Who Pays in Pay-for-Performance? Evidence from Hospital Prices and Financial Penalties *

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Abstract

Public pay-for-performance (P4P) programs tie hospital payments to predetermined sets of quality measures and are intended to encourage or discourage certain outcomes. To the extent that financial penalties from these programs induce some response by hospitals, such penalties may translate into higher negotiated payments from commercial insurance payers. In this paper, we employ data on commercial insurance payments from a large, multi-payer database to study the extent to which penalties levied under the Hospital Readmission Reduction Program (HRRP) and the Hospital Value Based Purchasing Program (HVBP), two major P4P components of the Affordable Care Act, caused changes in private hospital payments. We find that the bulk of any penalties resulting from HRRP and HVBP are borne by private insurance patients in the form of higher private insurance payments. Specifically, we show that HRRP and HVBP financial penalties led to increases in private payments of 1.9%, with effects concentrated among circulatory system procedures. These penalties were also associated with a 3.1% reduction in Medicare discharges. Our estimates are larger for hospitals with higher shares of privately insured patients, which suggests the importance of hospital bargaining power in facilitating higher commercial insurance payments.

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1 Introduction

Public pay-for-performance (P4P) programs create financial incentives for healthcare providers to improve quality. These programs tie public reimbursement payments to predetermined sets of quality measures and ultimately impose financial penalties or rewards in order to encourage or discourage certain outcomes. Historically, the United States health care system has operated in the absence of any large scale public P4P programs; however, this changed with the introduction of the Hospital Readmission Reduction Program (HRRP) and the Hospital Value Based Purchasing Program (HVBP), both introduced in 2012 as part of the cost containment provisions of the Patient Protection and Affordable Care Act (ACA). Starting in fiscal year 2012, hospitals were penalized (or potentially rewarded under HVBP) by up to 3% of the hospital's total Medicare revenues based on observed quality metrics.

In this paper, we hypothesize that negotiated payments with commercial insurers may be sensitive to the extent of HRRP/HVBP financial penalties.[1] The HRRP in particular acts as a relatively blunt policy instrument, with potentially large penalties for small deviations in quality. Penalized hospitals are therefore strongly incentivized to adjust their behaviors in order to reduce the burden of the penalties. If HRRP/HVBP penalties induced hospitals to make costly investments or other changes valued by insurers, then penalized hospitals may have been able to negotiate higher private payment rates relative to non-penalized hospitals. Our study therefore quantifies the extent to which financial penalties associated with HRRP/HVBP led to higher payment rates from private payers.

To empirically evaluate our hypothesis, we use compelling data on actual payments from private insurance firms to hospitals. Our data, maintained by the Health Care Cost Institute (HCCI), contain all hospital inpatient claims to three national commercial insurers from 2010 to 2015. These unique data, also used by Cooper *et al.* (2017) to examine broad trends in hospital pricing from 2007 through 2011, include payments for every claim during this period, which directly reveal the negotiated payment rates between hospitals and insurers and which may differ substantially from charge-based estimates of payments often used in the literature (Dafny, 2009; Dranove *et al.*, 2017). In our data, the correlation between

[1] Throughout, rather than use the term "price," we refer to the financial transfer for a given procedure as the "payment" from a private insurance firm to a hospital. A payment is distinctly different than a hospital "charge," which effectively represents a hospital's list price for a give procedure. Private insurance firms negotiate substantial discounts from charges.

actual payments and a charge-based proxy for payments from the Healthcare Cost Report Information System (HCRIS) is only 0.435, suggesting that charge-based estimates of payments may contain significant measurement error. Our data cover approximately 28% of individuals under the age of 65 who have employer-sponsored insurance (ESI). When merged with several other data sets on hospital and county characteristics, our final analytic data constitute a balanced panel of 50% of all inpatient prospective payment hospitals in the U.S. between 2010 and 2015.

To establish the causal effect of HRRP/HVBP financial penalties on private payer payment rates, we rely on two key institutional details of these P4P programs. First, both the quality metrics themselves and the algorithms for translating quality metrics into financial penalties changed over time, and because not all hospitals were penalized, HRRP/HVBP generated both cross-sectional and temporal variation in P4P penalties on the extensive and intensive margins. Second, penalized hospitals had little, if any, opportunity to adjust prior to the levying of penalties because the HRRP/HVBP penalties were calculated using data from several years prior to the start of the programs. In fact, the presence and magnitude of financial penalties from HRRP/HVBP were themselves quasi-random — there is evidence that the formulas used to assign HRRP/HVBP penalties have not sufficiently identified marginally low- versus high-performing hospitals, and recent studies also document substantial noise in HVBP penalties and suggest that a hospital's performance under the HVBP is largely due to chance (Friedson *et al.*, 2016; Wilcock *et al.*, 2018). Leveraging these institutional facts, we estimate an entropy-weighted hospital-level fixed effects estimator of hospital-level risk-adjusted commercial payments as a function HRRP/HVBP financial penalties. Entropy-weighting our regressions based on pre-HRRP/HVBP private payments (outcomes) and time-varying hospital characteristics (covariates), as well as focusing on within-hospital variation via hospital fixed effects, ensures balance between penalized and non-penalized hospitals (Hainmueller, 2012).

Importantly, while essentially all hospitals participate in the HRRP and HVBP, our identifying assumption is that the presence and magnitude of any financial penalty generated larger incentives for penalized hospitals to change behavior. Our focus on the financial penalties of the HRRP/HVBP, rather than the programs themselves, distinguishes our analysis from the existing HRRP/HVBP literature which tends to focus on the effects of the HRRP/HVBP on hospital quality and utilization (Ryan *et al.*, 2015; Mellor *et al.*, 2016; Gupta, 2020; Ryan *et al.*, 2017; Gupta *et al.*, 2018; Wilcock *et al.*, 2018). While the empirical results on both programs remain mixed, the prevailing opinion is that HRRP has been successful in decreasing readmissions among Medicare patients (Gupta, 2020).

Our results reveal an increase in average payments of 1.9% for penalized hospitals, with a 3.2% increase in payments for the most heavily penalized hospitals, relative to those hospitals receiving no penalty or a bonus. We also find substantial variation in payment increases across different service lines, with increases in average hospital payments for circulatory system (4.4%) and neonatal system (2.4%) claims, but with economically small and insignificant effects for respiratory system, musculoskeletal system, and labor and delivery claims.[2] In addition, we estimate larger effects among hospitals that are likely to be in a better relative bargaining position with insurers, as proxied by the hospital's share of private insurance patients (Wu, 2010). We also show that HRRP/HVBP penalties are associated with a significant movement away from public patients but not toward private patients. Relative to non-penalized hospitals, a HRRP/HVBP penalty is associated with a 3.1% drop in Medicare discharges but no significant change in private discharges. For the most heavily penalized hospitals, Medicare discharges drop by 8.9%. These results suggest that penalized hospitals may have adjusted their Medicare patient share in order to reduce their exposure to P4P penalties.

These results persist across a wide-variety of robustness checks. For example, we demonstrate nearly identical results when we re-estimate our preferred model without entropy-weighting for balance; when, instead of aggregating to the hospital level, we estimate our regressions with over 4.7 million patient-level observations; and when we estimate separate event study regressions around a hospital's first year of being penalized (Goodman-Bacon, 2018). In fact, our event study regressions demonstrate that hospitals initially penalized in 2012, the first year of HRRP/HVBP penalties, drive our overall results. Furthermore, event study results on 2012 penalized hospitals are consistent with the staggered timing of hospital/insurer contract negotiations, with small initial effects (consistent with some but not all contracts being re-negotiated in any given year) and persistently higher effects in each of the first few years.

To investigate the mechanisms behind our pricing estimates, we study investments that hospitals may

[2]We identify "admission categories" based on the major diagnostic category classifications.

make following HRRP/HVBP for which private insurers would plausibly be willing to pay. First, we directly test changes in hospital quality and changes in hospital services and costs. We estimate our preferred model on over 3 million privately insured individual acute care claims, and we find a statistically insignificant 0.1 percentage point decline in the probability of readmission. We also find no significant effects when we study private readmissions in the specific types of procedures targeted by HRRP/HVBP. We find similar null effects across several other outcomes, including: 1) readmissions specific to service lines affected by HRRP/HVBP; 2) the hospital's average charge per inpatient stay; 3) a measure of profitable services offered by the hospital (Horwitz & Nichols, 2009), suggesting that hospitals did not simply internalize the loss from HRRP/HVBP penalties; 4) the hospital's average DRG weight, suggesting little change in patient selection; and 5) average costs per discharge, suggesting no change in treatment intensity. We acknowledge that hospitals may have pursued some costly investments in response to P4P penalties, and the effects of P4P penalties on hospital costs may not be precisely observed in our analysis due to the well-documented measurement error in the HCRIS; yet, across a range of outcomes intended to capture mechanisms related to quality improvements, treatment intensity, and patient selection, we find economically small and statistically insignificant effects of HRRP/HVBP penalties.

One simple explanation for our payment results is that, by reducing exposure to publicly insured patients, hospitals were able to reallocate resources towards privately insured patients, which was rewarded with higher payment rates. This mechanism would be consistent the fact the private circulatory system claims drive our main results. However, our data do not allow us to separately identify this mechanism from one in which hospitals chose to push for a higher margin on fewer patients. Another simple explanation may be that private insurers are willing to pay for investments that improved outcomes for *Medicare* patients (even without an improvement in private insurance patients). Finally, a large literature also considers the role of public payments on hospital prices in the context of hospital cost-shifting (Cutler *et al.*, 2000; Frakt, 2011), which assumes that hospitals facing a reduction in public payment rates attempt to "fill the gap" by negotiating higher payment rates from private payers in the absence of any costly investment. While cost-shifting is a potential explanation for our results — Dranove (1988) demonstrate cost-shifting behavior theoretically for non-profit maximizing hospitals — we take as given that hospitals responded to the HRRP/HVBP penalties, especially considering the stated purpose of the HRRP/HVBP as quality improvement programs. Furthermore, given the existing evidence on the effects of HRRP/HVBP on Medicare patients, cost-shifting is unlikely to be the main mechanism driving our results.

An increase in hospital prices due to the design of P4P programs (e.g., the blunt penalties levied by the HRRP) is an important issue as policy makers further refine existing P4P programs and expand P4P into other areas. More generally, our analysis introduces another important factor in our understanding of variation in health care pricing. To our knowledge, we are the first to examine the effects of P4P penalties on private insurance payments to hospitals using actual private payer data.[3] Our results show that changes in public policy also meaningfully contribute to variation in private health care prices, even after adjusting for market power, hospital fixed effects, and other observable hospital and market characteristics. Given the high degree of concentration in many hospital markets, one potential consequence of such financial penalties is that hospitals may attempt to leverage subsequent investments in their negotiation with private payers over payment rates. Ultimately, the overall welfare effects of these programs depend not only on their effects on publicly insured patients but on the extent to which they shift provider incentives with respect to private payers and patients.

2 Policy Background: HRRP and HVBP

The adoption of the Medicare prospective payment system (PPS) in 1983, in which Medicare payments changed from pure fee-for-service to a capitated amount for each inpatient stay depending on diagnosis, generated incentives for hospitals to cut “excessive” procedures. PPS also created incentives for hospitals to discharge patients quickly. By 2011, Medicare paid $24 billion per year for 1.8 million hospital *readmissions* – admissions to any hospital within 30-days of discharge. While some readmissions are unavoidable, HRRP was a cost containment in the ACA designed to levy penalties on hospitals with “excessive” readmissions.

Starting in FY 2013 (October 2012-September 2013), HRRP penalized hospitals for which 30-day readmissions for acute myocardial infarction (AMI), heart failure (HF), and pneumonia (PN) exceeded

[3]Clemens & Gottlieb (2017), who study the market for physician services and find that private payments decreased following a reduction in Medicare payment rates. In our setting, payment rates are held constant and penalties are applied based on lagged quality.

risk-adjusted thresholds constructed as a function of national averages. Recall that this assessment was based on data collected from July 2008 through June 2011. In this first year of the program, hospitals faced a maximum cut in Medicare payments of 1% across all DRGs. In FY 2015, the maximum penalty increased to 3%, total penalties rose to $420m (Rau, 2015), and applicable conditions were expanded to include chronic obstructive pulmonary disease (COPD) and total hip and knee replacements. The Congressional Budget Office (2010) estimates that HRRP would reduce hospital payments from Medicare by $113 billion through 2019. There is also strong evidence suggesting that hospitals were aware of the potential impact of HRRP. For example, a national survey of hospital leaders found that nearly two-thirds of respondents reported that HRRP had a substantial impact on their hospital's efforts to reduce readmissions compared to prior readmission policies (Joynt *et al.*, 2016).

By contrast, the HVBP program is rooted in a standard principal-agent model in which the principal (CMS in this case) contracts with agents (hospitals) to provide quality care to Medicare enrollees. The HVBP program scores hospitals based on their achievement (comparison to other hospitals) as well as their improvement (comparison to their own previous performance). Similar to HRRP, HVBP bases changes in payments on past quality, with data collected over the same lagged time period as in HRRP. However, unlike HRRP, the HVBP program is funded by reducing all hospitals' base operating Medicare severity diagnosis-related group (MS-DRG) payments and creating rebate incentives depending on defined quality metrics. The percentage reduction increased annually up to 2%. The program defines several quality domains and converts measures of quality within each domain to points, which are aggregated and mapped to a total point score. The total point score determines the magnitude of the payment change, which may be positive or negative depending on if a hospital generates a rebate large enough to offset the reduction.

More generally, an active theoretical literature connects reimbursement models to patient outcomes, quality metrics, and social welfare (Adida *et al.*, 2017; Guo *et al.*, 2019). That literature emphasizes that alternative payment models may generate incentives for providers to engage in patient selection, "cream-skimming" healthier patients to reduce exposure both to P4P penalties and zero-marginal revenue payment methods (i.e., bundled payments). For example, Adida *et al.* (2017) develop a model of a provider under alternative payment schemes who potentially engages in patient selection, and they show that fee-for-service generates incentives for excessive treatment intensity, but it does not cause providers to engage in patient selection. Bundled payment, on the other hand, generates incentives for providers to cream-skim depending on the size of the bundled payment and the provider's degree of risk aversion.

Since the goal of both HRRP and HVBP is to improve hospital quality, a recent literature examines the effects of HRRP/HVBP on hospital readmission rates and other quality metrics. The existing literature in this area remains mixed. Gupta *et al.* (2018) find that HRRP was associated with a 1.6 percentage-point reduction in 30-day Medicare readmissions for heart failure but a 1.4 percentage-point *increase* in 30-day mortality. Gupta (2020), however, finds evidence of a reduction in Medicare hospital mortality rates (a decrease of about 3%, significant at the 10% level) from HRRP, which may account for as much as 60% of the reduction in readmissions. Mellor *et al.* (2016) similarly find that HRRP led to a decline in Medicare AMI 30-day readmission rates; however, evidence from Ibrahim *et al.* (2017) suggests that observed decreases in readmissions may have been driven by hospitals coding patients more severely and not by "real" quality improvements. Consistent with this result, Wilcock *et al.* (2018) find that the majority of HRRP penalties are a reflection of poor risk adjustment in the penalty calculation and not of true, underlying hospital quality.

Regarding HVBP, the literature generally finds little or no effect on hospital quality (Ryan *et al.*, 2015; Doran *et al.*, 2017; Norton *et al.*, 2017; Ryan *et al.*, 2017). Examining data from 2015 to 2016, Norton *et al.* (2017) did find some hospital response to HVBP, but this response was in specific areas with the greatest marginal revenue rather than those areas with larger quality benefits. Conversely, based on quality data from 2005 through 2014, the Government Accountability Office (2015) found no effect of HVBP on quality. This study also interviewed a handful of hospital officials and concluded "the HVBP program generally reinforced ongoing quality improvement efforts, but did not lead to major changes in focus." Friedson *et al.* (2016) offer an explanation for these findings, where the authors find that HVBP does not sufficiently discriminate between hospitals, and whether hospitals are penalized or rewarded by the HVBP program is largely a matter of chance rather than a reflection of true underlying quality.

3 Empirical Analysis

3.1 Data

Our primary data come from the Health Care Cost Institute (HCCI) and consist of over 3 million hospital-level claims from three large health insurance firms. The data account for roughly 28% of all individuals under the age of 65 with employer sponsored health insurance over the period of 2010 through 2015. To these data, we merge information on HRRP and HVBP penalties/rewards and other hospital cost information from the Healthcare Cost Report Information System (HCRIS); hospital-level characteristics such as bed count, for-profit status, and system membership from the American Hospital Association (AHA) annual surveys; data on a hospital's payer mix (i.e., the number and share of Medicare, Medicaid, or private insurance patients) also from HCRIS; and county-level demographic characteristics from the American Community Survey (ACS). We restrict our sample to urban community hospitals in the contiguous United States that have at least 30 staffed beds and at least 25 admissions in a given year. Our final sample consists of 1,386 hospitals and 8,316 hospital/year observations.[4]

To construct a measure of private payer payment rates, we aggregate the individual-level claims to the hospital/year level for three reasons. First, hospital payments are often bundled across services, so individual-level claims introduce additional noise, especially when procedures are common across multiple bundles. Second, HRRP/HVBP penalties are at the hospital-level — via a reduction in total Medicare payments — such that our source of identifying variation is at the hospital level. Finally, aggregating to the hospital-level is consistent with the literature in which researchers model private payments. Indeed, we follow Gowrisankaran *et al.* (2015), who use similar payment data from Northern Virginia, and aggregate payments to the hospital-level by dividing the total payment for each claim by the appropriate DRG weight and regressing this amount on individual (claimant) characteristics and hospital fixed effects. Using the estimated regression results, we predict the risk-adjusted mean hospital payment for a given year, which

[4]We also consider alternative samples in which we allow for missing net penalty values from HCRIS or where we arbitrarily set missing HRRP/HVBP values to 0 (e.g., under the assumption that missing values indicate that the hospital was excluded for the program in that year). Results from these samples are similar to those presented in the text and available upon request.

reflects the mean bargained payment.[5] All dollar valued variables are in real, 2010 dollars using the medical consumer price index for all urban consumers.

The log of the annual, within-hospital mean of private insurance payments constitutes our primary payment dependent variable. For brevity, we refer to this variable simply as the log mean payment. For comparison with the literature who lack such rich private payer data, we also construct a separate dependent variable payment measure based on the average net revenue for non-Medicare inpatient discharges, which we call the log mean net charge (Dafny, 2009). Since Medicaid revenues are not provided in HCRIS, the log mean net charge measure is a weighted average of net revenue per discharge for commercially insured and Medicaid patients where the weights equal the share of inpatient discharges belonging to each payer. To eliminate outlier log mean net charge values, we trim the lower and upper tails at the 5th and 95th percentile of the resulting payment distribution, and we normalize this estimated payment based on the hospital's observed case mix index (CMI) from the inpatient prospective payment system (IPPS) final rule files. This same measure has been used in recent studies examining hospital pricing behavior, including Schmitt (2018) and Lewis & Pflum (2015). Finally, we also model payer-specific discharges because of the natural connection between the level of payment and the volume of patients. These measures include the log number of Medicare discharges, the log number of Medicaid discharges, and the log number of other discharges (non-Medicare and non-Medicaid).

Table 1 presents summary statistics of our payment, charge, and discharge dependent variables across hospitals by fiscal year, along with the fraction of hospitals that received an HRRP/HVBP penalty. While average risk-adjusted payments received by hospitals increase by roughly 5% annually between 2010 to 2015, Table 1 demonstrates that the mean number of public patient discharges (Medicare and Medicaid) falls and the mean number of other discharges, which are mainly privately insured patients, increases. In addition to this variation, within-hospital patient mix may vary considerably over time as a function of public payments, which is why we treat payer-specific discharges as separate dependent variables in our econometric models that follow. Secular trends in these variables highlight the importance of fiscal year fixed effects in any econometric model of these outcomes. The last column of Table 1 shows the fraction of

[5] In the Appendix, we describe this process formally. We also present payment regressions at the individual level. Results at the individual and hospital levels are very similar.

hospitals subject to a net Medicare payment reduction. Note that the CMS fiscal year runs from October through the following September. Because of discrepancies between the fiscal year of the hospital and that of CMS, 32% of hospitals faced a penalty in their 2012 FY. By FY 2015, 79% of hospitals faced some payment reduction. The average penalty amount (in 2010 dollars) among hospitals ever penalized was $230,759, which increased from $187,467 in the first full year of the program (FY 2013) to $313,356 in FY 2015. With non-penalized hospitals receiving an average bonus of just over $74,000, the average relative payment reduction among penalized hospitals was around $305,000.

Table 1. Characterization of Research Sample over Time

Fiscal Year	Sample Size	Payment $ Mean (St. Dev.)	Medicare Discharges	Medicaid Discharges	Other Discharges	Percent Penalized
2010	1,386	10,729.22 (4,936.50)	4,614.62	2,010.11	7,898.18	0.00
2011	1,386	11,955.76 (5,230.90)	4,618.93	1,960.05	7,892.21	0.00
2012	1,386	12,903.58 (5,851.06)	4,493.31	1,810.27	8,019.04	0.32
2013	1,386	13,865.71 (6,093.97)	4,396.32	1,783.81	7,996.10	0.74
2014	1,386	14,340.29 (6,101.33)	4,260.43	1,726.25	7,852.71	0.76
2015	1,386	15,409.87 (6,811.15)	4,311.41	1,578.86	8,261.74	0.79
Total	8,316	13,200.74 (6,068.58)	4,449.17	1,811.56	7,986.67	0.43

Notes: Table presents summary statistics on a balanced panel of hospitals between 2010 and 2015. Payment represents the mean dollar amount paid (in 2010 dollars) to a hospital in a year over all acute care admissions. Penalty is a binary variable for whether the combination of HRRP and HVBP resulted in a net payment reduction. Other discharges denotes all discharges other than Medicare and Medicaid.

3.2 Research Design

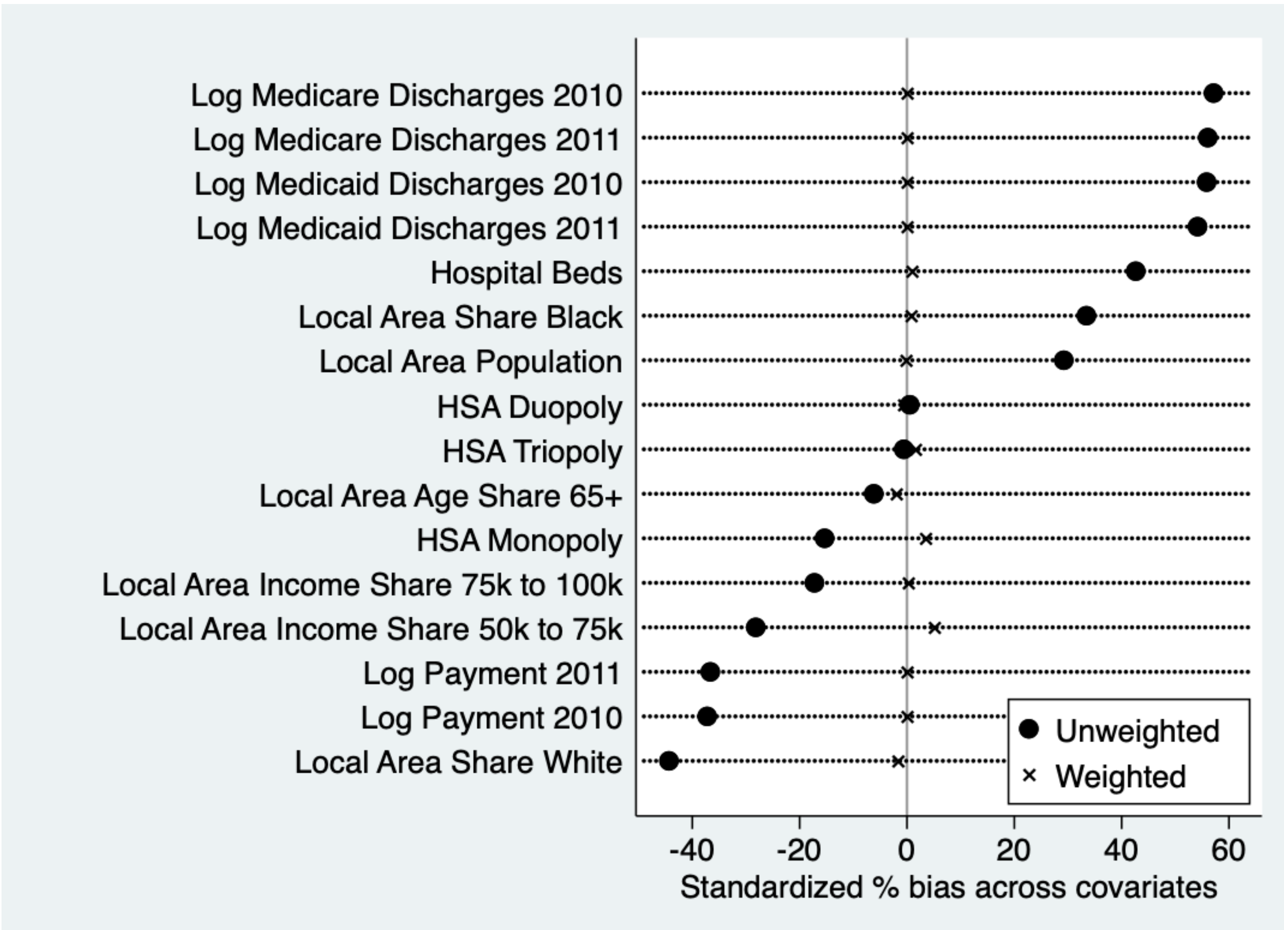
Our hypothesis is that the presence and magnitude of HRRP/HVBP reductions in Medicare payments may affect the negotiated payment rates that hospitals receive from private payers. If financial penalties realized through HRRP/HVBP cause hospitals to disproportionately adjust practices in ways that are valuable to private payers, then we expect to see private payment rates increase in penalized hospitals relative to non-penalized hospitals, and we expect this gap to increase in the size of the financial penalty. Furthermore, changes in Medicare reimbursement (through HRRP/HVBP penalties) and changes in private payer payment rates (through our main hypothesis) change the incentives to see public and private patients, respectively. Thus, we also hypothesize that the volume of public and private patients may be sensitive to extent of HRRP/HVBP penalties. While HRRP/HVBP generate incentives for all hospitals, our assumption, which is consistent with the HRRP/HVBP literature, is that the salience of financial penalties generated significantly greater incentives. Thus, our goal is to estimate the causal effects of HRRP/HVBP penalties (both along the extensive and intensive margins) relative to non-penalized hospitals.

Yet, HRRP/HVBP financial penalties are not randomly assigned — penalized hospitals likely vary on other dimensions (observed or unobserved), and to the extent that these dimensions are correlated with payments, a simple comparison of penalized and non-penalized hospitals following HRRP/HVBP would generate a biased estimate of the causal effect of a financial penalty on payments. To investigate, we calculate the standardized percentage bias – the percentage difference in the sample means between ever and never penalized hospitals divided by the square root of the average of the sample variances each group – for a variety of outcomes and covariates in 2010 and 2011, prior to HRRP/HVBP. Rosenbaum & Rubin (1985) suggest that standardized percentage bias of more than 20% in any one covariate or outcome implies an unbalanced sample between treatment and control units. Figure 1 presents the calculated bias (black dots) for both outcomes and covariates ranked by the degree of bias. For example, the standardized percentage bias of the log of the count of Medicare discharges in 2010 is 55%, which suggests that those hospitals that *will eventually be* penalized under HRRP/HVBP discharge a much higher fraction of Medicare patients. According to Figure 1, prior to HRRP/HVBP, penalized hospitals are significantly larger, as measured by the number of beds; they serve a much higher proportion of Black patients; and they receive significantly lower private payer payment rates.

To address the differences highlighted in Figure 1, we follow Hainmueller (2012) and generate maximum entropy weights based on the pre-HRRP/HVBP covariates and outcomes in Figure 1. To construct the weights, we use all covariates and outcomes listed in Figure 1, which capture the extent of observable heterogeneity prior to HRRP/HVBP.[6] Applying these weights to never-penalized hospitals, Figure 1 demonstrates the reduction in standardized percentage bias relative to the unweighted sample. Impor-

[6]See Hainmueller & Xu (2013) for technical details.

Figure 1. Covariate Balance



Notes: Figure presents the entropy weighted and unweighted standardized percentage bias for several covariates and outcomes. Standardized percentage bias is the percentage difference in the sample means between ever and never penalized hospitals divided by the square root of the average of the sample variances each group. Covariates are averages over the pre-HRRP/HVBP period. Outcomes such as a log discharges and log payments are specific to each year prior to HRRP/HVBP.

tantly, the weights are time invariant because they are based on year-specific pre-HRRP/HVBP outcomes and average pre-HRRP/HVBP covariates, and we apply these weights to the group of "never" penalized hospitals over all years, 2010-2015, in all regression models. We estimate within-hospital fixed effects regressions of our payment and discharge dependent variables on different measures of the financial penalties associated with HRRP/HVBP. Because Table 1 demonstrates variation in the timing of penalties, we also estimate event study two-way fixed effects estimators that isolate the effects for hospitals first penalized in each year of HRRP/HVPB (Goodman-Bacon, 2018).

3.3 Regression Analysis

Our preferred empirical specification isolates within-hospital variation in our dependent variables (payments and discharges) over time by whether a hospital faces a net penalty from HRRP/HVBP. To begin, we estimate an entropy-weighted two-way fixed effects estimator as a function of the extensive margin of penalty. Equation 1 presents our main empirical model:

$$y_{ht} = \alpha_h + x_{ht}^{'}\beta + \delta 1[Penalty_{ht}] + \sum_{j=2011}^{2015} \theta_t 1[t = j] + \epsilon_{ht}, \quad (1)$$

where outcome y_{ht} at hospital h in fiscal year t is a function of a hospital specific intercept, α_h; a vector of time-varying hospital and market-level exogenous characteristics, x_{ht}; an indicator for a net penalty under the combination of HRRP/HVBP policies; controls for year effects, θ_t; and an error term ϵ_{ht}. Because the penalty indicator is zero for all hospitals in 2010 and 2011, and because we include hospital fixed effects, Equation 1 represents an unscaled difference-in-differences estimator, which constitutes a weighted average of four difference-in-differences estimates corresponding to the four years in which a hospital may have first been penalized (Goodman-Bacon, 2018). Our parameter of interest, δ, captures the extent to which hospitals penalized under the HRRP/HVBP receive differential private payments relative to hospitals with no penalty (which includes hospitals that received a bonus).

The top panel of Table 2 presents separate estimates of δ for the log of mean payments, the log of mean net charges, and payer-specific (log) discharges.[7] From the second column of Table 2, we see that hospitals that faced payment reductions increased payments by 1.9% over the period of 2012-2015. This represents a roughly $264 increase in payments among penalized hospitals, on average.[8] Column 2 presents estimates from a similar model in which we replace negotiated payments with the log mean net charge, as discussed previously (Dafny, 2009; Lewis & Pflum, 2015; Schmitt, 2018; Dranove *et al.*, 2017). Results in column 2 suggest a statistically insignificant change in log mean net charges for penalized hospitals, which we argue demonstrates the importance of using actual payment data. Columns 3 and 4 of Table 2 show movement *away* from Medicaid and Medicare patients for penalized hospitals, with discharges decreasing by 4.5% and 3.1%, respectively. Only the Medicare discharge results are statistically significant. In Column 5, we find no statistical change in other (i.e., private) discharges.

To investigate the intensive margin effect of penalties on payments, we break the distribution of penalty size into quartiles and replace the indicator for net penalty in Equation 1 with indicators for each of the four penalty quartiles, where the omitted category represents those hospitals with either no penalty or a net bonus in Medicare reimbursements. The first column presents the mean penalty size and range within each quartile. Regression results are presented in the bottom panel Table 2 for each dependent variable, as well as the mean penalty per Medicare discharge and its range within each quartile. Consistent with our extensive margin results, we find that average payments are significantly higher in penalized hospitals relative to those receiving no change or a small bonus. We find no effect on payments for hospitals in the first (smallest) quartile of penalties; however, we find a 3.2% increase in mean payments for hospitals in the highest quartile of penalties. These results suggest that private payment increases are larger as the HRRP/HVBP penalty increases. Furthermore, we find monotonically increasing negative effects of a penalty on Medicaid and Medicare discharges in the size of the penalty. In the most penalized hospitals, both Medicaid and Medicare discharges drop by 8.9%.

[7]The Appendix presents the full set of estimates for all covariates.

[8]This interpretation is based on the average private insurance payment of $14,200 among penalized hospitals after FY 2012 (in 2010 dollars). Assuming this average payment reflects a 1.9% increase in the average payment in the absence of the penalty, we calculate the effect in dollar terms as $\$14,200 - \frac{\$14,200}{1+0.019}$.

Table 2. Entropy-Weighted Regression Results

Penalty Quartile	Mean Penalty Per Medicare Discharge [1%, 99%]	Log Mean Payment	Log Mean Net Charge	Log Medicaid Discharges	Log Medicare Discharges	Log Other Discharges
		Extensive Margin of Penalty				
Net Penalty	45.67	0.019**	-0.004	-0.045	-0.031***	-0.004
	[0.431, 199.082]	(0.008)	(0.016)	(0.032)	(0.016)	(0.021)
Quartile		Intensive Margin of Penalty: Reference Category = No Penalty or Bonus				
1	$6.62	0.005	-0.000	-0.004	0.001	0.012
	[$0.14, $13.92]	(0.008)	(0.015)	(0.031)	(0.015)	(0.019)
2	$22.48	0.024***	-0.008	-0.047	-0.018	-0.005
	[$13.95, $32.64]	(0.008)	(0.017)	(0.033)	(0.016)	(0.024)
3	$46.82	0.019**	-0.014	-0.055	-0.032*	-0.041
	[$32.56, $64.41]	(0.009)	(0.019)	(0.039)	(0.018)	(0.026)
4	$106.76	0.032***	0.007	-0.089*	-0.089***	-0.030
	[$64.17, $261.72]	(0.012)	(0.021)	(0.049)	(0.019)	(0.034)

Notes: $n = 8,316$. The top panel presents estimates of δ from Equation 1. The bottom panel breaks the distribute of penalty size into quartiles and estimates a version of Equation 1 relative to no penalty or a bonus. All regressions adjust never penalized hospitals with entropy weights and include hospital and year fixed effects. Other hospital level controls include bed count, number of nurses, and number of other non-medical staff. Market power variables are constructed using the overall hospital service area. Large market is a binary variable for a hospital in the top half of the market size distribution. In cases in which independent variables are missing, we recode them and control for missing variable indicators to ensure a balanced panel. Standard errors are clustered at the hospital level. The range of penalties is the 1st and 99th percentile within a quartile or, in the extensive margin case, overall. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. $n = 8,316$. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

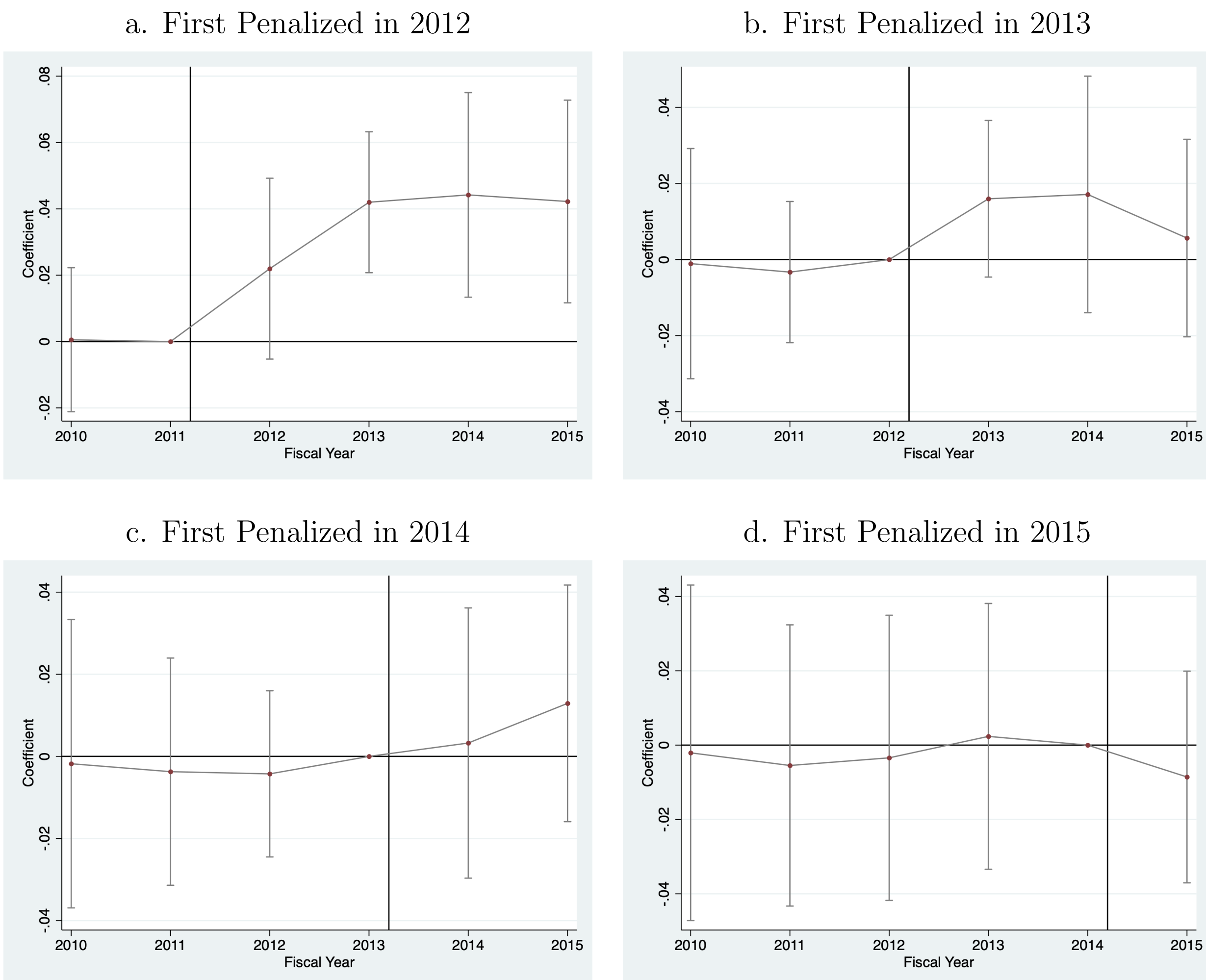
3.4 Event Study Analysis of Payments

For a causal interpretation of the results in Table 2, the underlying assumption in Equation 1 is that there are no time-varying characteristics that differentially affect payments in penalized hospitals relative to non-penalized hospitals net of our time-varying controls and fiscal year fixed effects. While we cannot test this assumption, we can look to conditional trends in outcomes prior to HRRP/HVBP. Furthermore, given concerns over the validity of two-way fixed effect estimates when treatment is realized for different observations in different periods (Goodman-Bacon, 2018), we test for evidence of differential pre-trends with event studies for each possible fiscal year in which a penalty might first be realized. Note that in our data, we have four different treatment groups defined by hospitals first penalized in 2012, 2013, 2014, or 2015, respectively, and there is substantial persistence in treatment such that most hospitals penalized in year t are also penalized in years $t + 1$, $t + 2$, etc. To estimate event studies for each treatment year, we interact the penalty dummy variable with year dummy variables and estimate separate treatment coefficients in each year (relative to the year prior to the penalty). For example, for those hospitals first penalized in fiscal year 2013, we normalize the coefficient on the interaction between a dummy variable for fiscal year and HRRP/HVBP penalty to zero, and we estimate two lag periods and two post-treatment periods. Each separate regression is estimated with entropy weights that are calculated based on the relevant pre-HRRP/HVBP outcomes.

Results with respect to our main payment variable are presented in Figures 2a-2d for each year in which a hospital could first be penalized. Unsurprisingly, given our use of entropy weights based on pre-period payments, Figures 2a-2d show no statistical evidence of pre-trends in payment leading to a hospital's first financial penalty.[9] Furthermore, Figure 2a suggests that hospitals first penalized in 2012 drive our overall results in Table 2. For those hospitals first penalized in 2012, payments increase relative to never penalized hospitals gradually over time, consistent with the fact that most provider/payer contracts are not re-negotiated each year. By 2014 and 2015, mean payments are roughly 4% higher. Figure 2b shows a small but imprecisely estimated increase in payments among the 2013 treatment group, and Figures 2c-2d show no evidence of a meaningful effect of penalties on payments.

[9] We find similar results for each of the discharge outcomes presented in Table 2. Results available upon request.

Figure 2



Notes: Figure presents estimates from separate event study estimators for the first instance of an HRRP/HVBP penalty. All regressions are estimated with separate entropy weights based on pre-HRRP/HVBP outcomes. Regressions include hospital and year fixed effects and the same controls used in Table 1. Brackets indicate the 95% confidence interval associated with each coefficient.

3.5 Summary of Results

To summarize, our results indicate that mean hospital payments increased by 1.9% in hospitals that experienced a net penalty from HRRP/HVBP. The effect size grows in the size of the financial penalty, with the highest penalized hospitals seeing a 3.2% increase in mean payments. We document evidence that publicly insured discharges declined, with Medicare discharges falling 3.1% overall and 8.9% in the most penalized hospitals. Finally, we show that hospitals first penalized in 2012 likely drove the above effects, with a 4.4% increase in mean payments two to three years after the initial 2012 penalty. Using entropy weights to achieve balance in pre-period covariates and outcomes, there is no evidence of differential pre-trends; however, the results do not hinge on our use of entropy weights, which we document in the Appendix.

Results in Table 2 and Figure 2 are consistent with our main hypothesis - penalized hospitals were able to increase the average payment received from private payers while also reducing their exposure to publicly insured patients. What remains to be seen is how and why these changes occurred. One simple explanation is that, by reducing exposure to publicly insured patients, hospitals were able to reallocate resources towards privately insured patients, which was rewarded with higher payment rates. Alternatively, private discharges may have gone up in the absence of the payment rate change, and instead hospitals, on average, chose to push for a higher margin on fewer patients. Unfortunately, our data are not rich enough to separately identify these dynamics. Instead, we examine other factors such as quality and process of care changes that could have led to higher payment rates. In what follows, we examine both heterogeneity in our main effects and mechanisms that may drive them.

4 Heterogeneous Effects

If HRRP/HVBP penalties induce some hospital behaviors that ultimately affect private insurance payments, then there are several dimensions by which we would expect effect sizes to vary. Perhaps the most natural source of variation is across service lines, particularly since only selected conditions are included as part of the HRRP/HVBP penalty calculations. Therefore, we examine heterogeneity across service lines by estimating Equation 1 for the log of mean payments within selected acute care admission service categories. Estimates of the extensive margin of penalties parameter δ are presented in Table 3 for several specific categories.[10]

By far the largest change in mean payments is with respect to circulatory system claims, where we find a 4.4% increase in payments among penalized hospitals. As two of the three original HRRP metrics where circulatory procedures (i.e., heart failure and AMI readmissions), results in Table 3 suggest that hospitals

[10]For each admission category, we restrict our sample to hospitals with at least 25 admissions in that category in each year of our sample.

Table 3. Log Payments for Condition Specific Admissions

	Nervous System	Respiratory System	Circulatory System	Musculoskeletal System	Labor and Delivery	Neonatal
Net Penalty	0.024	0.019	0.044***	0.000	-0.001	0.024*
	(0.019)	(0.020)	(0.012)	(0.011)	(0.008)	(0.015)
n	1,410	1,758	2,754	3,060	5,226	3,204
Mean	13,762.86	12,015.13	13,071.17	12,981.58	11,308.56	8,911.19

Notes: Each dependent variable is the log of mean payments within each service category. All regressions include hospital and year fixed effects. All regressions are estimated with entropy weights as discussed in the text. Further controls include those in our baseline specification for mean payments. In cases in which independent variables are missing, we recode them and control for missing variable indicators to ensure a balanced panel. Standard errors are clustered at the hospital level. We restrict the sample to include at least 25 admissions per hospital per year. *** p-value<0.01, ** p-value<0.05, * *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

and private payers increased payments in the area most associated with HRRP/HVBP.[11]

Given that payments are negotiated between providers and commercial insurers, another potentially important source of heterogeneity in our estimates is a hospital's relative bargaining power (Dor *et al.*, 2004; Gowrisankaran *et al.*, 2015; Lewis & Pflum, 2015; Ho & Lee, 2017). To investigate, we proxy for a hospital's bargaining position by following Wu (2010), who intuits that a hospital with a large share of private patients represents an important client for private payers, and thus maintains significant bargaining power over payment rates.[12] Thus, we construct a measure of a hospital's share of public patients relative to total patients, and we interact our penalty variable with indicators for each quartile of the public share distribution. We then estimate Equation 1 for each dependent variable as a function of these interactions between public share quartile and penalty status.

The top panel of Table 4 presents estimates of the base net penalty coefficient, which reflects the effect of a net penalty on the dependent variable for those hospitals with the smallest share of public patients, and the interaction coefficients between a net penalty and public share quartile binary variables. Results suggest that our initial estimate on the extensive margin in Table 2 is driven by hospitals with the smallest

[11] As opposed to results in Table 2, results in Table 3 are sensitive to the use of entropoy-weights - in the absence of such weights, the increase in circulatory claim payments is only 1.9%.

[12] Applying this intuition to a study of hospital cost-shifting following the Balanced Budget Act of 1997, Wu (2010) finds that hospitals with larger shares of private patients were more able to pass Medicare payment reductions on to private payers.

share of public patients. Indeed, the first column of Table 4 demonstrates that payments increased by 4.1% for hospitals with the smallest share of public patients, an effect that is nullified for those hospitals with the largest share of public patients (i.e., 0.041-0.044). We find little evidence that the share of public patients significantly shifts the change in Medicare, Medicaid, or other discharges as a result of an HRRP/HVBP penalty.

Table 4. Effect Heterogeneity

	Log Mean Payment	Log Mean Net Charge	Log Medicaid Discharges	Log Medicare Discharges	Log Other Discharges
Market Power Interactions					
Net Penalty	0.041***	0.020	0.010	-0.028	-0.013
	(0.016)	(0.024)	(0.041)	(0.020)	(0.021)
* Public Share 2	-0.016	0.000	-0.027	0.016	0.003
	(0.014)	(0.020)	(0.055)	(0.017)	(0.019)
* Public Share 3	-0.023	-0.035	-0.013	0.003	0.002
	(0.015)	(0.022)	(0.049)	(0.018)	(0.027)
* Public Share 4	-0.044***	-0.053**	0.002	-0.010	-0.021
	(0.017)	(0.024)	(0.046)	(0.021)	(0.026)
Hospitals Integrated Vertically with Physician Groups Prior to 2012					
Net Penalty	0.021	-0.011	0.033	-0.001	0.020
	(0.015)	(0.028)	(0.037)	(0.021)	(0.038)
Hospitals Never Observed to be Vertically Integrated with a Physician Group					
Net Penalty	0.005	-0.020	-0.131**	-0.047***	-0.015
	(0.010)	(0.034)	(0.051)	(0.015)	(0.018)

Notes: All regressions include hospital and year fixed effects. All regressions are estimated with entropy weights as discussed in the text. Further controls include those in our baseline specification for mean payments. The share of a hospital's patients insured by the public sector is broken into quartiles and interacted with penalty variables. In cases in which independent variables are missing, we recode them and control for missing variable indicators to ensure a balanced panel. Standard errors are clustered at the hospital level. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

Of course, hospitals with a large share of private patients must have a small share of public patients, which implies that the total dollar value of HRRP/HVBP would be lower. Thus, despite having more market power, these hospitals may have less incentive to adjust. As a result, we study another proxy for bargaining position based on whether a hospital is aligned with its network of physicians. Lewis & Pflum (2015), for example, find that hospitals that are affiliated with a physician group are able to negotiate a larger share of surplus. Vertical integration with physicians may therefore put some hospitals in a more favorable bargaining position, and thus facilitate a larger increase in private payments. To investigate, we estimate our preferred empirical model on data from only those hospitals that already owned a physician group or physician practice *prior* to 2012.[13] Thus, we estimate Equation 1 on only hospitals observed to be vertically integrated with a physician group prior to 2012. As shown in Table 4, among those hospitals already vertically integrated, the effect of a net penalty on payments is 2.1% but not statistically significant. Meanwhile, penalties are associated with a small and statistically insignificant effect on payments among those hospitals never observed to be vertically integrated.[14]

Results in Table 4 suggest that bargaining power may be important in translating HRRP/HVBP penalties into higher payments, but these results are sensitive to how one measures bargaining power in the data. We also tested for differential effects of a HRRP/HVPB penalty among hospitals operating as a monopoly, duopoly, or triopoly. Here, we found a positive but statistically insignificant effect of the interaction between a monopoly indicator and the penalty indicator, with a point estimate of 0.013. We estimated smaller and statistically insignificant effects on other interaction terms between penalty status and duopoly or triopoly indicators. This pattern of results persists for different measures of the hospital market.[15]

5 Mechanisms for Payment Increases

The results in Section 3 provide strong empirical evidence that penalized hospitals were able to increase private insurance payments. The effect size varies along several dimensions, but on average, we estimate

[13]The AHA surveys provide information at the hospital-level on whether a hospital currently has an "integrated salary model." This measure unfortunately does not capture *how many* physicians are employed by a hospital, but instead only captures if there is any integrated model reported between the hospital and any of its physicians.

[14]We also considered whether the penalty itself led to more integrated salary models by treating the binary integration measure as an additional outcome. Here, we estimate a very small and insignificant negative effect of being penalized on the probability of reporting an integrated salary model, suggesting that penalized hospitals were not integrating with physicians due to the penalty. These results are limited by the nature of our vertical integration data and are therefore excluded from the paper but available upon request.

[15]For brevity, the full results from these specifications are excluded from the paper but are available upon request.

an increase in private insurance payments to hospitals by 1.9%. It is unclear, however, exactly how a hospital could translate a penalty into higher mean private insurance payments, especially relative to non-penalized hospitals. While we find a significant reduction in publicly insured discharges, we do not find any meaningful change in the level of privately insured discharges, which suggests that our payment results cannot be explained by standard demand arguments. However, the reduction in publicly insured patients may indicate some reallocation within a hospital. In that light, we consider different mechanisms that may have facilitated the estimated increase in mean payments.

5.1 Changes in Hospital Quality

Since HRRP and HVBP are designed to improve hospital quality, it may be that hospital quality improvements ultimately led to our estimated payment increases. As discussed in Section 2, most of the existing studies of HRRP/HVBP on quality tend to focus on the Medicare population, but to explain increases in private insurance payments, we need to consider the effects of HRRP and HVBP on quality among private insurance payments. We are not aware of any evidence in the literature suggesting that quality in the private insurance market improved due to HRRP or HVBP programs. Indeed, in a study of private insurance patients in Florida and California, Demiralp *et al.* (2017) find no evidence that HRRP reduced the readmission rate among the non-Medicare population. To test this in our data, we directly investigate whether penalized hospitals improved quality (as measured by readmissions) in the commercial insurance market.[16] We estimate the effect of hospital penalty status on the probability of readmission using a linear probability model with data at the individual admission level. Following the Agency for Healthcare Research and Quality definition, we classify a readmission to be any admission to any inpatient prospective payment hospital within 30 days of a discharge.[17]

Our linear probability model of individual readmission on hospital-level penalty includes all controls from our main specification plus patient controls such as age range, gender, length of stay, DRG weight,

[16]Our data do not have a reliable measure of mortality. We therefore focus the analysis on readmissions. We also note that our data include inpatient stays in which the patient may have died in the hospital or soon after; however, given the age composition of the commercial sample, death is likely to be less frequent than in the Medicare population.

[17]See 2017 AHRQ Statistical Brief #230 for additional details on the readmission calculations. Our sample excludes newborns and transfers, and we limit the analysis to all patients with 12 months of private insurance coverage in a calendar year.

insurance product type (HMO, PPO, POS, EPO), and DRG fixed effects. As summarized in column 1 of Table 5, the results demonstrate that, even with a sample of over 3 million observations, we find an economically and statistically insignificant effect of penalty status on the probability of readmission.[18] To the extent that penalized hospitals are investing in quality to lower Medicare readmissions among the indicated areas, we find no evidence that such quality improvements are changing readmissions on average for the commercially insured population.

Table 5. Potential Mechanisms

	Patient-Level Readmission	Log Cost per Discharge	Log Charge	Profit Index	Average DRG Weight
Net Penalty	-0.001	-0.002	0.010	-0.002	-0.003
	(0.001)	(0.011)	(0.008)	(0.003)	(0.007)
n	3,345,641	8,238	8,316	8,316	8,316

Notes: All regressions include hospital and year fixed effects, and other hospital level controls include bed count, number of nurses, and number of other non-medical staff. All regressions are weighted with entropy weights as discussed in the text. In cases in which independent variables are missing, we recode them and control for missing variable indicators to ensure a balanced panel. Standard errors are clustered at the hospital level. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. *** p-value<0.01, ** p-value<0.05, * p-value<0.1.

More generally, it may be that penalized hospitals incurred some costly investments, perhaps with the aim of improving quality of care. While our data are limited in these areas, we also estimated the effect of hospital penalty status on the log of cost per discharge (hospital-wide).[19] As seen in column 2 of Table 5, we again find no significant or economically meaningful effects of being penalized on hospitals' average costs per discharge.

5.2 Changes in Services or Treatment Intensity

Since our outcome is calculated as an average payment per patient, our results could simply reflect increases in the intensity of treatment rather than an increase in the payment received for an otherwise identical

[18] We also estimate the model using the lagged net penalty, where we again find an economically and statistically insignificant effect of penalty status on the probability of readmission.

[19] We calculate costs per discharge based on data available in HCRIS.

service. Using our data on private payments, we therefore consider the extent to which hospitals respond to public penalties by changing treatment patterns or reallocating resources towards more profitable services. We first estimate the effects of Medicare payment reductions on charges among the commercial insurance population. This analysis uses within-hospital variation in charges as a general proxy for changes in intensity of treatment, with results presented in column 3 of Table 5. Here, we find no economically or statistically significant increase in charges among penalized hospitals.

We also follow Horwitz & Nichols (2009) in constructing a set of indicators for "profitable" (e.g., angioplasty or neonatal intensive care) versus "unprofitable" (e.g., alcohol dependency services or hospice care) hospital services.[20] We then constructed a "profitable services index" calculated as the ratio of profitable services to all profitable and unprofitable services identified by Horwitz & Nichols (2009). For example, if the hospital offered 2 profitable services and 2 unprofitable services, then the ratio for this hospital would be 50%. Treating this profitable services index as an additional outcome and repeating our analysis from Section 3, column 3 of Table 5 demonstrates that we find small and insignificant effects of being penalized. A similar pattern emerges in Table 5 when we consider average DRG weights.

5.3 Hospital Cost-Shifting

An alternative mechanism behind our results may be hospital cost-shifting, in which hospitals attempt to extract higher payment levels from private insurers as a result of public payment reductions, *without changing the underlying product.* Given the stated intention of the HRRP/HVBP and existing evidence on hospital responses to these programs, we suspect that cost-shifting is *not* a major mechanism driving our results. Nonetheless, in the absence of evidence on hospital investments or quality improvements for commercial insurance patients, in the Appendix, we present a model of a utility maximizing hospital that bilaterally bargains with a private insurer. The bargaining component of the model extends that of Dranove (1988), in which hospitals directly set prices. Importantly, we obtain a prediction of cost-shifting without hospitals deriving utility from something other than profits, which is necessary for cost-shifting to occur in Dranove (1988). If we interpret diminishing marginal utility simply as a reflection of risk-aversion

[20]A full list of relatively profitable and relatively unprofitable services is provided in Table 2 of Horwitz & Nichols (2009). Following their analysis, we identify whether a hospital offers these services based on responses from the AHA annual surveys.

(e.g., in the context of uncertain demand or uncertain "exposure" to the HVBP/HRRP penalties), then this model predicts any risk-averse hospital to potentially cost shift, regardless of whether the hospital is for-profit or non-profit.[21] Intuitively, risk aversion could be introduced through the presence of risk-averse shareholders or managers/administrators. In the case of physician-owned hospitals, diminishing marginal utility of profits is analogous to diminishing marginal utility of income to the physicians, since they are the residual claimants for hospital profits. Note that the costs of additional tests, longer inpatient stays, or other complications incurred outside of the initial surgery are generally borne by the hospital rather than the physician. In this way, the presence of risk aversion is less of an issue in the market for physician services since physicians are not generally exposed to the risk of higher costs for the same patient.

6 Discussion

This paper uses novel payment data from a large, multi-payer database to investigate how hospital payments from private insurers change due to penalties introduced from a large scale hospital pay-for-performance program. We use variation in pay-for-performance incentives generated by two cost-containment policies within the ACA — the Hospital Readmissions Reduction Program and the Hospital Value Based Purchasing program — to estimate the effect of pay-for-performance penalties on average hospital payments. Collectively, our analysis offers three central findings: 1) private insurance payments increased among hospitals penalized by the HRRP and HVBP; 2) changes in payments were largest among hospitals with larger penalties and among hospitals better positioned in a bilateral negotiation with insurers; and 3) Medicare and Medicaid discharges fell significantly. To quantify the payment effect, note that our estimated 1.9% increase in payments implies an increase of $264 per inpatient stay based on an average private insurance payment of approximately $14,200 among penalized hospitals (in 2010 dollars). As a back-of-the-envelope calculation, if one assumes that this payment increase applies to around 1,100 inpatient stays per year, then we estimate a total increase in private insurance payments of up to $290,400

[21] While it is commonly assumed that for-profit firms are risk-neutral, there is an influential literature examining the role of risk aversion in the context of demand uncertainty. See, for example, Sandmo (1971), Holthausen (1979), McDonald & Siegel (1985), Guiso & Parigi (1999), Chavas & Holt (1996), Asplund (2002), and many others.

per hospital per year.[22] To put this in context, penalized hospitals saw an average penalty of around $231,000, while non-penalized hospitals received an average bonus of just over $74,000. This yields a differential payment between penalized and non-penalized hospitals of approximately $305,000. An estimated increase of $290,400 in private insurance payments therefore suggests that 95% of the cost of HRRP/HVBP penalties is passed on to private insurers in the form of higher payments. We emphasize, however, that this percentage estimate is very sensitive to small changes in our point estimates.

While our data allow us to test several mechanisms that may ultimately translate pay-for-performance penalties into higher prices, our analysis suggests that there is no single mechanism employed across all hospitals. Gupta (2020) reaches a similar conclusion when examining the mechanisms underlying reductions in Medicare readmissions due to the HRRP. More importantly, we do not find any meaningful effects on readmissions in the private insurance market, nor do we find any effects of penalties on cost per discharge (based on hospital cost reports) or the intensity of treatment. We acknowledge that granular data on hospital cost structures is notoriously difficult to obtain. Indeed, the stated goal of the HRRP/HVBP was to improve hospital quality, and a large body of anecdotal evidence suggests that hospitals actively attempted to improve their performance under these programs. We suspect that such efforts are costly to hospitals or potentially valuable to private insurers and should therefore translate into higher private insurance payments; however, to the extent that these efforts involve non-monetary investments such as changes to processes in care delivery or specific administrative oversight, we likely cannot measure these investments using existing data from hospital cost reports or claims data. Therefore, regardless of the underlying investments that may translate into higher prices, our central conclusion is that any investments due to pay for performance penalties ultimately serve to increase price without an obvious offsetting quality improvement.

We stress that these results should not be interpreted to suggest that pay-for-performance in health care is inherently bad. Instead, we interpret our results as highlighting the importance of how the pay-for-performance program is designed. In the case of the HRRP, hospitals need only be below average in

[22] Our price data are based on just over 550 inpatient stays per year per hospital and reflect nearly 30% of all commercial insurance claims. Extrapolating to 1,100 assumes that some but not all commercial insurers captured in our data would have experienced the same price increase as estimated in our analysis.

one area in order to incur some percent penalty levied on all Medicare payments. Most hospitals are not better than average in every dimension, and indeed, as the number of conditions in the HRRP has grown, so too has the percentage of hospitals penalized in a given year. In practice, the HRRP is a relatively blunt instrument that penalizes most hospitals in a given year. Subsequently, HRRP penalties may serve as a poor quality signal. The HVBP may similarly suffer from some basic design problems. For example, in tracking a hospital's performance across 20-plus metrics, it becomes difficult to discern a true quality signal from each hospital. When applied to a highly concentrated private industry, our results suggest that such pay-for-performance programs may have important effects on the private insurance population. Depending on the driving mechanism behind our results, such effects may not be seen under alternative, simplified payment models, such as the all-payer system in Maryland. Further research is needed to understand how hospitals respond to pay-for-performance programs under different payment models.

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