

By Laurence C. Baker, M. Kate Bundorf, and Daniel P. Kessler

DOI: 10.1377/hlthaff.2013.1279
 HEALTH AFFAIRS 33,
 NO. 5 (2014): 756–763
 ©2014 Project HOPE—
 The People-to-People Health
 Foundation, Inc.

Vertical Integration: Hospital Ownership Of Physician Practices Is Associated With Higher Prices And Spending

Laurence C. Baker is a professor of health research and policy at Stanford University, in California, and a research associate at the National Bureau of Economic Research, in Cambridge, Massachusetts.

M. Kate Bundorf is a professor of health research and policy at Stanford University and a faculty research fellow at the National Bureau of Economic Research.

Daniel P. Kessler (fkessler@stanford.edu) is a professor in the Law School and the Graduate School of Business, a professor (by courtesy) in the Department of Health Research and Policy, and a senior fellow at the Hoover Institution, all at Stanford University. He is also a research associate at the National Bureau of Economic Research.

ABSTRACT We examined the consequences of contractual or ownership relationships between hospitals and physician practices, often described as vertical integration. Such integration can reduce health spending and increase the quality of care by improving communication across care settings, but it can also increase providers' market power and facilitate the payment of what are effectively kickbacks for inappropriate referrals. We investigated the impact of vertical integration on hospital prices, volumes (admissions), and spending for privately insured patients. Using hospital claims from Truven Analytics MarketScan for the nonelderly privately insured in the period 2001–07, we constructed county-level indices of prices, volumes, and spending and adjusted them for enrollees' age and sex. We measured hospital-physician integration using information from the American Hospital Association on the types of relationships hospitals have with physicians. We found that an increase in the market share of hospitals with the tightest vertically integrated relationship with physicians—ownership of physician practices—was associated with higher hospital prices and spending. We found that an increase in contractual integration reduced the frequency of hospital admissions, but this effect was relatively small. Taken together, our results provide a mixed, although somewhat negative, picture of vertical integration from the perspective of the privately insured.

The share of US physician practices owned by hospitals more than doubled from 2002 to 2008.¹ This trend toward vertical integration between hospitals and physicians means that more producers of complementary services that were once independent are now either commonly owned or related by contract.

Whether this trend has been good for consumers has been the subject of considerable debate.² On the one hand, vertical integration has the potential to improve the quality and efficiency of care by reducing what are broadly described by economists as “transaction costs.”³ For example, closer ties between physicians and hospitals can

improve communication across care settings and reduce wasteful duplication of diagnostic tests.

On the other hand, vertical integration may hurt consumers by allowing hospitals and physicians to raise prices. By employing or contracting with physicians, hospitals may increase their market power by amassing control over a larger bundle of services⁴ or by depriving their rivals of a source of or destination for referrals.^{5,6} In addition, vertical integration may increase physicians' incentives to supply unnecessary treatments if such treatments are used as a vehicle to pay what are effectively kickbacks for inappropriate referrals.⁷

Understanding how vertical integration of physicians and hospitals affects spending and the quality of care has become especially important in recent years. The Affordable Care Act creates incentives that are likely to intensify the historical trend toward vertical integration. The act rewards doctors and hospitals that join together in an accountable care organization (ACO) by making them eligible for cash bonuses from Medicare. In theory, ACOs affect only how providers relate to Medicare. However, most health policy analysts believe that in practice, these organizations will increase the extent to which doctors and hospitals bargain with private purchasers jointly instead of independently.^{6,8}

Nonetheless, there has been little research on the consequences of vertical integration in health care, and no nationwide analysis of a key policy issue: the effects of vertical integration on hospitals' pricing power. This article seeks to fill that gap.

Using hospital claims from the Truven Analytics MarketScan Commercial Claims and Encounters database that contained information on a large group of the nonelderly privately insured for the period 2001–07, we constructed county-level indices of hospital prices, volumes as measured by hospital admissions, and spending, and we adjusted them for differences in enrollees' age and sex. We measured hospital-physician vertical integration by combining information on hospitals' relationships with physicians from the American Hospital Association Annual Survey with patient-flow information from Medicare.

We estimated the effects on prices, volumes, and spending of hospital-physician vertical integration, hospital market competitiveness, and other characteristics of hospital markets. Our estimates enabled us not only to test whether vertical integration influenced prices, volumes, and spending, but also to determine the mechanisms through which vertical integration had these effects.

Previous Literature

Theories of medical markets provide reasons why vertical integration could be beneficial or could be harmful. Classical models that emphasize transaction costs generally treat vertical integration as an efficiency-improving response to situations in which arm's-length contracts across organizations are difficult to arrange.⁹ This situation can easily arise in medicine since providing care is complex, which makes it difficult both to specify in advance the desired course of action—such as the type of treatment that is appropriate for each possible clinical situation—

and to measure outcomes.

Vertical integration addresses these difficulties by consolidating production within a single organization, thereby eliminating the need for contracting among separate firms. In addition, vertical integration may bring efficiency gains if it enables doctors or hospitals to efficiently set prices for services that must be produced jointly.¹⁰

But vertical integration may also be used in ways that do not benefit consumers. Interviews conducted by the Center for Studying Health System Change in 2010 suggest three ways in which this could occur.¹¹

First, hospitals could employ or contract with physicians to increase admissions, diagnostic testing, and outpatient services at their facilities. Legal and contractual restrictions prohibit hospitals from directly paying physicians for referrals. However, these restrictions can be circumvented at least in part by vertical integration that allows hospitals to create contracts with doctors that effectively pay them for referrals. Because it is extremely difficult to police payments between parties that share fixed assets or a complex contractual relationship, it is hard to prevent these types of arrangements.¹²

Second, hospitals can use vertically integrated relationships with physicians to gain a competitive advantage over other hospitals. For example, if hospitals need a minimum number of patients to maintain efficient scale, then establishing vertically integrated relationships that are exclusive—in either form or effect—can enable a dominant hospital to effectively increase its competitors' costs by “locking up” the pool of admitting physicians.

And third, vertical relationships can be a way for physicians and hospitals to bundle their services together and charge insurers higher prices. Anticompetitive bundling is formally prohibited by antitrust laws.¹³ However, after-the-fact enforcement takes time and is incomplete in practice.¹⁴

Because theories offer a range of possible effects, empirical investigation of hospital-physician relationships is necessary both to understand the practical implications of increasing vertical integration and to develop optimal health care policy responses. Nonetheless, there are few articles on this topic, and all of them have important limitations.

The two articles that are most similar to ours linked selected states' hospital discharge data from the 1990s with American Hospital Association data on the extent of hospital-physician vertical integration.^{15,16} One study found that vertical integration was associated with an increase in the level of discounted charges com-

pared to charges at unintegrated hospitals, but not with a change in the number of admissions or the quality of care.¹³ The other study found that vertical integration had no effect on discounted charges.¹⁴

Another study examined how vertical integration affected the cost and quality of care for Medicare beneficiaries who were treated by cardiologists.¹⁷ This study examined a different form of vertical integration: whether a cardiologist provided both diagnostic and therapeutic care, or diagnostic care only. The study found that patients initially examined by a cardiologist who provided both diagnostic and therapeutic care had net higher health spending but similar health outcomes compared to patients seen by a cardiologist who provided diagnosis only. However, for patients who received surgery, initial examination by an “integrated” cardiologist reduced spending and improved outcomes compared to initial examination by a nonintegrated cardiologist. Although this study does not directly inform the debate over hospital-physician vertical integration, the results are consistent with the idea that vertical integration can simultaneously have harmful and beneficial effects.

These articles provided a range of insights into the consequences of vertical integration. But they did not provide direct empirical evidence on a key policy issue: whether or not vertical integration forecloses competition and increases prices paid by the privately insured.

The two studies that examined the privately insured used hospital-average discounted charges, not prices, as the dependent variable.^{13,14} The difference between hospital charges and prices, in the context of this article, is discussed in more detail below. In addition, neither of these two studies controlled for factors that affect prices or other effects that are correlated with hospital vertical integration decisions—effects such as hospital market competitiveness and the integration decisions of competing hospitals.

Study Data And Methods

PRICE, VOLUME, AND SPENDING INDICES To calculate county price, volume, and spending indices for hospital services, we used data from Truven Analytics MarketScan for approximately 2.1 million hospital claims from people enrolled in a fee-for-service health plan in the period 2001–07. The MarketScan data contained information from claims filed by privately insured people who obtained insurance through a participating employer.

For each claim, we analyzed what is commonly referred to as the allowed amount—the amount

The Affordable Care Act creates incentives that are likely to intensify the historical trend toward vertical integration.

that 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 part of this amount from the insurance plan and part of it from the patient in the form of copayments or deductibles. The allowed amounts are not charges or a function of charges. Instead, they are the actual transaction payments under contracts with health plans, including payments made by both the patient and the insurer. In what follows, we refer to the allowed amount as the price.

We used the data to construct three county-level indices. The first was an index of the price per hospital admission, which measured the total price paid for hospital admissions in the county divided by the number of admissions. Counties where the average price per admission was above the national mean had an index value of more than 1; those where the average price was below the national mean had an index value of less than 1. The second index measured the number of admissions per enrollee. The third tracked spending per enrollee in an analogous way.

The indices were constructed in such a way that the spending index was equal to the product of the price index and the volume index. By construction, the indices had a mean of 1 in every year. Percentage-point changes in the indices can be interpreted as percentage changes. Before analyzing the indices, we used linear regression to adjust them for age and sex differences across counties.

VERTICAL INTEGRATION AND OTHER HOSPITAL MARKET CHARACTERISTICS In the American Hospital Association Annual Survey, hospitals report information on their relationship with physicians. Following previous work,^{13,14} we divided vertically integrated hospitals into the

Past vertical integration decisions may have been driven by inefficiencies in the Medicare fee schedule.

following four groups: fully integrated organizations, closed physician-hospital organizations, open physician-hospital organizations, and independent practice associations.

Fully integrated organizations are the most tightly vertically integrated form. This is the only one of the four forms in which the hospital owns the physician practice. In closed physician-hospital organizations, the next most tightly vertically integrated form, a hospital contracts with selected physicians on the basis of cost, quality, or both. According to the contract, the hospital provides administrative services and does some coordination of care. Physicians who belong to closed organizations generally do not sign similar contracts with other hospitals but remain free to admit patients to them. Open physician-hospital organizations, in contrast, are generally open to all members of the medical staff who wish to participate. Independent practice associations are the least tightly vertically integrated form. They are nonexclusive arrangements in which the hospital generally provides physicians with few services other than assistance in contracting with health plans.

We classified hospitals that reported more than one type of vertically integrated relationship as having the tightest type that they reported. These variables did not explicitly quantify the extent to which vertical integration was clinical or financial in nature. As we discuss below, this may influence the application of our results to possible future contexts in which the mix of clinical and financial integration may deviate from the mix present in our data.

We constructed county-year-level measures of the share of the market served by hospitals characterized by each type of vertical integration with physicians. These measures were constructed using methods developed by one of us in previous work.¹⁸ The methods take into account hospital-specific market areas, defined using Medicare inpatient claims and enrollment data to identify

patient flows, and do not assume that all patients residing in a given county go to hospitals in that county.

We used the same methods to construct measures for each county and year of the share of the market served by hospitals with each of several other characteristics: ownership (nonprofit or for-profit), teaching status, system membership, bed size (fewer than 100 beds, 100–300 beds, or more than 300 beds), and hospital capacity. Finally, we computed a Herfindahl-Hirschman index of overall hospital market competitiveness.

Further details about the construction of these variables are available in the online Appendix.¹⁹

OTHER DATA To obtain information on other time-varying characteristics of counties, we used the Area Resource File (for population, number of Medicare beneficiaries, number of physicians, and median household income) and the Medicare wage index (to measure hospitals' labor costs). A list of all of the variables used in our analysis and their means and standard deviations are presented in Appendix Table 1.¹⁹

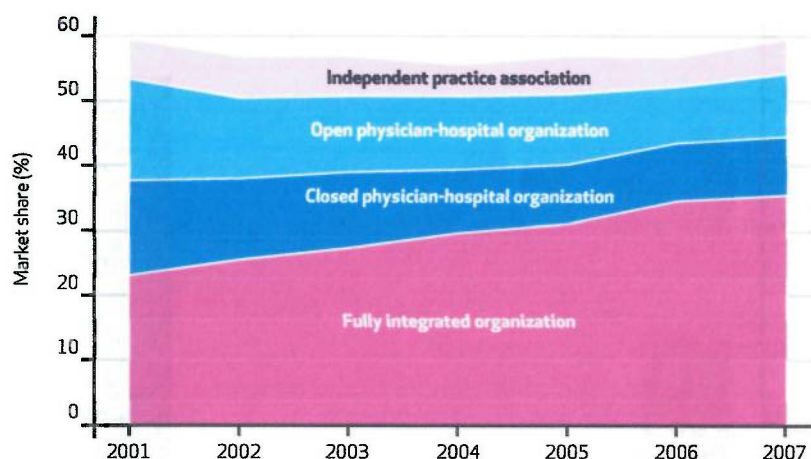
METHODS We estimated county-level regression models using data from the period 2001–07. The dependent variables in these regressions were the price, volume, and spending indices. The independent variables included the share of the market served by hospitals in each of the four integration categories, hospital market competitiveness, and the other controls described above. In addition, we included dummy variables for year and county, which controlled for unobserved characteristics of counties that may affect integration and prices and for time trends during our study period.

We present results derived from the regression models that estimated the change in the price, volume, or spending index associated with a one-standard-deviation change in the share of the market served by hospitals with each type of integration, holding all other variables fixed. For comparison, we also include an estimate of the change in the indices that would be associated with a one-standard-deviation change in the hospital Herfindahl-Hirschman index.

LIMITATIONS The validity of our analysis depends on two key assumptions. First, we assumed that changes in vertical integration within counties were not due to unobserved factors that also affected price and volume. To make this assumption as plausible as possible, we controlled for several other characteristics of the hospital market environment, including nonprofit or for-profit ownership, teaching status, system membership, hospital and physician capacity, beneficiary income, and market size and competitiveness. However, these controls were necessarily incomplete.

EXHIBIT 1

Market Share Of Medicare Patients For Four Types Of Integrated Hospitals, 2001-07

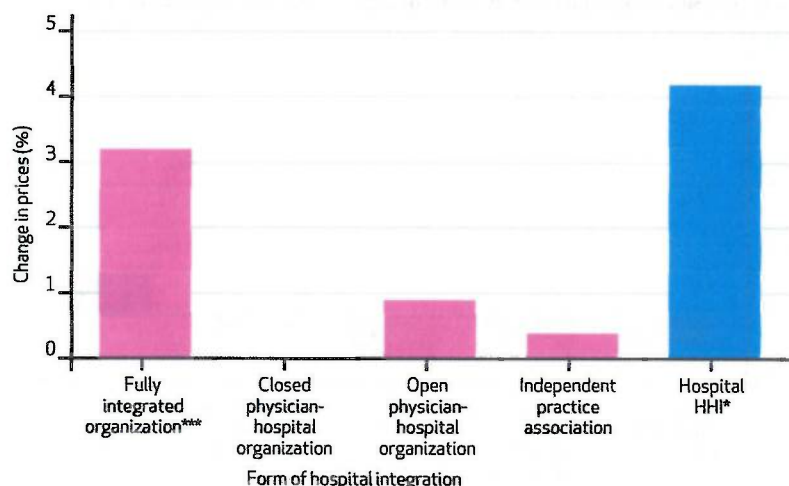


SOURCE: Authors' analysis of American Hospital Association and Medicare data. NOTE: The four types of vertically integrated organizations are explained in the text.

To the extent that hospitals and physicians vertically integrated in response to unobserved factors that reduced prices and volumes, such as pressure from health plans, our estimates of the effect of integration understate true (positive) effects on prices and overstate true (negative) effects on volumes. This would lead us to understate the costs and overstate the benefits of inte-

EXHIBIT 2

Effect Of Hospital Integration And Market Competitiveness On Hospital Prices



SOURCE: Authors' analysis of American Hospital Association, Medicare, and Truven Analytics Market-Scan data. NOTE: The bars represent the estimated effect on the average county-level price of a hospital admission associated with a one-standard-deviation increase in market share of each of the four forms of vertical integration. County and year fixed effects and the hospital market and county characteristics listed in Appendix Table 1 (see Note 19 in text) were held constant. Selected parameter estimates and standard errors from the regressions underlying the exhibit are available in Appendix Table 2. HHI is Herfindahl-Hirschman index, which is a measure of market competitiveness. * $p < 0.10$ *** $p < 0.01$

gration. We hypothesized that any bias in our estimates would be in this direction. However, we cannot dismiss the possibility that the opposite was true.

Second, our analysis did not allow us to distinguish between clinical and financial vertical integration. Our policy prescriptions assumed that the mix of clinical and financial vertical integration in the future, conditional on the type of integrated organization, will resemble that in the past. Because there are reasons to believe that this may not be the case, this limitation may be important.

Past vertical integration decisions may have been driven by inefficiencies in the Medicare fee schedule. For example, a vertically integrated physician organization might be able to collect a facility fee that would be unavailable to it if it were freestanding. Future vertical integration decisions may hold promise for greater efficiency, insofar as they would be driven by incentives for sharing real productivity gains through ACOs. Investigation of these assumptions is an important topic for future research.

Finally, the generalizability of our results may be limited by the time period and geographic areas covered by the MarketScan data. Our study sample ended in 2007. It also covered only between one-quarter and one-fifth of all US counties, although the counties in the data contain most of the US population and are broadly representative of the country as a whole (see Appendix Table 1).^{19,20}

Study Results

In 2001 fully integrated organizations had a smaller market share (23.3 percent) than all organizations using any of the three contractual forms (36.3 percent) (Exhibit 1). However, over time this relationship flipped: In 2007 the market share of fully integrated organizations was 35.6 percent, whereas the share of organizations using the other three forms had fallen to 23.0 percent. About 40 percent of the market was served by hospitals that used none of the four forms of vertical integration.

Vertical integration in the form of fully integrated organizations was associated with increases in hospital prices: A one-standard-deviation increase in the market share of such hospitals was associated with an increase in prices of 3.2 percent ($p = 0.003$, Exhibit 2). In contrast, there was no systematic or significant effect on prices of the three forms of contractual integration.

For comparison purposes, Exhibit 2 presents estimates of the change in prices associated with changes in hospital market competitiveness as

measured by the hospital Hirschman-Herfindahl index (HHI). A one-standard-deviation increase in the index was associated with a price increase of 4.2 percent ($p = 0.058$). This effect is a bit larger than that of increasing the share of fully integrated organizations. Yet market competitiveness has received a large amount of policy attention, while the potential impact of increased vertical integration has not.

Exhibit 3 replicates Exhibit 2, substituting our spending index for the price index. We found two key differences between the effects of market structure on spending and the effects on prices. First, the changes in spending associated with an increase in the share of fully integrated organizations were smaller than (although not statistically distinguishable from) the associated changes in prices. Second, estimates of the spending changes associated with hospital market competitiveness were larger than (although also not statistically distinguishable from) estimates of the associated price changes. As in Exhibit 2, the estimated changes associated with the other three forms of integration were small and not significant.²¹

In some circumstances, vertical integration was associated with a lower rate of hospital admissions (Exhibit 4). An increase in the market share of hospitals that had open physician-hospital organizations was associated with a small but statistically significant decrease in volume. A one-standard-deviation increase in the market share of such hospitals was associated with a 0.7 percent decrease in admissions ($p = 0.025$). The other forms of vertical integration also had small negative associations with volume, but none was statistically significant. The hospital HHI was associated with a modest increase in volume, but that association also was statistically indistinguishable from zero.²²

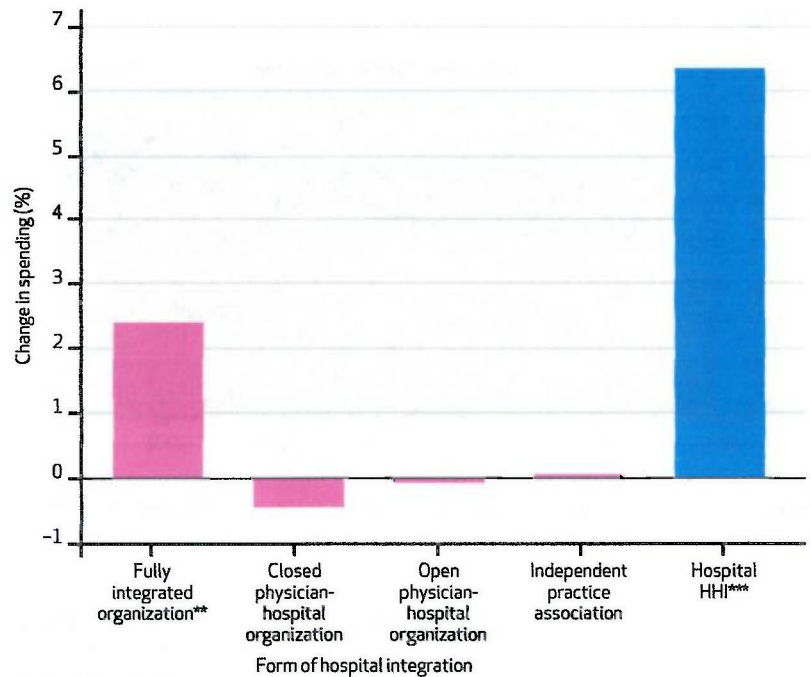
Discussion

During 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 Affordable Care Act that give hospitals and physicians incentives to organize jointly into ACOs.

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. At the same time, health policy analysts have expressed the concern that integration can have unintended harmful consequences for consumers. According to economic theory, vertical integration has the potential to increase

EXHIBIT 3

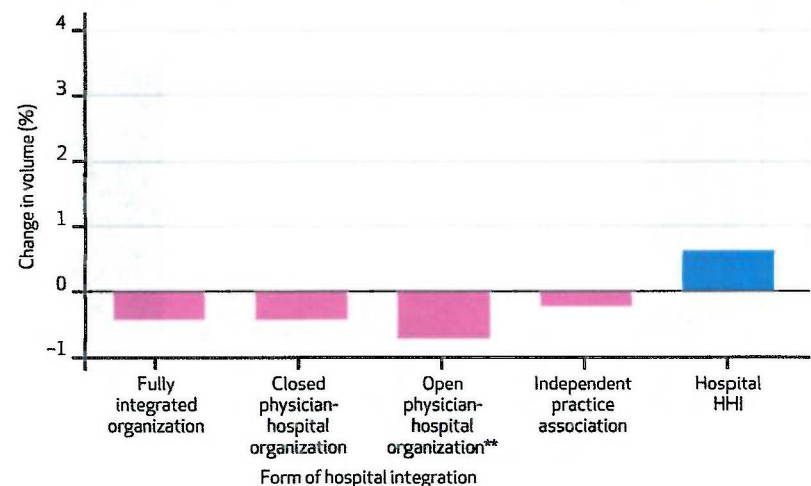
Effect Of Hospital Integration And Market Competitiveness On Hospital Spending



SOURCE Authors' analysis of American Hospital Association, Medicare, and Truven Analytics Market-Scan data. **NOTES** The bars represent the estimated effect on hospital spending associated with a one-standard-deviation increase in market share of each of the four forms of vertical integration. County and year fixed effects and the hospital market and county characteristics listed in Appendix Table 1 (see Note 19 in text) were held constant. Selected parameter estimates and standard errors from the regressions underlying the exhibit are available in Appendix Table 2. HHI is Herfindahl-Hirschman index, which is a measure of market competitiveness. ** $p < 0.05$ *** $p < 0.01$

EXHIBIT 4

Effect Of Hospital Integration And Market Competitiveness On Hospital Volume



SOURCE Authors' analysis of American Hospital Association, Medicare, and Truven Analytics Market-Scan data. **NOTES** The bars represent the estimated effect on hospital volume associated with a one-standard-deviation increase in market share of each of the four forms of vertical integration. County and year fixed effects and the hospital market and county characteristics listed in Appendix Table 1 (see Note 19 in text) were held constant. Selected parameter estimates and standard errors from the regressions underlying the exhibit are available in Appendix Table 2. HHI is Herfindahl-Hirschman index, which is a measure of market competitiveness. ** $p < 0.05$

the market power of providers, especially hospitals, and to encourage physicians to supply inappropriate treatments by facilitating hospitals' payments of kickbacks that would be illegal if they were made formally.

Our study had two key findings. First, in its tightest form, vertical integration appears to lead to statistically and economically significant increases in hospital prices and spending. This is consistent with the hypothesis that vertical integration increases hospitals' market power. We found that a one-standard-deviation increase in the market share of hospitals that own physician practices was associated with significant increases in prices and spending of 2–3 percent. In comparison, a one-standard-deviation increase in the hospital Hirschman-Herfindahl index increased prices and spending by 4–6 percent.

Second, the consequences of looser forms of vertical integration were more benign and potentially socially beneficial. Increases in these forms of integration did not appear to increase prices or spending significantly and may even decrease hospital admission rates. This finding is consistent with the hypothesis that vertical integration can improve the coordination of care.

However, the effects on volume associated with these types of integration were small—so small that they did not generate a significant reduction in hospital spending. In addition, although our estimates of the effect of contractual integration on price were statistically indistinguishable from zero, the imprecision of our estimates limited our ability to confidently assess their true impact.

For these reasons, and because we did not examine the effect of integration on the quality of care or patient health outcomes, our assessment of the implications of vertical integration for the overall well-being of patients and society more generally is necessarily somewhat speculative. Investigation of these issues is an important topic for future research.

Conclusion

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 physician practices leads to

Our most definitive finding is that hospital ownership of physician practices leads to higher prices and higher levels of hospital spending.

higher prices and higher levels of hospital spending. There is some evidence that looser forms of integration may be socially beneficial. However, hospital ownership of physician practices is rising, and contractual integration is falling. As a result, contractual integration is now a minority of total integration.

The fact that we did not find systematic significant positive effects of any form of vertical integration on hospital volume rules out a crude model of physician-induced demand, in which hospitals integrate simply to pay physicians to increase the aggregate number of admissions. As Exhibit 4 shows, the estimated volume change associated with an increase in the tightest form of vertical integration (fully integrated organizations) was negative. Even at the upper bound of the 95 percent confidence interval (not shown in Exhibit 4), a one-standard-deviation increase in the tightest form of integration would be associated with only a 0.4 percent increase in hospital volume, which is a relatively small amount.²³

The absence of a positive association does not disprove the broader hypothesis that integration is harming patients through implicit payments for referrals. For example, hospitals may still be sharing profits with physicians who opt to treat patients at more costly facilities or with more costly procedures than is medically appropriate. Investigation of this possibility, along with the other open questions above, provides considerable opportunity for future research into the consequences of vertical integration. ■

These findings were presented at the National Bureau of Economic Research Hospital Organization and Productivity Conference, Harwich, Massachusetts, October 4–5, 2013. Daniel Kessler has

received speaking and consulting fees, and Laurence Baker has received consulting fees, from integrated delivery systems. Baker and M. Kate Bundorf have received support from the National

Institute of Health Care Management for this work. The authors thank Jack Boeglin and Tarun Narasimhan for exceptional research assistance. All errors are the authors' own.

NOTES

- 1 Kocher R, Sahni NR. Hospitals race to employ physicians—the logic behind a money-losing proposition. *N Engl J Med*. 2011;364(19):1790–3.
- 2 Baicker K, Levy H. Coordination versus competition in health care reform. *N Engl J Med*. 2013;369(9):78–91.
- 3 Williamson OE. The vertical integration of production: market failure considerations. *Am Econ Rev*. 1971;61(2):112–23.
- 4 Gal-Or E. The profitability of vertical mergers between hospitals and physician practices. *J Health Econ*. 1999;18(5):623–54.
- 5 Bacher GE, Chernew ME, Kessler DP, Weiner SM. Regulatory neutrality is essential to establishing a level playing field for accountable care organizations. *Health Aff (Millwood)*. 2013;32(8):1426–32.
- 6 Berenson RA, Burton RA. Accountable care organizations in Medicare and the private sector: a status update [Internet]. Washington (DC): Urban Institute; 2011 Nov 3 [cited 2014 Mar 20]. Available from: <http://www.urban.org/publications/412438.html>
- 7 Pauly MV. The ethics and economics of kickbacks and fee splitting. *Bell J Econom*. 1979;10(1):344–52.
- 8 Rosch JT. Accountable care organizations: what exactly are we getting? [Internet]. Washington (DC): Federal Trade Commission; 2011 [cited 2014 Mar 20]. Available from: http://www.ftc.gov/sites/default/files/documents/public_statements/accountable-care-organizations-what-exactly-are-we-getting/111117fallforumspeech.pdf
- 9 Bresnahan TF, Levin JD. Vertical integration and market structure. Cambridge (MA): National Bureau of Economic Research; 2012 Mar. (NBER Working Paper No. 17889).
- 10 Gaynor M. Is vertical integration anticompetitive? Definitely maybe (but that's not final). *J Health Econ*. 2006;25(1):175–80.
- 11 O'Malley AS, Bond AM, Berenson RA. Rising hospital employment of physicians: better quality, higher costs? [Internet]. Washington (DC): Center for Studying Health System Change; 2011 Aug [cited 2014 Mar 20]. (Issue Brief No. 136). Available from: <http://www.hschange.com/CONTENT/1230>
- 12 Afendulis CA, Kessler DP. Vertical integration and optimal reimbursement policy. *Int J Health Care Finance Econ*. 2011;11(3):165–79.
- 13 See, for example, *Cascade Health Solutions v. PeaceHealth*, 515 F.3d 883 (9th Cir. 2008).
- 14 Greenlee P, Reitman D, Sibley DS. An antitrust analysis of bundled loyalty discounts. *International Journal of Industrial Organization*. 2008;26(5):1132–52.
- 15 Cuellar AE, Gertler PJ. Strategic integration of hospitals and physicians. *J Health Econ*. 2006;25(1):1–28.
- 16 Ciliberto F, Dranove D. The effect of physician-hospital affiliations on hospital prices in California. *J Health Econ*. 2006;25(1):29–38.
- 17 Afendulis CA, Kessler DP. Tradeoffs from integrating diagnosis and treatment in markets for health care. *Am Econ Rev*. 2007;97(3):1013–20.
- 18 Kessler DP, McClellan MB. Is hospital competition socially wasteful? *Q J Econ*. 2000;115(2):577–615.
- 19 To access the Appendix, click on the Appendix link in the box to the right of the article online.
- 20 As Appendix Table 1 shows (see Note 19), we had data on vertical integration and other market and area characteristics for 2,454 of the approximately 3,100 US counties with residential population. It also shows that although the MarketScan data only cover one-quarter to one-fifth of all US counties, the counties they cover include most of the US population and are broadly representative of the United States as a whole.
- 21 We also estimated the model underlying Exhibit 3 using enrollee-level data with standard errors clustered at the county-year level. The estimated effects of fully integrated organizations and hospital market competitiveness were of similar magnitudes and statistically significant ($p < 0.01$). Estimates of the effects of the other three forms of integration remained small and insignificant.
- 22 We also estimated the model underlying Exhibit 4 using enrollee-level data with standard errors clustered at the county-year level. The estimated effects of open physician-hospital organizations was of a similar magnitude and statistically significant ($p < 0.05$). Estimates of the effects of the other three forms of integration and hospital market competitiveness remained small and insignificant.
- 23 This calculation is based on the coefficients and standard errors shown in Appendix Table 2 and the standard deviation of the market share of fully integrated organizations in Appendix Table 1 (see Note 19).

