Vertical Alignment between Hospitals and Physicians as a Bargaining Response to Commercial Insurance Markets

SUPPLEMENTAL ONLINE APPENDIX

In this supplemental appendix, we directly examine the sensitivity of our results to potential misreporting in our measures of alignment and the influence of horizontal integration among hospitals (excluded from our initial analysis). As in our primary results in the main text, we again focus our analysis on the pooled sample with HHI measured at time $t-1$.

1 Misreported Alignment

The AHA survey collection process as well as observed data on physician-hospital alignment suggests that alignment may not be accurately reported in all cases. We explicitly allow for misreported alignment with a semiparametric monotone rank estimator (MRE), which is robust to misreported ordered outcomes (Cavanagh & Sherman, 1998; Abrevaya & Hausman, 1999; Hausman, 2001). The MRE is the $K \times 1$ coefficient vector, $\hat{\beta}$, that maximizes the objective function

$$S(b) = \sum_{i=1}^{N} M(y_i) \text{Rank}(x_i \beta), \tag{1}$$

where $M(y_i)$ is some increasing function and where $\text{Rank}(x_i\beta)$ is such that $x_1\beta < x_2\beta < ... < x_N\beta$ implies $\text{Rank}(x_m\beta) = m$. As discussed in Cavanagh & Sherman (1998) and Abrevaya & Hausman (1999), β is only identified up to a scale and requires the normalization, $|\beta_k| = 1$. Consistency then requires that $x_i\beta$ are associated with higher y_i on average. Individual misreporting is therefore allowed, provided that higher $x_i\beta$ yields higher alignment on average.[1] We estimate β using the Nelder-Mead algorithm, with $M(y_i) = \text{Rank}(y_i)$ and 95% confidence intervals calculated by taking the 97.5 and 2.5 percentiles from 200 bootstrap replications. For identification, we also set $|\beta_1| = 1$ and normalize our estimates to a vector length of one.

[1] This is a common requirement in misreporting-robust point estimates, with similar conditions imposed in the binary misreporting case (Hausman, 2001).

The estimates themselves are difficult to interpret; however, we can still examine the sensitivity of potentially mismeasured alignment by comparing estimates across different estimators. We therefore re-estimate our initial ordered probit model, again setting $|\beta_1| = 1$ and with unit vector length. The resulting coefficient estimate on lagged HHI is 0.017 from the ordered probit model (p-value < 0.01), and the 95% confidence interval from the MRE is [0.009, 0.024]. The point estimate in the ordered probit model therefore falls well within the confidence interval generated by the MRE. Moreover, the effect of HHI remains statistically significant when using the MRE. The results therefore suggest that our initial ordered probit estimates (Table 4 in the main text) are robust to mismeasurement in our physician-hospital alignment variable.

2 Influence of Horizontal Integration and Alternative Reimbursement Models

As discussed previously, vertical integration and horizontal integration are intuitively related, as larger hospital systems tend to exhibit high degrees of both horizontal and vertical integration. Horizontal integration has also been shown to increase bargaining power for hospitals (Gowrisankaran *et al.*, 2015; Lewis & Pflum, 2015). Moreover, vertical integration may be driven by a move toward population health and alternative (e.g., capitated) reimbursement models rather than by a pure bargaining motive.

Measures of horizontal integration and presence of capitated payment models were excluded in our initial analysis as these are also outcomes of insurance market concentration (Angrist & Pischke, 2009). In this section, we revisit this issue and consider additional specifications that include measures of hospital market share, the count of hospitals in the county, and the percentage of a hospital's patients for which insurance reimburses the hospital on a capitated basis. Our measures of hospital market share are based on discharges from the Healthcare Cost Report Information System (HCRIS), and we calculate market shares at the zip code level.

Results from these additional specifications are presented in Table 1, where we find larger estimated effects than our original estimates in Table 4 of the text. Differences in these estimates are expected, since these estimates now incorporate a form of selection bias reflecting the relationship between insurance market concentration and horizontal integration, as well as the relationship between insurance market concentration and an insurer's ability to negotiate a capitated payment model. Nonetheless, the qualitative finding of increased physician-hospital alignment due to insurance market concentration persists even when we control for measures of horizontal integration and the presence of capitated reimbursement models.

References

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Table 1: **Effects of Insurance Market HHI with Alternative Specifications**[a]

	(1)	(2)	(3)
HHI_{t-1}	0.527	0.665	0.773
	(0.244)**	(0.243)***	(0.270)***
	[0.259]**	[0.260]***	[0.289]***
Hospital Market Share	-0.034	-0.026	-0.184
	(0.125)	(0.125)	(0.149)
	[0.108]	[0.108]	[0.127]
No. of Hospitals in County		-0.038	-0.037
		(0.010)***	(0.011)***
		[0.012]	[0.014]***
% Capitated			0.008
			(0.005)
			[0.004]**
Marginal Effects of Insurance HHI			
Traditional	-0.151	-0.190	-0.292
Support	-0.008	-0.010	-0.101
Referral	0.038	0.048	-0.014
Employee	0.161	0.203	0.199
Equity	0.376	0.475	0.548

[a]Results based on ordered probit regressions. Standard errors in parenthesis are clustered at the MSA level, and standard errors in brackets are clustered at the hospital level. Coefficient estimates are presented in the first row with marginal effects in subsequent rows. Regressions include hospital specialty, number of staffed beds, system affiliation, teaching status, not-for-profit or for-profit ownership, as well as time and state fixed effects. County demographic variables also included in the regressions but excluded from the table are total population, percent ages 18 to 34, percent ages 35 to 64, percent white, percent black, percent earning between $50k and $75k, percent earning between $75k and $100k, percent earning between $100k and $150k, percent earning >$150k, percent graduating high school, percent with some college or associates degree, percent graduating college. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$