>lt;sup>6</sup>I observe that in some hospital 2023 price reports, Highmark BCBS payments are benchmarked to DRGbased weights that are not equal to Medicare's DRG weights. The differences are small ( $\mathbb{R}^2$  of 0.92 between the weights). See Dorn (2025) for further discussion.

large in the regions in which it actively competed (more than 27% of estimated 2016 sales in the northern panhandle), and paid prospectively for an estimated 56.2% of payments (more than three-quarters from two hospitals in Wheeling in the state's northern panhandle). Carelink (especially with Wheeling Hospital and Mon Health Medical Center) and UnitedHealth (especially with WVU Health System) also would sometimes pay prospectively. Highmark BCBS would pay the state's largest hospital, CAMC, based on charges; I estimate 92% of the insurer's other payments were prospective. Further detail on contract structure is available in Appendix Table 10.



Figure 12: The ratio of payments to reported costs over time for Highmark BCBS (blue) and the other, small and medium-sized, insurers I model (red). Dashed lines indicate one percentage point and three percentage point annual increases, respectively.

The patterns in Figure 11 suggest that Medicare-based Highmark BCBS payments should go up more slowly over time than list price-based payments used by other insurers. Figure 12 shows that such a pattern held. In that figure, I plot the ratio of payments to reported hospital costs over time for Highmark BCBS and the other modeled insurers. Other modeled insurers' payments generally went up around three percentage points faster than costs, similar to the list prices they typically used as benchmarks. Highmark BCBS payments went up much more slowly, roughly increasing one percentage point more quickly than costs annually. As a result, whereas Highmark BCBS markups were close to the rest of the market in 2006, by 2015 Highmark BCBS was paying far less than the other insurers for care. I decompose the change in payments in Appendix Figure 15 and find that 31.6% of the divergence is explained by the slower rate at which Highmark BCBS prices increased between negotiations.

### 4 Conclusion and Some Open Questions

This paper describes hospital-insurer bargaining in West Virginia and some stylized facts on contract dynamics. This is an unusual opportunity: typically, business-to-business contracts are considered trade secrets. I find that the largest insurer paid lower prices under three- or five-year contracts, while smaller insurers agreed to auto-renew contracts with fast price growth. I find some correlates of contract length and renewal, but the correlations are weak and do not explain the patterns in the data.

The results here point to exciting directions for future work. The existence of both threeand five-year Highmark BCBS contracts raises the question of the drivers of contract length. The pervasiveness of auto-renew contracts with prices calculated as a fixed fraction of list prices raises questions about auto-renew dynamics, negotiation costs, and how renewal decisions interact with hospital list prices.

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## A Additional Tables and Figures

Variable	Mean	SD	Min	P05	P25	P50	P75	P95	Max	% Missing
Panel A: Descriptive Statistics — DCL (4717 Obs.)										
Inpat. Discount (%)	12	13.7	0	0	5	7	15	43.6	96	0
Outpat. Discount (%)	10.9	10.2	0	2	5	7	13.6	32.5	100	0
	Panel I	B: Desci	riptive	Statisti	cs - D	CL (M	odeled l	nsurers	, 1762 (	Obs.)
Inpat. Discount (%)	16.5	16.7	0	0	5	10	23	55.5	78.7	0
Outpat. Discount (%)	14	11.5	0	2	5	10	17.8	39.7	63.5	0

Table 5: Descriptive statistics for reported discounts for all insurers (top panel) and modeled insurers (bottom panel). The extreme high discounts for nonmodeled insurers reflect very small contracts.

Variable	Mean	Min	P50	Max	% Missing				
Panel C: Contract Dates — DCL									
Contract Date	07/17/2005	01/01/1985	01/01/2008	08/01/2015	86.9				
Expiration Date	11/29/2014	07/31/2009	09/30/2014	12/31/2022	95.4				
Submission Date	04/28/2011	05/01/2000	07/22/2011	07/08/2015	90.5				
	Panel D: Cor	ntract Dates —	DCL (Modele	d Insurers)					
Contract Date	04/27/2006	10/01/1992	05/02/2008	08/01/2015	71				
Expiration Date	11/25/2014	07/31/2009	09/30/2014	12/31/2022	88.1				
Submission Date	03/14/2011	05/01/2000	07/22/2011	07/08/2015	78.3				

Table 6: Descriptive statistics for reported contract date information across all years. Contract expiration dates include occasional dates on DC reports, but do not include dates for auto-renew contracts.

Variable	Mean	SD	Min	P05	P25	P50	P75	P95	Max	% Missing
	Panel I	E: Contra	ict Scale	e - FY	2011+(2)	2434 Obs	s.), Inpat	ient		
Discharges	276.2	562.1	0	1	17	60	261.5	1336.3	4050	77.9
Discharges (+Impute)	80.2	285.1	0	2.9	7.2	19.4	44.4	296.8	4050	0
Inpat. Discount (%)	12.6	13.7	0	2	5	7	15	45.2	76.8	0
Discount Amount (\$m)	1.6	4	0	0.003	0.1	0.2	0.8	8.7	33.2	78.6
Net Revenue (\$m)	5	13.6	0	0.015	0.2	0.9	3.5	21.5	122.9	78.6
Net Revenue (\$m, +Impute)	1.4	6.6	0	0.029	0.1	0.3	0.8	4.1	122.9	0.8
Cost (\$m)	2.6	6.9	0	0.006	0.1	0.5	1.7	11.7	65	78.6
Cost (+Impute, \$m)	0.7	3.4	0	0.016	0.038	0.1	0.4	2.2	65	1.5
Charge/Discharge (\$100s)	196.5	88.4	25.5	84.3	127.9	177.8	255.3	360.1	566.2	78.6
Cost/Discharge (\$100s)	74.8	33.1	11.1	31.1	51.3	67	101.3	132.6	197.9	78.6
	Panel I	F: Contra	ict Scale	e - FY	2011+(2)	2434 Obs	s.), Outpa	atient		
Visits (100s)	111.9	208.5	0	0.1	8.8	32.2	124.2	495	1388.6	77.9
Visits (100s, +Impute)	35.9	107.6	0	1.5	4.6	9	20.4	145.5	1388.6	0
Outpat. Discount (%)	10.6	9.5	0	3	5	7	13	30.3	85.2	0
Discount Amount (\$m)	2.4	4.5	0	0.002	0.1	0.4	2	12.8	26.9	78.2
Net Revenue (\$m)	9.1	17.1	0	0.014	1	2.6	9.2	41	138.7	78.2
Net Revenue (\$m, +Impute)	2.7	8.7	0	0.1	0.3	0.7	1.6	10.2	138.7	0
Cost (\$m)	4.4	8	0	0.006	0.4	1.2	4.6	22.8	53.9	78.2
Cost (\$m, +Impute)	1.3	4.1	0	0.1	0.2	0.3	0.7	5.1	53.9	0.4
Charge/Visit (\$100s)	12.5	20.1	1.2	5.2	7.9	10.1	13.2	30.4	449.5	78.3
Cost/Visit (\$100s)	4.7	9.3	0.6	2.2	3.2	3.8	4.7	10	211.7	78.3

Table 7: Descriptive statistics for reported (most rows) and reported or imputed (where noted) scale for contracts reported in fiscal year 2011 or later.



Figure 13: Percentage of West Virginia hospitals that were designated as Critical Access Hospitals (CAHs) by CMS (red), percentage of CAHs that were exempted from the rate regulation system starting in 2000 (green), and the estimated percentage of inpatient days accounted for by CAHs (blue). West Virginia had many CAHs that did not report prices (green line), but by construction those hospitals were small (blue line) and generally far from modeled hospitals.

Dependent Variables:	Payment as a	a % of List Price	Payment a	s a % of Cost
Weight:	None	Payments	None	Payments
Model:	(1)	(2)	(3)	(4)
Variables				
Highmark BCBS	$-12.69^{***}$	-13.50***	$-19.37^{***}$	-24.10***
	(1.415)	(2.119)	(5.508)	(5.119)
HPUOV	-7.735***	-15.82***	$-7.494^{**}$	$-23.48^{***}$
	(1.911)	(5.105)	(3.121)	(6.012)
Aetna	-5.906***	-5.996***	-8.404**	-8.551**
	(1.772)	(1.743)	(3.383)	(3.722)
Carelink	-6.760***	-6.322**	-6.423**	-4.639
	(2.104)	(2.497)	(2.790)	(4.233)
Cigna	-2.114*	-0.7340	-0.3319	2.341
	(1.225)	(1.949)	(1.392)	(4.903)
Fixed-effects				
Hospital	Yes	Yes	Yes	Yes
FY	Yes	Yes	Yes	Yes
Fit statistics				
Observations	2,434	2,424	2,424	$2,\!424$
$\mathbb{R}^2$	0.60458	0.77758	0.75014	0.83548
Within $\mathbb{R}^2$	0.48802	0.60303	0.10963	0.30561

Clustered (Hospital) standard-errors in parentheses Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

Table 8: Equivalent of Table 3 but for outpatient care.

Hospital	In Graph?	Rev	venue BCBS	Dise All	count BCBS	Reporting FY	Inferred Lengths
CAMC		\$417,862,647.00	\$285,238,397.00	4.80%	6%	2016	Extensions of one,
WVU Hospitals Cabell Hunting-	Υ	\$278,811,597.00 \$272,539,782.00	\$200,598,568.00 \$176,619,296.00	$\frac{19.52\%}{18.42\%}$	20.61% 23.50%	2015 2016	Three-year Five-year to four-year
ton Wheeling Hospital	Υ	\$159,971,668.00	\$63,654,808.00	40.39%	34.93%	2016	Unclear (possible auto-
St Mary's	Y	\$144,751,736.00	\$86,939,816.00	18.05%	24.28%	2016	renew) Five-year then two- year (possible exten- sion)
Monongalia Gen- eral		\$138,979,407.00	\$103,879,209.00	20.88%	23.59%	2016	Six-year then three- vear
United Hospital Center	Υ	\$134,727,091.00	\$81,421,150.00	15.66%	18.52%	2015	Three-year
Camden Clark	Y	\$98,335,409.00	\$54,698,466.00	23.14%	29.95%	2014	Unclear (PPO) + auto-renew (indem- nity)
Berkeley Medi- cal/City Hospital		\$74,953,507.00	\$48,455,056.00	18.16%	20.49%	2015	Three-year
Thomas Memorial		\$71,024,440.00	\$41,274,899.00	32.80%	41.29%	2016	Three-year then two- year (possible exten- sion) then five-year
Weirton Medical		\$66,702,536.00	\$31,196,310.00	31.27%	32.04%	2016	Unclear
Raleigh General	Υ	\$60,470,207.00	\$45,642,177.00	25.50%	29.29%	2016	Five-year then three- plus-year
St Joseph's Park- ersburg	Υ	\$52,246,336.00	\$31,626,084.00	14.30%	14.56%	2011	Three-year
St Francis		\$52,029,161.00	\$35,351,246.00	32.95%	36.50%	2016	Three-year then two- year then five-year
Ohio Valley General	Υ	\$44,493,771.00	\$15,207,254.00	50.29%	46.90%	2015	Three-year then four- year (possible exten-
Davis Medical		\$37,239,141.00	\$31,267,626.00	7.58%	8%	2016	Unclear (possible auto- renew)
Logan General	Υ	\$34,352,337.00	\$27,085,327.00	21.77%	25.01%	2015	Four-year then one- year extension then
Bluefield Regional		\$31,184,636.00	\$21,449,548.00	24.41%	29.39%	2016	Three-year then five-
Greenbrier Valley	Υ	\$30,191,851.00	\$16,833,176.00	22.10%	31.43%	2015	Unclear then three- vear then five-vear
CAMC Teays Valley		\$27,563,472.00	\$18,189,391.00	16.14%	17.40%	2014	Unclear (PPO) + auto-renew (indem- nity)
Fairmont General		\$27,531,075.00	\$17,767,911.00	36.23%	39.29%	2014	Auto-renew then three-year extension
Beckley ARH		\$22,844,975.00	\$17,669,671.00	36.01%	19.54%	2016	Five-year then auto- renew
Pleasant Valley Reynolds Memo- rial	Υ	\$21,506,321.00 \$17,717,136.00	\$12,562,204.00 \$6,925,282.00	22.04% 27.56%	26.94% 32.93%	2016 2016	Five-year Three-year then five-
Summersville Memorial		\$17,396,596.00	\$14,716,112.00	19.48%	9%	2016	Unclear
Stonewall Jackson		\$17,278,863.00	\$9,201,879.00	17.72%	23.79%	2016	Three-year then five- year
St Joseph's Buck- hannon		\$16,847,110.00	\$10,113,971.00	22.10%	27.74%	2014	Auto-renew then four- year
Jackson General	Υ	\$15,551,857.00	\$4,786,469.00	18.30%	25.74%	2012	Unclear
Wetzel County		\$11,115,696.00	\$5,703,622.00	30.54%	37.09%	2014	Unclear
Charleston Surgi- cal	Υ	\$10,063,729.00	\$6,355,743.00	33.75%	41.73%	2016	Three-year then five- year

Table 9: Manually inferred sequence of Highmark BCBS contract lengths for hospitals with reported end dates, with size and discount statistics from the hospital's last contract report.

Weight	Payor	Prospect	tive	Share-of-Cl	harges
		Auto-Renew	Expires	Auto-Renew	Expires
Payments (Inpatient)	Total	6.24	40.50	37.09	16.17
Payments (Inpatient)	Non-BCBS	10.69		85.88	3.43
Payments (Inpatient)	BCBS	3.11	69.01	2.75	25.14
Payments (Outpatient)	Total	9.65	40.47	37.76	12.12
Payments (Outpatient)	Non-BCBS	12.79	0.18	85.18	1.85
Payments (Outpatient)	BCBS	7.45	68.80	4.41	19.34
Contract-Years (Inpatient)	Total	6.33	6.50	85.58	1.59
Contract-Years (Inpatient)	Non-BCBS	6.17		93.55	0.28
Contract-Years (Inpatient)	BCBS	7.76	66.81	11.64	13.79
Contract-Years (Outpatient)	Total	6.37	6.71	85.54	1.38
Contract-Years (Outpatient)	Non-BCBS	6.04	0.05	93.69	0.23
Contract-Years (Outpatient)	BCBS	9.48	68.53	9.91	12.07

Table 10: Percentage of payments and contract years by expiration type and inferred contract benchmark, where BCBS includes non-Highmark BCBS. Share of charges contracts were likely benchmarked to hospital list prices. Prospective contracts were likely benchmarked to something else, most typically based on Medicare diagnosis weights.

Dependent Variable:	Any Change								
		Inpatient	-	-	Outpatient				
Model:	(1)	(2)	(3)	(4)	(5)	(6)			
Variables									
$\{\Delta^{(1)}\}_{-}$	0.1897			-1.406*					
$(\Lambda(1))$	(0.6355)			(0.7866)					
$\{\Delta^{(1)}\}_+$	0.2720**			0.4432***					
$(\Lambda(2))$	(0.1188)	0.00.1**		(0.1304)	0.0000*				
$\{\Delta^{(2)}\}_{-}$		$-2.604^{***}$			$-0.9289^{*}$				
$(\Lambda(2))$		(1.132)			(0.4704)				
$\{\Delta^{(-)}\}_+$		(0.0745)			(0.1017)				
$\int \Lambda(3)$		(0.0743)	110.1		(0.1017)				
$\{\Delta^{(i)}\}_{-}$			(287.8)						
$\{\Lambda^{(3)}\}$			0 1959***			0 1395*			
$(\Delta)^+$			(0.0686)			(0.0720)			
			(0.0000)			(0.0.20)			
Fixed-effects	V	V	V	V	17	V			
Insurer	Yes	Yes	Yes	Yes	Yes	Yes			
Hospital	Yes	Yes	Yes	Yes	Yes	Yes			
FY	Yes	Yes	Yes	Yes	Yes	Yes			
Fit statistics									
Observations	2,813	2,554	2,225	2,813	2,554	2,225			
$\mathbb{R}^2$	0.14928	0.18381	0.18758	0.15010	0.18196	0.18532			
Within $\mathbb{R}^2$	0.00327	0.00476	0.00445	0.00424	0.00251	0.00168			

Clustered (Insurer) standard-errors in parentheses Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

Table 11: A version of Table 12 (Page 43) that includes heterogeneity between relative increases in list prices for list price reductions ({  $\Delta$ }<sub>-</sub> = min{ $\Delta$ , 0}) and list price increases ({ $\Delta$ }<sub>+</sub> = max{ $\Delta$ , 0}). When list prices increased, larger list price increases (increases in { $\Delta$ }<sub>+</sub>) were associated with auto-renew contract changes. When list prices decreased, there is some indication that larger decreases (decreases in { $\Delta$ }<sub>-</sub>) were associated with contract changes.



Figure 14: Analog of Figure 3 for outpatient care.



Figure 15: Analog to Figure 12 but decomposing the difference in payment-to-cost ratios by (from left to right) removing Carelink, which was acquired at the end of 2014; consistently applying the 2006 hospital-insurer care composition; imposing that prices increase proportionally to list prices outside of years with a new inferred negotiation; and imposing that new negotiations update prices proportionally to list prices. The remaining difference is any correlation of care composition with list price increases.



Figure 16: The ratio of list price charges (top) and real payments (bottom) to reported costs by Medicare (red) and private payors (blue) for West Virginia hospitals by year from hospital reports. Dashed lines represent Medicare 2006 values extrapolated based on 103% and 99% annual changes, respectively.

#### A.1 Nonrenewal Regressions

Auto-renew contracts were generally benchmarked to a hospital's list prices (Figure 11). As a result, changes in hospital list prices would directly contribute to changes in payments while a contract remained in place. To roughly assess the magnitude of the resulting incentive's effect, I regress the existence of one-year-ahead auto-renew share of charges contract changes on changes in projected charged list prices. The regression is exploratory and descriptive.

The outcome  $Y_{ijt}$  is an indicator for hospital *i* and insurer *j* having an auto-renew contract in place in the contract report for year t-1 and either a different contract or dropped contract in the report for fiscal year *t*. This measure allows me to include renegotiated auto-renew contracts that also led to a change in reported insurer name. The association of interest is the change in log projected list prices per case. Define  $p_{ht,c}$  as the projected list price per case for care type *c* (inpatient per discharge or outpatient per visit) at hospital *h* in the state's rate review decision for fiscal year *t*. Also define the change in percent charges as  $\Delta_{ht,c}^{\tau} = log(p_{ht,c}) - log(p_{ht-\tau,c})$  with Winsorization at the 5% and 95% level. The regression specification is

$$Y_{ijt} = \beta \Delta_{hj,c}^{(\tau)} + \delta_h + \delta_j + \delta_t + \varepsilon_{ijt}$$

where  $\delta_h$  are hospital fixed effects,  $\delta_j$  are insurer fixed effects, and  $\delta_t$  are fiscal year fixed effects that control for system-wide inflation. I estimate the regression with ordinary least squares and cluster the standard errors by insurer. I emphasize that the estimated coefficient  $\beta$  is a residual correlation, and should not be interpreted as a meaningful causal parameter.

The main regression results are in Table 12. I find that increases in list prices are associated with contract renegotiation. This pattern holds across inpatient care and outpatient care. The association is particularly strong for one-period changes in charges and carries more statistical evidence against a null of zero residual correlation for inpatient care. In

Dependent Variable:	Any Change					
	Inpatient			Outpatient		
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
$\Delta^{(1)}$	$0.2661^{**}$			$0.2687^{*}$		
	(0.1043)			(0.1450)		
$\Delta^{(2)}$		$0.1502^{**}$			$0.1521^{*}$	
		(0.0645)			(0.0914)	
$\Delta^{(3)}$		· · · ·	$0.1839^{***}$		· · · ·	$0.1395^{*}$
			(0.0510)			(0.0720)
Fixed-effects						
Insurer	Yes	Yes	Yes	Yes	Yes	Yes
Hospital	Yes	Yes	Yes	Yes	Yes	Yes
FY	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics						
Observations	2,813	2,554	2,225	2,813	2,554	2,225
$\mathbb{R}^2$	0.14927	0.18172	0.18753	0.14819	0.18117	0.18532
Within $\mathbb{R}^2$	0.00327	0.00221	0.00439	0.00201	0.00154	0.00168

Clustered (Insurer) standard-errors in parentheses Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

Table 12: Regression of the existence of changes to previous-year auto-renew share of charges contracts on log list prices over the previous one  $(\Delta^{(1)})$ , two  $(\Delta^{(2)})$ , or three  $(\Delta^{(3)})$  years. Increases in list prices are consistently associated with contract changes after controlling for hospital, insurer, and fiscal year fixed effects. Results with heterogeneity between list price increases and decreases are available in Table 11 (Page 39).

Table 11 (Page 39), I estimate separate coefficients for the negative- and positive-part of list price changes. I find stronger statistical evidence that larger increases in list prices are associated with contract renegotiation. There is some indication that for decreases in list prices, larger *decreases* are associated with contract changes, but those estimates are statistically imprecise. That said, this association only explains a very small amount of the variation in contract changes: the largest within  $R^2$  across all specifications is 0.00462. The association also becomes more muted if the prior fiscal year's list price change is used to avoid issues of reverse causality.