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The Effects of Vertical Integration on Hospital Prices, Spending, and Volume

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Abstract

In markets for medical care, vertical integration -- contractual or ownership relationships between hospitals and physicians -- can have opposing effects. Integration can reduce health spending and increase quality by improving communication across care settings, but it can also enhance providers' market power and facilitate the payment of kickbacks for inefficient referrals. We investigate the impact of integration with hospital claims from the Truven MarketScan Commercial Claims and Encounters data base on the non-elderly privately insured from 2001-2007. We construct county-level indices of hospital prices, volumes, and spending, adjusted for differences in enrollees' age and gender. We measure hospital-physician integration by combining information on hospitals' relationships with physicians from the American Hospital Association with information from Medicare. We find that hospital ownership of physicians leads to higher hospital prices and spending. Although we find that contractual integration reduces the frequency of hospital admissions, these effects are relatively small. Taken together, our results provide a mixed, although somewhat negative, picture of vertical integration from the perspective of the privately insured.

Introduction

Over the past decade, markets for medical care have become more vertically integrated. Producers of complementary services that were once independent are now either commonly-owned or related by contract. The share of U.S. physician practices owned by hospitals, for example, more than doubled from 2002-2008 (Kocher and Sahni 2011).

The welfare implications of this trend have been the subject of considerable debate. On one hand, vertical integration has the potential to improve quality and efficiency by reducing what are broadly described by economists as "transaction costs" (Williamson 1971). Closer links between physicians and hospitals, for example, can improve communication across care settings and reduce wasteful duplication of diagnostic tests. On the other hand, vertical integration may be used to exploit consumers. By employing or contracting with physicians, hospitals may enhance their market power through bundling (Gal-Or 1999) or depriving their rivals of a source or destination for referrals (Bacher et al. 2013; Berenson, Ginsburg, and Kemper 2010). In addition, integration may enhance physicians' incentives to supply unnecessary treatments. This could occur if it is used as a vehicle to pay kickbacks for inefficient referrals (Pauly 1979).

Understanding how integration of physicians and hospitals affects spending and the quality of care has become especially important in recent years. The historical trend towards integration is likely to intensify due to incentives created by the Affordable Care Act (ACA). The ACA rewards doctors and hospitals that join together in an Accountable Care Organization (ACO) by making them eligible for cash bonuses from Medicare. Even though, in theory, ACOs only affect how providers relate to Medicare,

most health policy analysts believe that in practice they will increase the extent to which doctors and hospitals bargain with private purchasers jointly rather than independently (Berenson and Burton 2011; Rosch 2011).

Yet, despite this, there has been little study of the consequences of vertical integration in health care, and no nationwide analysis of a key policy issue -- the effects of integration on hospitals' pricing power. Our paper seeks to fill this gap. We use hospital claims from the Truven MarketScan Commercial Claims and Encounters data base on the non-elderly privately insured from 2001-2007. We construct county-level indices of hospital prices, volumes, and spending, adjusted for differences in enrollees' age and gender. We measure hospital-physician integration by combining information on hospitals' relationships with physicians from the American Hospital Association (AHA) annual survey with information from Medicare. We estimate the effects on prices, volumes, and spending of hospital/physician integration, concentration in hospital and physician markets, and the interaction between integration and concentration. Our estimates enable us not only to test whether or not integration influences prices, volumes, and spending, but also to distinguish between the hypothesized mechanisms through which integration has these effects.

Our paper proceeds in five parts. Part I reviews the previous literature. Part II describes our data, and Part III presents our models. Part IV presents our results, and Part V concludes.

I. Previous Literature

In theory, the welfare consequences of vertical integration in markets for medical care are indeterminate. Classical transaction cost economics generally treats vertical integration as an efficient response to contracting frictions (Bresnahan and Levin 2012); the complexity and uncertainty inherent in the production of health services make this explanation intuitively appealing. In addition, as Gaynor (2006) observes, there may be efficiency gains from vertical integration if it enables doctors or hospitals to internalize the consequences of the other group's pricing decisions; this is just a special case of the more general benefit from eliminating double marginalization among producers of complements (Spengler 1950).

But vertical integration may also be used to exploit consumers. Interviews conducted by the Center for Studying Health System Change in 2010 (O'Malley, Bond, and Berenson 2011) suggest three ways that this could occur. First, hospitals could employ or contract with physicians in order to increase admissions, diagnostic testing, and outpatient services at their facilities. Both public and private insurers prohibit payments to physicians for referrals, but this can be at least partially circumvented by integration, because policing transfer payments among parties that share fixed assets or a complex contractual relationship is extremely difficult (Afendulis and Kessler 2011). Second, hospitals can use vertical relationships with physicians to make it more difficult for other hospitals to compete, and vice versa; this is just a special case of the more general problem of strategic foreclosure (Whinston 2007). Third, vertical relationships can be a way for physicians and hospitals to bundle their services together and extract more surplus from insurers out of the reach of the antitrust laws (Gal-Or 1999).

For these reasons, empirical investigation of the consequences of hospital/physician relationships is essential to evaluating competing economic theories of and developing optimal health care policy towards vertical integration. Yet, there are few papers on this topic, all of which have important limitations. The two papers closest to ours are Cuellar and Gertler (2006) and Ciliberto and Dranove (2006). They link selected states' hospital discharge data from the 1990s with American Hospital Association data on hospital characteristics, including their extent of vertical integration with physicians. They estimate hospital-level fixed-effects models of the effect of vertical integration on discounted charges, number of admissions, and various measures of quality of care. Cuellar and Gertler (2006) find that integration is associated with an increase in the level of discounted charges, but not on number of admissions or quality; Ciliberto and Dranove (2006) find that integration has no effect on discounted charges.

Other work examines how vertical integration affects cost and quality of care for Medicare beneficiaries. Afendulis and Kessler (2007) compares the empirical consequences of diagnosis by an "integrated" cardiologist -- one who can provide surgical treatment -- to the consequences of diagnosis by a non-integrated cardiologist. They find that diagnosis by an integrated cardiologist leads, on net, to higher health spending but similar health outcomes. However, for patients who receive surgery, diagnosis by an integrated cardiologist reduces spending and improves outcomes. This work is therefore consistent with the idea that vertical integration can simultaneously have harmful and beneficial effects.

Although these papers have provided a range of insights into the consequences of vertical integration, they have not provided direct empirical evidence on a key policy issue -- whether vertical integration forecloses competition and increases prices paid by

the privately insured. Afendulis and Kessler (2007) are not able to examine the effect of integration on prices because they analyze its consequences in a publicly-insured population. The dependent variable in Cuellar and Gertler (2006) and Ciliberto and Dranove (2006) is hospital-average discounted charges, not prices; hospital-average discounted charges only measure prices under the assumption that prices across admissions within a hospital are, conditional on covariates, an equiproportional function of charges, an assumption that is unlikely to be correct. In addition, neither of these papers control for other factors that affect prices and are correlated with hospital integration decisions, such as hospital market competitiveness and the integration decisions of competing hospitals.

In this paper, we seek to address these limitations. We analyze the actual transaction prices paid by insurers and patients to hospitals for a nationwide sample of privately-insured individuals for 2001-2007. We estimate the effect at the county level on prices, volume, and spending of the density of vertical integration, controlling for county fixed effects, time fixed effects, and time-varying characteristics of counties, including demography, capacity, and market structure. Our specification thereby captures the direct consequences of a hospital's choice to vertically integrate as well as the spillover effects onto other hospitals in its geographic market. We also test whether the effects of integration vary in different types of markets, as economic theory suggests they might, in order to develop more targeted policy recommendations.

II. Data and Variable Construction

MarketScan: Price, Volume, and Spending Indices

To calculate county price, volume, and spending indices for hospital services, we use data from MarketScan on approximately 2.1 million hospital claims from individuals enrolled in a fee-for-service health plan between 2001 and 2007. The MarketScan data contain information from claims filed by privately insured individuals who obtain insurance through a participating employer. Though (as we discuss below) these data are not representative of the entire U.S. population, the areas they span are sufficient to characterize patterns of geographic variation.

From each claim, we analyze what is commonly referred to as the "allowed amount" – the amount the plan allows the hospital to be paid for the service, after the application of contractual discount provisions and other plan rules but before adjustment for patient copayments or deductibles. The hospital may receive this amount partly from the insurance plan and partly from the patient in the form of copayments or deductibles. Note that the "allowed amounts" we study are not charges or a function of charges, but the actual transaction payments under contracts with health plans, including payments made both by the patient and by the insurer. In what follows, we refer to the allowed amount as the price.

Our dependent variables are three age-gender-adjusted indices: an index of the price per hospital admission in county i at year t (P_{it}), of hospital spending per enrollee (S_{it}), and of the number of hospital admissions per enrollee (V_{it}). We calculate P_{it} to be the national average price per admission plus the residual from an enrollment-weighted regression across counties of price in year t on age and gender indicator variables, all divided by the national average price per admission. We calculate S_{it} and V_{it} analogously,

so that $P_{it} = S_{it} / V_{it}$. The indices have mean 1 in every year by construction, so percentage-point changes in them can be interpreted as percent changes.

Medicare and AHA: Vertical Integration, and other Hospital and Physician Market Characteristics

The previous literature suggests two channels through which vertical integration can affect prices and volumes: the level of integration, and the interaction of integration with hospital and physician market concentration.

To measure the level of integration, we follow the approach in Kessler and McClellan (2000). We view the level of integration as an example of a hospital characteristic like non-profit/for-profit status or size. We define the density of each hospital characteristic H in county i at year t, Z_{it}^{H}, as

$$Z_{it}^{H} = \sum_{\substack{j \text{ serving} \\ \text{county } i}} c_{ijt} \times \sum_{\substack{k \text{ admitting} \\ \text{to } j}} b_{kjt} \times \sum_{\substack{j \text{ serving} \\ \text{zipcode } k}} a_{jkt} AHA_{jt}^{H} ,$$

where j and k index hospitals and zip codes, respectively; a_{jkt} is the share of elderly Medicare patients who live in zip k admitted to hospital j; b_{kjt} is the share of patients admitted to hospital j who live in zip k; c_{ijt} is the share of patients who live in county i admitted to hospital j ; and AHA_{jt}^{H} is an indicator variable from the American Hospital Association survey that is equal to 1 if the hospital has characteristic H, including large/small size (omitted group is medium size), for-profit/nonprofit ownership (omitted group is public ownership), teaching, system, and vertical integration status.[1] The b_{kjt}-weighting in Z_{it}^{H} assumes that the characteristics of hospital j's market depends on the weighted average of all of the zip-code patient residence areas that it serves; the c_{ijt}-

[1] a_{jkt} , b_{kjt} , and c_{ijt} are derived from 100% MEDPAR inpatient claims files, matched with fee-for-service Medicare enrollment files.

weighting defines a county's characteristics as the weighted average of all of the hospitals that serve patients who live in county *i*.

We divide vertically integrated hospitals into the four groups proposed by Cuellar and Gertler (2006) and Ciliberto and Dranove (2006): fully-integrated organizations (FIOs), closed physician-hospital organizations (CPHOs), open physician-hospital organizations (OPHOs), and independent practice associations (IPAs). FIOs are the most tightly integrated form; they are the only one in which the integrated entity owns the physicians' practice. CPHOs, the next-most tightly integrated form, are based on a contractual relationship exclusive to the physician group in which the hospital provides administrative services and does some coordination of care; OPHOs are like CPHOs but without the exclusivity requirement. IPAs, the least-tightly integrated form, are non-exclusive arrangements in which the hospital generally provides few services other than assistance in contracting with health plans. We classify hospitals with more than one type of vertical relationship as having the tightest type that they report.

To measure the interaction of integration with hospital and physician market concentration, we begin by constructing Hirschman-Herfindahl indices (HHIs) of hospital and physician services. We construct an HHI of hospital services, $HHHI_{it}$, according the method in Kessler and McClellan (2000), where

$$HHHI_{it} = \sum_{\substack{j \text{ serving} \\ \text{county } i}} c_{ijt} \times \sum_{\substack{k \text{ admitting} \\ \text{to } j}} b_{kjt} \times \sum_{\substack{j \text{ serving} \\ \text{zipcode } k}} a_{jkt}^2 .$$

Based on a 20% beneficiary sample of Medicare physician claims, we construct an HHI of primary-care physician services, $PHHI_{it}$, according to the method in Baker, Bundorf, and Royalty (2012). We use claims from physicians reporting a specialty of "family practice," the most common specialty in the data.

The ideal measure of interaction between integration and hospital market concentration would capture the extent to which physicians serving a hospital market are integrated with a concentrated group of hospitals. Integration with a concentrated group of hospitals could benefit consumers, if it facilitates coordination of care, or harm consumers, if it facilitates foreclosure. We proxy for this with two "vertical HHIs" that allow for differentiation between integrated and non-integrated hospitals (Ganz 2007; Shi and Chavas 2011), an HHI of FIO hospitals and an HHI of all other vertically-integrated hospitals:[2]

$$HHHIFIO_{it} = \sum_{\substack{j \text{ serving} \\ \text{county } i, \\ AHA_{jt}^{FIO}=1}} c'_{ijt} \times \sum_{\substack{k \text{ admitting} \\ \text{to } j, \\ AHA_{jt}^{FIO}=1}} b'_{kjt} \times \sum_{\substack{j \text{ serving} \\ \text{zipcode } k, \\ AHA_{jt}^{FIO}=1}} a'^{2}_{jkt}$$

and

$$HHHIXFIO_{it} = \sum_{\substack{j \text{ serving} \\ \text{county } i, \\ AHA_{jt}^{XFIO}=1}} c''_{ijt} \times \sum_{\substack{k \text{ admitting} \\ \text{to } j, \\ AHA_{jt}^{XFIO}=1}} b''_{kjt} \times \sum_{\substack{j \text{ serving} \\ \text{zipcode } k, \\ AHA_{jt}^{XFIO}=1}} a''^{2}_{jkt}$$

where a_{jkt}', b_{kjt}', and c_{ijt}' (and a_{jkt}'', b_{kjt}'', and c_{ijt}'') are constructed in the same way as a_{jkt}, b_{kjt}, and c_{ijt}, except that they are defined only for vertically integrated hospitals of the given type.

Conversely, the ideal measure of interaction between integration and physician market concentration would capture the extent to which hospitals serving a physician market are integrated with a concentrated group of physicians. Because our data do not specify which individual physicians are integrated, we can not calculate vertical HHIs for physicians analogous to the ones we calculate for hospitals. For this reason, we proxy for the interaction between physician concentration and integration with the product of $PHHI_{it}$ and $[Z_{it}^{FIO} \mid Z_{it}^{XFIO}]$.

[2] The simple product $Z_{it}^{H} \times HHHI_{it}$ neglects to capture where the integration is occurring.

Other sources

To obtain information on the time-varying characteristics of counties, we use the Area Resource File (for population, the number of Medicare beneficiaries, the number of physicians, and median household income) and the Medicare wage index (to measure hospitals' labor costs).

III. Models

Our basic model specifies county-average hospital prices, volumes, and spending as a function of county- and time-fixed-effects; hospital market competitiveness $HHHI_{it}$; hospital market characteristics Z_{it} ; and other time-varying county characteristics X_{it}:

$$\begin{matrix} P_{it} \\ V_{it} \\ S_{it} \end{matrix} = \alpha_i + \theta_t + \beta HHHI_{it} + Z_{it}\gamma + X_{it}\delta + \varepsilon_{it}, \qquad (1)$$

where the coefficients of interest are the elements of γ that correspond to the area densities of vertically-integrated organizations.

We also estimate two extensions to equation (1). The first includes vertical HHIs to proxy for interactions between hospital market concentration and vertical integration:

$$\begin{matrix} P_{it} \\ V_{it} \\ S_{it} \end{matrix} = \alpha_i + \theta_t + \beta HHHI_{it} + Z_{it}\gamma + \lambda^{FIO} HHIFIO_{it} + \lambda^{XFIO} HHIXFIO_{it} + X_{it}\delta + \varepsilon_{it}. \qquad (2)$$

In equation (2), hypothesis tests on λ show whether the concentration of vertical relationships in relatively few hospitals affects hospital prices, conditional on the density of vertically-integrated organizations and overall hospital market concentration.

The second includes physician market concentration and the interaction between physician market concentration and the density of vertical relationships:

$$\begin{matrix} P_{it} \\ V_{it} \\ S_{it} \end{matrix} = \alpha_i + \theta_t + \beta HHHI_{it} + Z_{it}\gamma + \rho PHHI_{it} + \pi^{FIO} PHHI_{it} Z_{it}^{FIO} + \pi^{XFIO} PHHI_{it} Z_{it}^{XFIO} + X_{it}\delta + \varepsilon_{it}. \quad (3)$$

In equation (3), hypothesis tests on π show whether the interaction between the physician market concentration and the density of vertically-integrated organizations affects prices, conditional on the independent effects of each.

IV. Results

Table 1 presents descriptive statistics on the variables used in our analysis. The first column of the each panel of the table presents means and standard deviations for the control variables for all US counties that had the controls present in every year 2001-07. As the table shows, we had control variables present for 2,454 of the approximately 3,100 US counties with residential population, covering around 94 percent of the US population (= 279.7 million / 296.4 million total population in 2005 [not in any table]). The second column of each panel presents means and standard deviations for all variables, but only for the counties that had at least 10 MarketScan hospital claims and 100 enrollees in every year 2001-07. Although we only capture price, volume, and spending information on around a third of the counties with control variables (639 / 2,454), these counties cover around two-thirds of the US population. Comparing the first and the second columns shows that analysis counties are representative of the country as a whole in most (although not all) dimensions. Analysis counties are larger on average (302,000 population as compared to 114,000), and more likely to be in midwestern and southern states, but with mostly similar health care market characteristics. Although analysis counties have a higher density of for-profit hospitals and are slightly more competitive

than the US as a whole (reflecting their regional distribution and size), they have very similar densities of vertical integration.

Figure 1 shows how the types of vertical arrangements have changed over our study period. In 2001, integration by ownership (FIO) was less prevalent than the three contractual forms of integration combined (Closed PHO, Open PHO, IPA): the patient-flow weighted density of FIO hospitals was 0.233, as compared to a density of 0.363 of the other types. Over the decade, however, this relationship flipped; by 2007, the density of FIO hospitals rose to 0.353, or more than 50 percent, whereas the density of contractual interaction fell to 0.240.[3]

Table 2 presents estimates that use price as the dependent variable. The first two columns present estimates from variants of equation (1): column (1a) presents estimates from models that include controls for each of the four different forms of integration, and (1b) presents estimates that aggregate the three contract forms of integration (closed PHO, open PHO, IPA) into one. Because the dependent variable is an index with mean 1, a one percentage point (0.01) change in it is equal to a one percent change.

Columns (1a) and (1b) show that vertical integration in the form of FIOs (i.e., hospital ownership of physicians) increases hospital prices. According to (1b), a one-standard-deviation increase in the density of FIOs increases prices by 3.2 percent (= 0.138 * 0.235 [Table 1], $p = 0.003$). This effect is smaller than the effect of hospital market concentration: a one-standard-deviation increase in the hospital HHI increases prices by 4.4 percent (= 0.374 * 0.117 [Table 1], $p = 0.049$). In contrast, there is no

[3] Although we find a large increase in hospital ownership of physicians as do Kocher and Sahni (2011), our percentage increase is smaller. This may be due to the fact that a) our measure is based on the share of hospitals reporting ownership of physicians, rather than the share of physicians reporting being owned by hospitals and b) our measure of density is weighted by patient flows, rather than unweighted.

systematic or statistically significant effect on prices of the density of contractual integration.

In addition, the interaction between FIO integration and hospital market concentration has a statistically significant effect on prices. According to column (2), a one-standard-deviation increase in the HHI of FIO-integrated hospitals increases prices by 2.4 percent (= 0.110 * 0.219 [Table 1], $p = 0.048$). That is, holding constant the *density* of FIOs and hospital market concentration overall, increasing the *concentration* of FIO hospitals increases prices, over and above the independent effects of density and hospital concentration.

Columns (3a)-(3c) present estimates from variants of equation (3). The models underlying columns (3a)-(3b) are the same as those underlying column (1a)-(1b), but with physician HHI added as a control. Physician HHI has a statistically significant positive effect on hospital prices: a one-standard-deviation increase in physician market concentration increases hospital prices by 2.7 percent (= 0.177 * 0.153 [Table 1], $p = 0.028$). The positive effect of physician concentration on prices is offset by a negative effect in markets with high densities of contractual integration (column (3c)), but this is only marginally statistically significant and economically important at the extremes of the distribution. In particular, the interaction effect fully counterbalances the direct effect of physician concentration only in markets with a density of contractual integration of at least 0.791 (=0.277 / 0.350), more than three times the mean of 0.254 [Table 1].

Table 3 replicates table 2, substituting our spending index for the price index. There are three differences between the effects of market structure on spending versus prices. First, point estimates of the effect of FIO integration on spending are smaller than (although not statistically distinguishable from) estimates of the effect on prices (columns

(1a)-(2)). Second, estimates of the effect of hospital market concentration on spending are larger than (although also not statistically distinguishable from) estimates of the effect on prices (all columns). Third, the effect of physician concentration on spending is smaller and statistically insignificant (columns (3a)-(3c)).

Table 4 replicates tables 2 and 3, using volume as the dependent variable. Table 4 shows that, in some circumstances, vertical integration reduces the rate of hospital admissions. Contract integration -- especially through open PHOs -- has a small but statistically significant negative effect on volume. A one-standard-deviation increase in open PHOs, for example, leads to a 0.8 percent (= -0.050 * 0.149 [Table 1]) decrease in admissions, $p = 0.025$. The concentration of FIO-integrated hospitals also reduces volume by approximately the same amount: a one-standard-deviation increase in their HHI decreases volume by 0.8 percent (= -0.036 * 0.219 [Table 1], $p = 0.031$). Finally, physician concentration has a small, marginally statistically significant negative effect on volume. A one-standard-deviation increase in the physician HHI reduces volume by 1.2 percent (= -0.077 * 0.153 [Table 1], $p = 0.060$).

V. Conclusion

Over the past decade, hospitals have entered into tighter relationships with their admitting physicians. This trend is expected to intensify as a result of provisions of the ACA that give hospitals and physicians the incentives to organize jointly into Accountable Care Organizations. The problem is that vertical integration can have both socially beneficial and socially harmful effects. There is almost universal agreement that greater coordination of care, especially between physicians and hospitals, would be in patients' best interests. But at the same time, health policy analysts have expressed the

concern that integration can have the unintended consequence of harming consumers. According to economic theory, vertical integration has the potential to enhance the market power of providers, especially hospitals, and to encourage physicians to supply unnecessary treatments by facilitating hospitals' payments of (otherwise illegal) kickbacks.

Thus, empirical evidence on the effects of vertical integration -- and how these effects vary in different market settings -- is essential to policy and our understanding of markets for medical care more generally. Yet, there have been few papers on the topic, and none that assess the impact of integration on the prices paid by and spending of the privately insured.

In this paper, we investigate these issues with data on hospital claims from Truven MarketScan for 2001-2007. We construct county/year-level price, volume, and spending indices from MarketScan, and match them with area densities of hospital/physician integration, hospital and physician market competitiveness, hospital labor costs, and other area and market characteristics based on Medicare, AHA, and the Area Resource File. Our models also include county- and time-fixed effects, so our estimates are identified off of changes over time within counties. We report four key findings.

First, in its tightest form, vertical integration leads to statistically and economically significant increases in hospital prices and spending, holding constant hospital and physician market competitiveness and several other characteristics of hospital markets. This is consistent with the hypothesis that vertical integration facilitates the exercise of hospitals' market power. A one-standard-deviation increase in hospital ownership of physicians (i.e., the density of FIOs) increases prices by 3.2 percent, and spending by 2.5 percent (= 0.105 * 0.235 [Table 1], p = 0.030). By

comparison, a one-standard-deviation increase in hospital market concentration (i.e., an increase in the hospital HHI) increases prices by 4.4 percent, and spending by 6.5 percent (= 0.553 * 0.117 [Table 1], $p = 0.006$) -- more than twice as much.

Second, the consequences of looser (contractual) forms of vertical integration are more benign, and potentially socially beneficial. Increases in the density of contract integration do not significantly increase prices or spending, and actually significantly decrease hospital admissions rates; this is consistent with the hypothesis that vertical integration can improve coordination of care. However, these volume effects are small -- sufficiently small that they do not lead to a statistically significant reduction in hospital spending. In addition, although our estimates of the effect of contractual integration on price are statistically indistinguishable from zero, the imprecision of our estimates limits our ability to confidently assess their true impact. For these reasons, and because we do not examine the effect of integration on the quality of care or patient health outcomes, our assessment of the welfare consequences of vertical integration is necessarily somewhat speculative. Investigation of these issues is an important topic for future research.

Third, there is heterogeneity across markets in the effect of hospital ownership of physicians. In particular, increasing the concentration of hospitals that own physicians, holding constant their density and overall hospital market concentration, accentuates the positive direct effect of ownership on prices and has an independent direct negative effect on volumes. However, the volume effects of FIO-hospital concentration, like the volume effects of contractual integration, are small -- sufficiently small that concentration still has a net positive effect on hospital spending.

Fourth, hospital prices are higher in markets with greater physician concentration. Although this may represent a causal effect, it may also be due to the fact that physician

concentration is correlated with unobserved dimensions of hospital market concentration, or that physician and hospital market concentration are both caused by a common, underlying factor. However, the fact that we find a small, marginally significant negative effect of physician concentration on hospital volume suggests otherwise; hospital concentration has no such effect (although it is not statistically distinguishable from the effect of physician concentration). Determining whether physician concentration has independent effects on hospital prices and volume, and the mechanisms through which it occurs, is an important topic for future work.

Taken together, our results provide a mixed, although somewhat negative, picture of vertical integration from the perspective of the privately insured. Our most definitive finding is that hospital ownership of physicians leads to higher prices and higher levels of hospital spending. Although there is some evidence that contractual integration may be socially beneficial, hospital ownership of physicians is rising, and contractual integration is falling -- so much so that contractual integration now represents a minority of the total.

The fact that we did not find systematic, significant positive effects of any form of integration on hospital volume, however, rules out a crude model of physician moral hazard in which hospitals integrate simply to pay physicians to increase the aggregate number of admissions. The point estimate of the effect of FIOs is negative, and even at the upper bound of the 95 percent confidence interval, a one-standard-deviation increase in the density of hospital ownership of physicians increases hospital volume by only 0.4 percent (= 0.016 * 0.241 = [1.96 * 0.018 - 0.019] * 0.241) -- a relatively small amount. The absence of a positive effect does not reject the broader hypothesis that integration is reducing social welfare through implicit payment for referrals; for example, hospitals may still be sharing profits with physicians who reallocate patients to more costly

facilities or more costly procedures. Investigation of this possibility is also an important topic for future work.

Figure 1: Density of Vertical Integration by Type, 2001-2007

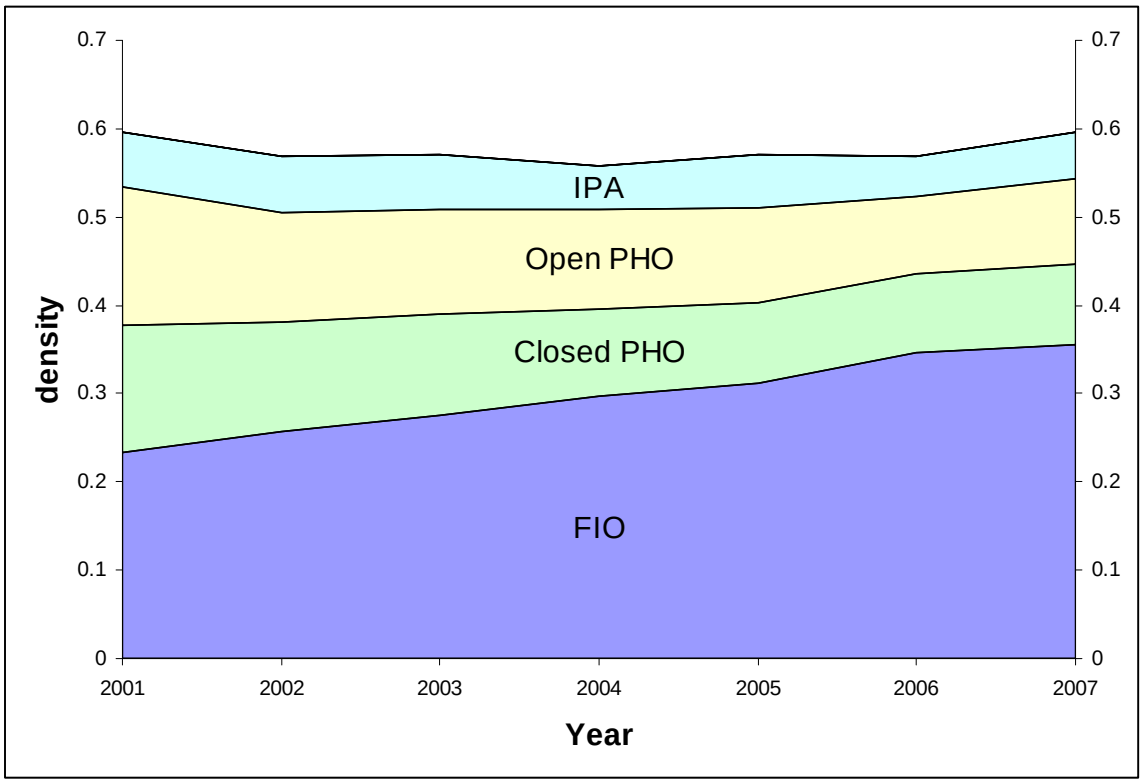

Table 1: Descriptive Statistics for Variables Used in Analysis

	All US mean (sd)	Sample mean (sd)		All US mean (sd)	Sample mean (sd)
County characteristics			Hospital market characteristics		
Population (1,000,000)	0.114	0.302	Fully-integrated	0.311	0.325
	(0.336)	(0.611)	organization (FIO)	(0.247)	(0.235)
Medicare beneficiaries	0.139	0.131	Closed PHO	0.088	0.096
/pop	(0.037)	(0.035)	(exclusive contract)	(0.131)	(0.137)
Physicians/1,000 pop	2.365	2.404	Open PHO	0.097	0.104
	(1.491)	(1.282)	(nonexclusive contract)	(0.156)	(0.149)
Median income	0.472	0.510	IPA	0.072	0.054
(100,000 $)	(0.124)	(0.138)		(0.120)	(0.094)
Medicare wage index	1.011	0.989	Hospital capacity index	0.975	0.904
	(0.159)	(0.124)		(0.491)	(0.403)
Northeast region	0.190	0.084	For-profit	0.130	0.166
				(0.182)	(0.200)
Midwest region	0.225	0.263			
			Non-profit	0.754	0.704
South region	0.356	0.518		(0.256)	(0.276)
West region	0.229	0.137	<100 bed hospital	0.094	0.077
				(0.153)	(0.111)
Physician market characteristics					
Physician HHI	0.145	0.123	>300 bed hospital	0.497	0.526
	(0.182)	(0.153)		(0.235)	(0.212)
MarketScan Price, Volume, Spending			Teaching	0.303	0.305
Price index		1.000		(0.241)	(0.237)
		(0.269)			
			System	0.641	0.675
Spending index		1.000		(0.253)	(0.243)
		(0.306)			
			Hospital HHI	0.481	0.453
Volume index		1.007		(0.151)	(0.117)
		(0.199)			
			HHI of FIO hospitals	0.570	0.569
Price per hospital admission ($)		10786		(0.225)	(0.219)
		(5077)			
			HHI of XFIO-hospitals	0.567	0.596
Hospital spending per enrollee ($/yr)		686	(contract integrated)	(0.240)	(0.229)
		(401)			
			# counties	2,454	639
			Annual population	279,690,260	192,941,513
			Annual MarketScan enrollees		3,485,764

Notes: All US includes counties with county and market characteristics in every year 2001-2007; statistics are population weighted. MarketScan counties include those with > 10 claims and > 100 enrollees in every year 2001-2007; statistics are enrollment weighted.

Table 2: Effect of Vertical Integration and Selected Market Characteristics on Hospital Prices

	(1a)	(1b)	(2)	(3a)	(3b)	(3c)
Fully-integrated organization (FIO)	0.137 ***	0.138 ***	0.117 ***	0.138 ***	0.138 ***	0.158 **
	(0.046)	(0.046)	(0.043)	(0.046)	(0.046)	(0.063)
Closed PHO (exclusive contract)	0.001			0.008		
	(0.049)			(0.049)		
Open PHO (nonexclusive contract)	0.062			0.061		
	(0.065)			(0.065)		
IPA	0.043			0.041		
	(0.075)			(0.075)		
Vertical integration XFIO (contract integrated)		0.037	0.014		0.038	0.097
		(0.045)	(0.045)		(0.045)	(0.065)
Hospital HHI	0.360 *	0.374 **	0.340 *	0.353 *	0.366 *	0.366 *
	(0.190)	(0.190)	(0.192)	(0.190)	(0.190)	(0.191)
HHI of FIO hospitals			0.110 **			
			(0.055)			
HHI of XFIO-integrated hospitals			0.040			
			(0.030)			
Physician HHI				0.173 **	0.177 **	0.277 **
				(0.081)	(0.080)	(0.116)
Physician HHI*FIO						-0.095
						(0.200)
Physician HHI*vertical integration XFIO						-0.350 *
						(0.196)

Notes: N = 4,473 = 639 counties x 7 years. Models include county- and year-fixed effects plus county and market controls in Table 1. Heterscedasticity-consistent standard errors in parentheses. *, **, *** denote statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 3: Effect of Vertical Integration and Selected Market Characteristics on Hospital Spending

	(1a)	(1b)	(2)	(3a)	(3b)	(3c)
Fully-integrated organization (FIO)	0.103 ** (0.048)	0.105 ** (0.048)	0.085 * (0.046)	0.104 ** (0.048)	0.105 ** (0.048)	0.114 * (0.066)
Closed PHO (exclusive contract)	-0.033 (0.053)			-0.030 (0.053)		
Open PHO (nonexclusive contract)	-0.005 (0.064)			-0.005 (0.064)		
IPA	0.006 (0.079)			0.005 (0.078)		
Vertical integration XFIO (contract integrated)		-0.012 (0.046)	-0.040 (0.046)		-0.011 (0.046)	0.043 (0.066)
Hospital HHI	0.547 *** (0.202)	0.553 *** (0.202)	0.529 *** (0.203)	0.544 *** (0.201)	0.549 *** (0.201)	0.551 *** (0.202)
HHI of FIO hospitals			0.096 * (0.055)			
HHI of XFIO-integrated hospitals			0.058 (0.035)			
Physician HHI				0.091 (0.095)	0.093 (0.094)	0.173 (0.138)
Physician HHI*FIO						-0.029 (0.230)
Physician HHI*vertical integration XFIO						-0.326 (0.224)

Notes: See Table 2.

Table 4: Effect of Vertical Integration and Selected Market Characteristics on Hospital Volume

	(1a)	(1b)	(2)	(3a)	(3b)	(3c)
Fully-integrated organization (FIO)	-0.019 (0.018)	-0.019 (0.048)	-0.013 (0.018)	-0.020 (0.017)	-0.020 (0.017)	-0.017 (0.023)
Closed PHO (exclusive contract)	-0.033 (0.025)			-0.022 (0.025)		
Open PHO (nonexclusive contract)	-0.050 ** (0.022)			-0.050 ** (0.022)		
IPA	-0.025 (0.033)			-0.025 (0.033)		
Vertical integration XFIO (contract integrated)		-0.034 ** (0.017)	-0.033 * (0.018)		-0.034 ** (0.017)	-0.037 (0.023)
Hospital HHI	0.054 (0.086)	0.046 (0.086)	0.062 (0.086)	0.057 (0.087)	0.049 (0.087)	0.048 (0.087)
HHI of FIO hospitals			-0.036 ** (0.017)			
HHI of XFIO-integrated hospitals			0.007 (0.013)			
Physician HHI				-0.075 * (0.040)	-0.077 * (0.040)	0.076 (0.053)
Physician HHI*FIO						-0.022 (0.091)
Physician HHI*vertical integration XFIO						0.018 (0.084)

Notes: See Table 2.

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