The Impact of Provider Consolidation on Price: Horizontal Integration and Tied Purchasing

Caroline S. Carlin, PhD, Medica Research Institute

Roger Feldman, PhD, University of Minnesota

Bryan Dowd, PhD, University of Minnesota

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Abstract

In recent years, U. S. hospitals have accelerated the trend toward acquisition of physician practices. If the hospital and physician practice had different levels of market power prior to the acquisition, the tied contracting that results when health plans must negotiate with the combined entity may have an impact on prices. In addition, when the hospital already owns a number of clinics, this new acquisition results in horizontal integration of clinic systems, possibly increasing its market power for physician services. However, there is a paucity of empirical literature documenting the impact of vertical integration of hospitals and physician practices on prices.

This study leverages changes in a large metropolitan area, in which three multispecialty clinic systems were acquired by hospital-owned integrated delivery systems at the end of 2007. We examine the impact of these hospital acquisitions on global measures of hospital and physician prices, and on unit prices for several high-frequency physician procedures. We find evidence of an increase in physician prices for health plan enrollees attributed to both the acquired clinic system and the acquiring IDS's legacy clinic system, supporting the hypothesis that horizontal integration between the newly acquired clinics and the previously owned legacy clinics increases market power. In addition, we find changes in hospital prices consistent with the impact of tied physician and hospital contracting in a differentiated market.

Introduction

In reaction to health reform efforts, U. S. hospitals have accelerated the trend toward acquisition of physician practices. More than half of physician practices are now owned by hospitals or integrated delivery systems.[1] This trend toward hospital ownership of physician practices facilitates the development of accountable care organizations (ACOs), required by the Patient Protection and Affordable Care Act to participate in the Medicare shared saving program. In theory, a vertically integrated delivery system, providing both hospital and physician services, should be able to accept global reimbursement for care and more easily coordinate care, creating the possibility of higher quality, lower cost care, motivating the integration of ACOs into health reform.

However, a growing body of evidence indicates that hospital-owned clinic systems deliver care at a higher annual cost than physician-owned clinic systems,[2-5] while not leading to demonstrably better quality. While theoretical work has explored the structure of physician-hospital alignment (for example, Trybou et al,[6] Burns and Muller[7]), very few studies have examined empirical data to identify the impact of hospital acquisition on prices of care. In their recent review of the literature, Hwang et al[8] found no peer-reviewed studies that directly compare the cost of care in integrated and separate environments. Many of the empirical studies we found in this area[2,3] rely on cross-sectional data without controls for the endogeneity of ownership, leaving unanswered the question: Does hospital acquisition of clinic systems increase prices, or are clinic systems that have higher prices more attractive targets for acquisition?

This study leverages changes in Minneapolis-St. Paul ("Twin Cities") metropolitan area, in which three multispecialty clinic systems were acquired by hospital-owned integrated delivery systems at the end of 2007. We examine the impact of hospital acquisition on global measures of hospital and physician prices, as well as on unit prices for several high-frequency physician services. A rich dataset allows us to attribute health plan enrollees to clinics within integrated delivery systems (IDSs) or to independent clinic systems, and to control for the health risk of the enrollees in the attributed population. Our research design allows us to distinguish between price differences due to the selection of the clinic system to be

acquired by the IDS and differences driven by the acquisition itself. In addition, we attempt to distinguish between the causes of acquisition-related price changes.

Theory

The "intervention" in this analysis is the acquisition of a multispecialty clinic system by a hospital-owned IDS. We focus on the effect of such acquisitions on changes in price indices that capture the average physician and hospital unit prices, and on changes in specific unit prices (fees). While some types of vertical[a] relations among hospitals and physicians have received attention, including exclusive and 'most favored nations' contracts, hospital ownership itself has received relatively little attention in the health economics and health policy literature. Nor has it received significant antitrust scrutiny[9,10] due, in part, to a lack of relevant data, and because many previous studies in industries other than health care found that vertical integration actually lowered prices.[9] Furthermore, both the predicted effect of vertical integration on prices and the empirical results in the health care industry are ambiguous.[11,12]

Two competing theories lead to the predicted effect of vertical integration between a stand-alone hospital and a clinic system, theories about transaction costs and tied purchasing. If transaction costs are reduced and other efficiencies are gained through factors such as strengthened administrative controls and economies of scope, we would expect to see prices decline for both the hospitals and the clinic systems.[13] However, there has been very little empirical support for a theory of transaction cost economies in hospital and physician integration (e.g., Cueller and Gertler[11]), suggesting that we would not be able to detect the impact of increased efficiencies on either physician or hospital prices in the midst of the market power changes discussed below.

Alternatively, Gal-Or[14] presents a theory that predicts the impact of tying the hospital and clinics together in contracting with health plans. In this tying scenario, the hospital can say to the payer, "The only way your enrollees can gain access to our hospital is to contract with these clinics." For that strategy

[a] Following Gaynor,[9] we use the terms "vertical" and "vertical integration" to describe an ownership relation between a hospital and a physician practice, though the services are often complementary rather than vertically integrated.

to be effective, however, the hospital must be a "must have" hospital in any provider network developed by the insurer in that market area; through tied contracting the hospital extends its market power to the clinic system. This theory predicts that the entity (hospital or clinic system) with the weaker market power prior to integration benefits from the strength of the stronger entity after integration. As discussed below, we believe there is significant market power in this region, at least for hospital services.

The theory becomes more complex when a clinic system is not acquired by a stand-alone hospital, but by an existing IDS; in this case we have vertical integration between the member hospital(s) and the new clinic system, and we also have horizontal integration between the legacy clinic system and the newly-acquired clinic system. As Gaynor[9] notes, integration of a clinic system into a hospital-based IDS simply could reduce the number of competing clinic systems in the market, leading to increased physician prices.

Our setting combines both elements. As the two largest IDSs in the market, the acquiring integrated delivery systems had considerable market pricing power for both hospital and physician services prior to the acquisition. Each controlled 25-27% of the licensed hospital beds in the seven-county metropolitan area over the course of our study.[15] Assuming the distribution of the attributed enrollees in the health plan is representative, together their legacy clinic systems also provide physician services to about 30% of the patients in the state. The three acquired multispecialty clinic systems may benefit from increased market power due to horizontal integration with the legacy clinic systems, which we hypothesize will lead to increased physician prices in both the acquired clinic systems and the legacy clinic systems.[b] Because of tied contracting, the acquired clinic systems' physician prices also may be impacted by differences in market power between the acquiring hospitals and the acquired clinic systems; however we anticipate that for physician prices, the tying effect will be overwhelmed by the impact of horizontal integration.

[b] It is important to note that the Minnesota Attorney General, using the Twin Cities metropolitan area as the definition of market area, did not have antitrust concerns about these acquisitions at the time they occurred. While the Twin Cities has a good highway infrastructure and, except for the Mississippi River, very few geographic barriers, we believe it is unlikely that individual patients would select their physicians from such a broad geographic area.

Because the hospital systems in the acquiring IDSs already are integrated with their legacy clinic systems, we expect little or no additional efficiency gains for the hospitals. There is clearly no horizontal integration across hospitals in this scenario. Thus we can be relatively certain that any acquisition effect resulting in an increase in hospital prices is a result of tied contracting. The existence and direction of the tying effect for hospital prices depends on the relative market power of the acquired and acquiring groups. For example, if the clinic system has greater market power than the acquiring hospital, we would expect to see that market power extended to the hospital, increasing hospital prices.

In fact, there are two causes of market power of interest: market concentration and product differentiation. The nature of market concentration in these hospital and physician services markets has been described above. While there were no objective measures of differentiation due to hospital and clinic system quality at the time of the acquisitions, we use the Minnesota Community Measurement 2011 patient experience survey[c] to measure quality through the patient's rating of his or her clinic location and hospital. These ratings identify the fraction of surveyed patients who would rate their provider or hospital as "9" or "10" on a 10-point scale, where 10 is the best score. Assuming that the relative ratings were stable over time,[d] we use these 2011 ratings to develop our hypothesis about the impact of tying on prices in the post-acquisition years (2008-2011). One IDS (IDS1), with an average patient experience rating for their flagship hospital and increasing hospital market share,[16] acquired a clinic system (Acq3) with an above-average rating in its main clinic location and a second clinic system (Acq1) with a rating at or below average. If differentiation were the only source of market power, we would expect that the net effect of these acquisitions would be little or no impact on hospital prices for this IDS. The second IDS (IDS2), with a below-average patient experience rating at its flagship hospital location and declining hospital market share,[16] acquired a clinic system (Acq2) with an above-average rating in its main clinic

[c] This was the first in a series of biannual patient surveys, available at http://mncm.org/reports-and-websites/reports-and-data/.

[d] An assumption supported by stability in the relative ranking for the subset of clinics in the 2009 pilot of the survey. Hospital patients were not included in the pilot survey.

location. Again, if differentiation were the only source of market power, we would expect that the impact of this acquisition would be an increase in hospital prices for that IDS.

Methods

Study Setting

The setting for this study is the state of Minnesota, with data concentrated primarily in the 11-county Minneapolis-St. Paul, Minnesota metropolitan area, in the years 2006 through 2011. Near the end of 2007, three physician-owned multispecialty clinic systems were acquired by two hospital-owned IDSs. Using data from a regional health plan, we study the enrolled population attributed to these three clinic systems and the legacy clinic systems in the acquiring IDSs for two years prior to and four years after the acquisitions, using enrollees attributed to clinic systems in three other IDSs and to four other physician-owned clinic systems as controls. Our data include all claims for the enrollees attributed to one of the twelve clinic systems (3 acquired, 2 acquiring, 7 control) in our study, together representing more than a quarter of the enrollees covered in the plan's commercial and Medicaid products.

Plan enrollees are retrospectively attributed to a clinic system at the end of the calendar year if the majority of their primary care dollars were spent within that system. The attribution was done by the health plan using primary care identified by the service location and the specialty of the treating provider. Specialties comprising primary care include general practice, internal medicine, family practice and OB-GYN. The service must be delivered in an office visit setting or, for Medicaid enrollees only, an emergency department. The dollars are the allowed charges, after deductions for negotiated provider discounts and services not covered, and include the amounts paid by both the plan and the enrollee.

Data are collected on enrollees in five mutually exclusive groups. The first two groups are composed of enrollees attributed to "treatment clinic systems":

1. The three acquired multispecialty clinic systems (labeled Acq1, Acq2, and Acq3), with 22 primary care locations.

2. The remaining legacy clinic systems that already were owned by the two acquiring IDSs (IDS1 and IDS2).

The latter three groups of enrollees are those attributed to "control clinic systems":

3. Clinic systems owned by three IDSs (IDS3, IDS4, and IDS5) that provided hospital and multispecialty clinic services; one is hospital owned, one is insurer owned, and one is physician owned.
4. Two physician-only multispecialty clinic systems (MS1, MS2).
5. Two physician-only primary care clinic systems with limited specialty services (PC1, PC2).

The acquired clinic systems in the first group, above, were the only substantive clinic system acquisitions in this region during the time period of our study.

Data

The data are drawn from the claims files of commercial group and managed Medicaid products of a regional health plan in the upper Midwest. In total, the study population includes 796,398 person-years across the six-year study period, with summary statistics shown in Table 1. The study population is weighted toward females (59%) with an average age of 42. Because the study population consists of enrollees who accessed primary care, the population is slightly older and more female than the average across all enrollees in Minnesota (average age 41 and 53% female in 2011). Individual health risk is measured by Resource Utilization Bands developed from the Johns Hopkins ACG system.[17] To avoid issues of endogeneity, these health risk measures are based on the prior year's diagnosis code history. By using prior-year health risk, we are restricted to using only the person-years of data with a previous year of coverage. The only meaningful shift in the population statistics caused by this restriction is a modest increase in the average age, from 41.6 to 42.1 years.

These summary statistics include neighborhood effects drawn from the 2011 5-year American Community Survey[18] and matched to the enrollee's residential address at the census-tract level. On average, the neighborhoods are primarily White and non-Hispanic (84%), English-speaking (88%), have

at least a high school degree (56% without a 4-year college degree, 36% with a 4-year degree), and have few households below the federal poverty limit (9%). However, these averages mask a significant amount of variation, as seen in Table 1.

The majority of the population is enrolled in a broad PPO network, but there is meaningful exposure in a more restricted network (18%) and a managed Medicaid population (16%). Sixty-eight percent of the exposure is concentrated in the clinic systems affiliated with the three largest IDSs in the region (IDS1, IDS2, and IDS3).

Price Variables

We are interested in measuring the impact of vertical integration of clinic systems into hospital-owned IDSs on the price of health care. (We explore the impact of vertical integration on patterns of care delivery and quality indicators elsewhere.[19]) We first developed global indices of the average prices for total and professional-only services for each health plan enrollee. These indices, constructed at the enrollee-year level, are normalized for differences in utilization patterns by computing the ratio of actual allowed charges per member per-month (PMPM) to PMPM charges computed using a standardized fee schedule:

$$\text{Price Index} = (\text{Actual PMPM Charges})/(\text{Standardized PMPM Charges})$$

We developed the *actual* PMPM charges by summing the allowed charges for each enrollee and dividing by the enrollee's months of exposure in that year. "Allowed charges" means claims covered by the plan, after the negotiated provider discounts are applied. These charges include the total covered amounts, whether paid by the enrollee or by the plan. Because some groups have pharmacy coverage carved out to another provider, pharmacy spending was excluded from all groups to create parity in the measures.

The *standardized* PMPM charges are computed by multiplying the enrollee's units of utilization times prices from a common fee schedule, developed as a simple average of allowed charges for each

type service, averaged across all providers and across the 6-year timeframe. There are four types of average fees:

- Inpatient facility charges – a dollar amount per admission, computed within DRG code.
- Outpatient facility charges when a CPT4 code is present – a dollar amount computed for each CPT4 code.
- Outpatient facility charges when a CPT4 code is not present – a dollar amount computed for each revenue code. This is a small fraction of total allowed charges, typically for items such as sterile supplies and IVs.
- Professional charges – a dollar amount computed for each CPT4 code.

Standardized PMPM charges were developed by multiplying encounters by these standardized fees, summing within person-year, and dividing by the enrollee's months of exposure.

This total price index allows us to model the impact of acquisition on all prices. We also computed an index of professional charges only, to model the average impact of acquisitions on just physician prices. Because we use only plan enrollees who were attributed to a clinic system based on their patterns of primary care, no enrollee has total or professional claims equal to zero. Thus, we do not need to worry about dividing by zero in calculating this price index. The distributions of these indices are bell-shaped curves with their means at 1 by construction. A price index of 1 indicates an average price (fee) across time and provider groups; an index of 1.2 would indicate average price levels 20% higher than average. More than 98% of the observations in the total and professional price indices are between 0 and 2.

It is important to note that these person-level indices associate any price effect of clinic system acquisition to the clinic system to which the member is attributed based on their primary care spending. But an individual could receive care from a variety of hospitals and clinic systems[e] over the course of the

[e] In this market, integrated delivery systems provide 50-60% of the total services (measured by allowed charges) for enrollees attributed to their clinic systems; independent clinic systems provide 10-20% of the total services for their attributed enrollees. Either type of system typically provides 25-50% of professional services for the enrollees attributed to their system.

year. Therefore, in addition to these global measures of price, we selected five CPT4 procedure codes for which we model unit prices, where we can associate prices with the specific clinic system completing that procedure. These include two procedure codes for common office visits for established patients (99213, 99214), two for adult preventive exams (99395, 99396), and one common surgical procedure (20610 - aspirate or inject a major joint or bursa). These procedures were selected because they were among the most common office visit or surgical procedures, contributing significant dollars to total spending. We use the allowed charges (unit price) for each procedure.

Finally, we wanted to develop a measure of hospital prices. We tested unit prices for particular high-frequency admission types (by DRG), but our data were distorted by a DRG coding change that occurred in October 2007, making it difficult to find enough high-frequency admission types with clear coding to estimate a meaningful set of regressions. Therefore, we used the standardized fees described above to develop a hospital price index for each admission that was simply:

Hospital Price Index = (Actual Price of Admission for a DRG)/(Standardized Fee for That DRG)

This index is centered at 1 by construction, but many admissions had extreme values, with actual prices as high as 10-25 times the standardized fee. A close examination of the data showed that the majority of these extreme values came from psychiatric and substance abuse admissions, where the length of stay can be quite variable. Therefore, we focus on results with psychiatric and substance abuse admissions excluded.

Our units of analysis include enrollees, physician procedures, and hospital admissions. These variables are categorized into clinic systems (and thus into treatment or control groups) by either retrospective attribution or by the entity providing the service. To enhance clarity, the price variables, the unit of analysis of their models, and the means by which these variables are categorized into a clinic system are summarized in Table 2.

Econometric Models

Our econometric models are simple linear regressions with errors clustered within individual enrollees. Our models are informed by a classic difference-in-differences (DID) equation, which controls for endogeneity caused by time-invariant unobserved characteristics of the treatment and control groups. Given observations from twelve clinic systems and IDSs, over the course of six years, the regressions are structured as follows:

$$y_{itj} = \beta_1' x_{itj} + \sum_{j=1}^{12} \beta_{2j} \text{ClinicSystem}_j + \sum_{t=2006}^{2011} \beta_{3t} \text{Year}_t + \sum_{j=1}^{5} \sum_{t=2008}^{2011} \beta_{4jt} \text{Treat}_{jt} + \varepsilon_{ijt}$$

Here, *ClinicSystem*, *Year* and *Treat* are indicator variables identifying, respectively, which clinic system the observation is from, the year of observation, and whether the observation was exposed to the impact of clinic system acquisition (either as the acquired or acquiring entity). The treatment clinic systems are identified by j=1 – 5, and the post-acquisition time frame by t=2008 – 2011. The treatment effects are the twenty values of β_{4jt}, estimating the impact of the acquisition on the acquired clinic systems and the acquiring clinic systems. By allowing these acquisition effects to vary by year, we can see how patterns in prices evolve over time. The reference value for *ClinicSystem* is IDS1, and for *Year* is 2006. Covariates controlling for observed characteristics of the enrollee and their environment are captured in the vector x_{ijt}.

Our treatment and control group structure is complex, and we risk not including the correct acquisition counterfactual in estimating our models. To check the robustness of our results, we re-estimate the models using subsets of the population. To test the Total Price Index and Physician Price Index results, we re-estimate using only (1) observations from the three acquired multispecialty clinic systems compared with observations from the two non-acquired multispecialty clinic systems, and separately (2) observations from the two acquiring IDSs' clinic systems compared with observations from the three other IDSs' clinic systems. We use similar subpopulations to test the robustness of the models of Procedure Unit Prices. To test the Hospital Price Index results, we re-estimate the model restricting the comparison hospitals to only hospitals in IDS3-5.

Because enrollees move in and out of plan coverage and attribution to a clinic system, the enrollees attributed to a clinic system can change from year to year. To test the robustness of our results to that sort of enrollee migration, we developed a panel of "stable" enrollees who have a minimum of 12 months of attributed coverage in 2006-2007 and at least 12 months of attributed coverage in 2008-2011, and re-estimated our models on subset of the population.

Results

Total and Professional Price Indices

The results of the regressions for the total and professional price indices are shown in Table 3. For the acquired clinic systems, there is very little impact on prices in the first year after the acquisition, then a steep increase through years two and three, with a flattening of the acquisition-related effect in year four. There are some differences by clinic system, with Acq1 and Acq3 showing the largest acquisition effects. Among the clinic systems in the acquiring IDSs, we see price increase patterns similar to, but smaller than the increases in the acquired clinic systems. This is easiest to see in Figure 1, which displays a set of graphs comparing total and professional acquisition effects, grouped in their post-acquisition organizational affiliations.

Both price indices tend to decline with member's age, health status and for females, counter to trends in expected utilization levels. Neighborhood effects often are statistically significant, but are small. For example, a 10 percentage-point increase in the fraction of neighbors with a 4-year college degree would generate a total price index change of -0.003. Given lower reimbursement rates it is not surprising that Medicaid enrollees have dramatically lower price indices. Only enrollees in the IDS3 clinic systems had prices higher than enrollees in the reference clinic systems in IDS1. Note that, because we define the clinic system indicators according to the system in which the enrollee received the majority of his or her primary care, that IDS or independent clinic system may not perform all of the services in the price index, diffusing the impact of negotiating power on the price index. The general time trend moves in the direction expected, with price indices increasing at a steady pace from 2006 through 2011.

Professional Procedure Unit Prices

The results of separate regressions for each of the five procedure codes are shown in Table 4. The acquisition effects can be interpreted as dollar differences in unit prices. Note that the effects by acquired or acquiring clinic system (and the time-invariant provider control variables) are determined by the clinic system that *performs* the procedure, rather than the *attributed* clinic system used for total and professional price indices, because we are trying to capture the impact of contractual reimbursement on specific procedures. Acquisition effects are nearly monotonically increasing by year. The early acquisition effects (2008, 2009) are often negative, with strong growth as new, post-acquisition contracts are negotiated. By 2011, when all acquired clinic systems were paid under the acquiring IDS's physician contracts, the acquisition effects for acquired clinic systems ranged from 9% to 18% of the mean charge for office-based procedures. The acquisition effect for the surgical procedure is less consistent, with two acquired clinic systems achieving significant increases by 2011, and one having no long-term effect. The acquisition effect on clinic systems in the acquiring IDSs is again more modest, with office-based procedures achieving acquisition-related increases of 3-10% of the mean charge for office based procedures, and a reduction in fees for the surgical procedure.

The impacts of other enrollee attributes are generally similar to the impacts on global price indices, though there are some differences. Unit prices decrease as the enrollee gets sicker, and for office visits for female enrollee. However, the impact of age is not monotonic. Again, neighborhood effects are often statistically significant but a 10 percentage-point change rarely has a full dollar's impact on unit prices. Medicaid unit prices are dramatically lower than the commercial prices; IDS3 owns the only clinic system more expensive than the clinic system in the reference IDS1; and general time trend is generally monotonically increasing. The only exception to this monotonicity in trend is a drop in preventive care visit unit prices in 2008.

Hospital Price Indices

By examining hospital prices, we hope to detect the impact of contractually tying access to the newly acquired clinics to the acquiring hospital systems. Regression results for the hospital price index are shown in Table 5. The acquisition effects are also displayed graphically in Figure 2. Tied contracting appears to have had little or no impact on hospital prices in IDS1, but tying resulted in increased prices in IDS2. These increased prices for hospitals in IDS2 are consistent with the below-average patient experience rating of their flagship hospital and the hospital system's declining market share, in combination with the above-average patient experience rating of the main clinic location in Acq2.

Robustness of Results

We conducted a series of analyses to check the robustness of our results to the definition of comparison groups and to the unbalanced nature of our panel data set. In the first of these robustness checks, we explored the appropriateness of our control group structure by restricting the comparison groups for the acquired clinic systems (Acq1, Acq2, Acq3) to just the two multispecialty clinic systems that remained physician-owned (MS1, MS2); in a separate set of regressions we restricted the controls for the acquiring IDSs (IDS1, IDS2) to the three IDSs that were not involved in an acquisition (IDS3, IDS4, IDS5). These sub-analyses produced results that are very consistent with the results presented here.

The second robustness check explored the impact of having an unbalanced panel in the main analysis, so that we could not estimate a true difference-in-difference model. We used a subset of the population with a minimum of 12 months of attributed enrollment both prior to and after the year-end 2007 acquisition to test the robustness of our results from the larger, more variable population. This test is of particular importance to the total and professional price index models, where unobserved member characteristics are more likely to have an impact on the mix of services in the indices capturing average prices. This sub-analysis found acquisition effects that are very similar in magnitude and pattern to those presented in Table 3 and Figure 1. A similar consistency of results is seen in the physician unit price and hospital price index results.

Finally, we were concerned that the estimated difference in acquisition effects between the acquired clinic systems and the clinic systems in the acquiring IDSs merely captured pre-existing differences in trends, rather than an acquisition effect. While our ability to test this concern is limited because we have only two years of data prior to the acquisitions, we see clear discontinuities in the organization-specific time trends from 2006 to 2007 and the trends in the post-acquisition periods, supporting the results presented here. All of these robustness checks are available from the corresponding author on request.

Conclusion

We used global and procedure-specific measures of hospital and physician prices to examine the impact of vertical integration between a multispecialty clinic system and a hospital-owned integrated delivery system. We found evidence of an increase in physician prices for enrollees attributed to both the acquired clinic system and the acquiring IDS's clinic system, supporting the hypothesis that horizontal integration between the new and legacy clinics increases market power. This suggests that the market definition used by the Attorney General to assess the antitrust impact of these acquisitions may have been too broad to predict this increase in market power. In addition, we find changes in hospital prices following a pattern that provides evidence of the impact of tied contracting of physician and hospital services.

It is important to note that these increases in prices do not necessarily dictate a net reduction in the value of these health care services. We document elsewhere[19] early evidence of reduced inpatient admissions and more appropriate emergency department usage due to the acquisition, among other markers of improved quality of care.

Figure 1 – Total and Professional Price Index Acquisition Effects by Organizational Affiliation

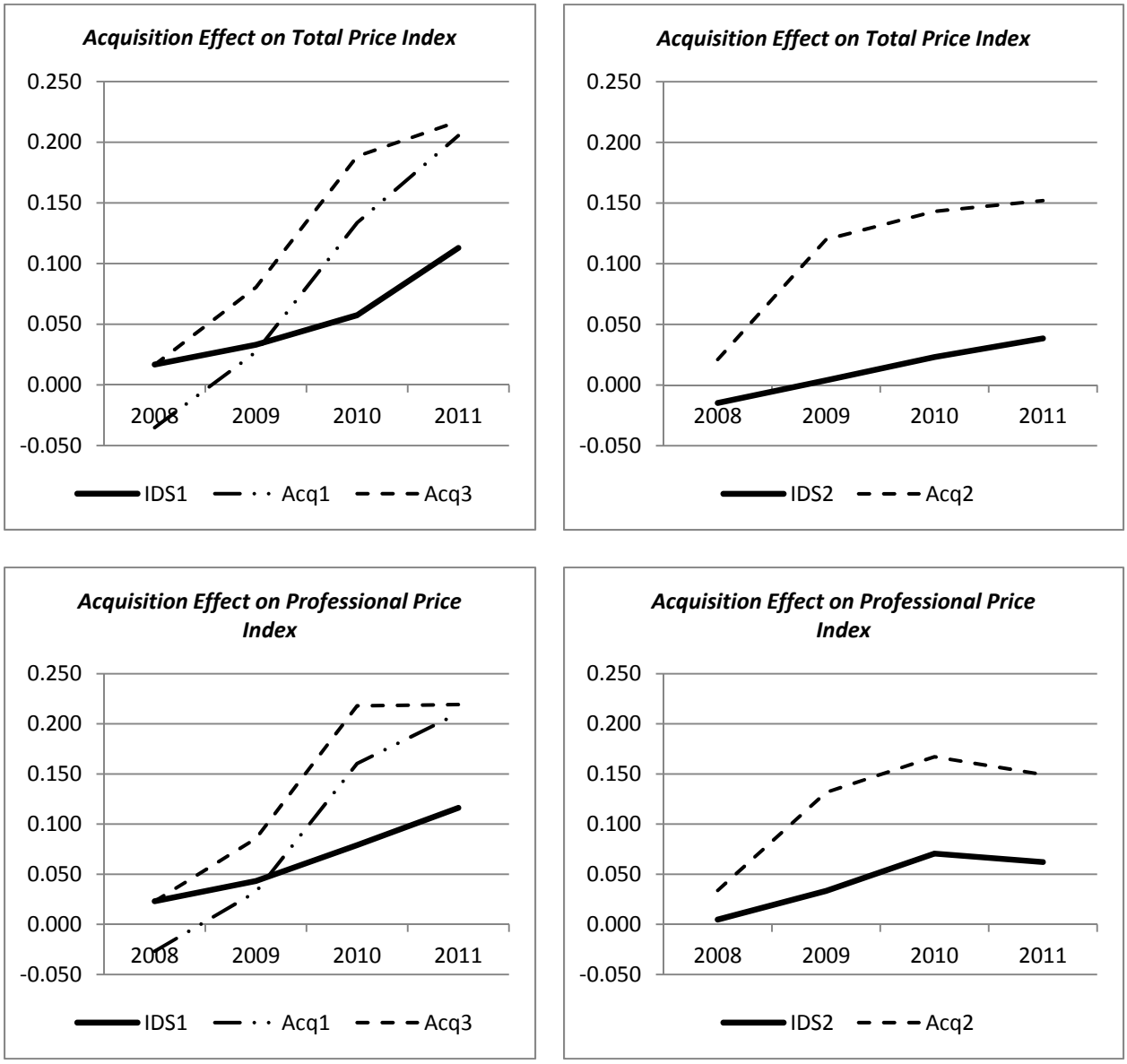

Figure 2 – Hospital Admission Price Index Acquisition Effects

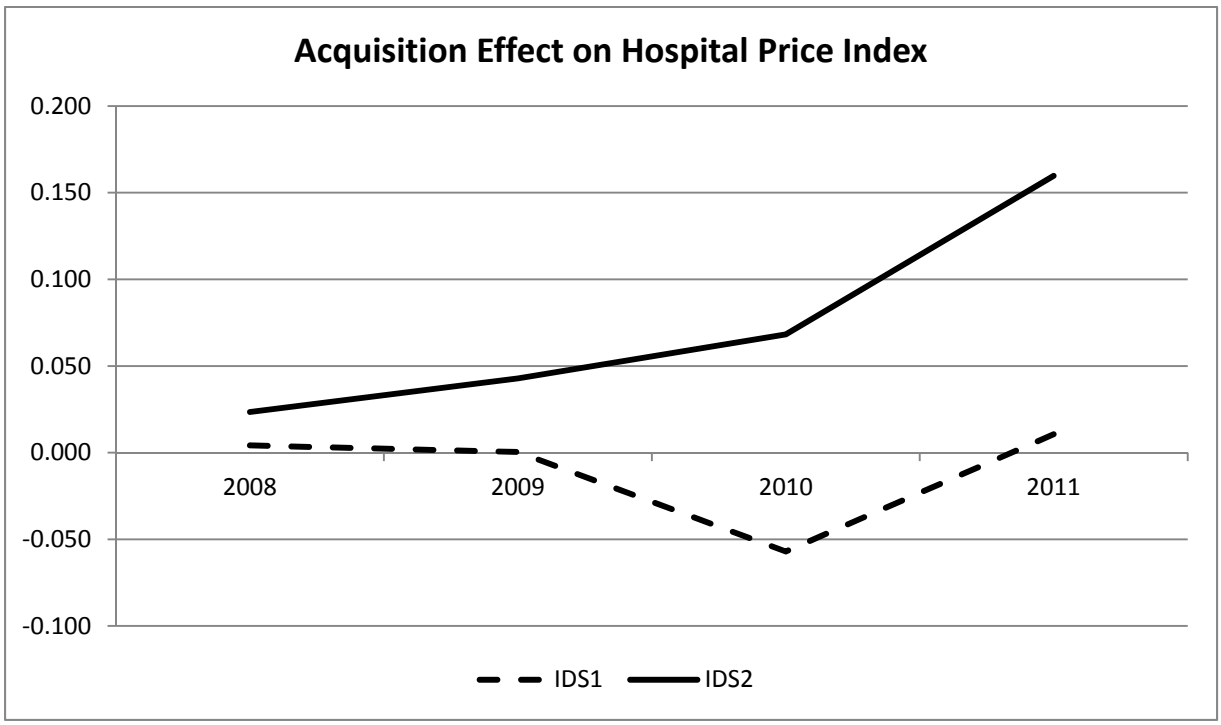

Table 1 – Summary of Data

	Mean	Minimum	Maximum
Enrollee Demographics			
Age	42.1	18	105
Female	59.1%		
Prior Year Health Status			
No diagnosis history	8.4%		
Health users	11.8%		
Low healthy risk	14.6%		
Moderate health risk	49.0%		
High health risk	12.8%		
Very high health risk	3.4%		
Neighborhood Effects			
% less than High School/GED	7.3%	0.0%	64.3%
% High School/GED but no Bachelor's degree	56.4%	0.0%	85.8%
% Bachelor's degree or greater	36.3%	0.4%	95.1%
% White, non-Hispanic	84.4%	0.0%	100.0%
% speaking English only	88.0%	5.4%	100.0%
% households with income below the federal poverty limit	8.6%	0.0%	92.4%
Product			
Broad PPO plan	65.7%		
Restricted network with medical home designation	18.0%		
Managed Medicaid plan	16.3%		

	Person-years
Attributed Clinic System	
Treatment Groups	
Acquired clinic system (Acq1)	44,928
Acquired clinic system (Acq2)	31,200
Acquired clinic system (Acq3)	15,838
Clinic system in acquiring integrated delivery system (IDS1)	256,515
Clinic system in acquiring integrated delivery system (IDS2)	113,057
Control Groups	
Clinic system in integrated delivery system (IDS3)	171,749
Clinic system in integrated delivery system (IDS4)	58,080
Clinic system in integrated delivery system (IDS5)	30,922
Physician-owned multispecialty clinic system (MS1)	20,784
Physician-owned multispecialty clinic system (MS2)	16,191
Physician-owned primary care clinic system (PC1)	25,511
Physician-owned primary care clinic system (PC2)	11,623
Calendar Years	
2006	145,570
2007	132,755
2008	131,503
2009	130,370
2010	126,661
2011	129,539

Table 2 – Summary of Price Variables

Variable Name	***Unit of Analysis***	***Clinic System Assignment***
Total Price Index	Member-year	Attributed provider
Professional Price Index	Member-year	Attributed provider
Procedure Unit Price	Procedure	Servicing provider
Hospital Price Index	Inpatient admission	Servicing provider

Table 3 –Total and Professional Price Index Regressions

	Total Price Index		Professional Price Index	
	Coef	p-val	Coef	p-val
Acquisition Effect				
Acq1 2008	0.017	0.000	0.023	0.000
Acq1 2009	0.080	0.000	0.086	0.000
Acq1 2010	0.189	0.000	0.218	0.000
Acq1 2011	0.217	0.000	0.219	0.000
Acq2 2008	0.021	0.000	0.034	0.000
Acq2 2009	0.120	0.000	0.132	0.000
Acq2 2010	0.143	0.000	0.167	0.000
Acq2 2011	0.152	9.000	0.149	0.000
Acq3 2008	-0.035	0.000	-0.027	0.000
Acq3 2009	0.027	0.000	0.032	0.000
Acq3 2010	0.134	0.000	0.160	0.000
Acq3 2011	0.205	0.000	0.210	0.000
IDS1 2008	0.017	0.000	0.023	0.000
IDS1 2009	0.033	0.000	0.043	0.000
IDS1 2010	0.057	0.000	0.079	0.000
IDS1 2011	0.113	0.000	0.116	0.000
IDS2 2008	-0.015	0.000	0.005	0.045
IDS2 2009	0.004	0.137	0.033	0.000
IDS2 2010	0.023	0.000	0.071	0.000
IDS2 2011	0.038	0.000	0.062	0.000
Age				
18-22	*omitted*		*omitted*	
23-29	-0.012	0.000	-0.004	0.001
30-44	-0.017	0.000	-0.014	0.000
45-59	-0.023	0.000	-0.031	0.000
60+	-0.103	0.000	-0.100	0.000
Female	-0.013	0.000	-0.013	0.000
Prior Year Health Status				
No Valid Diagnosis	-0.006	0.000	-0.007	0.000
Healthy User	*omitted*		*omitted*	
Low Risk	-0.012	0.000	-0.011	0.000
Moderate Risk	-0.036	0.000	-0.033	0.000
High Risk	-0.057	0.000	-0.054	0.000
Very High Risk	-0.087	0.000	-0.084	0.000
Neighborhood Effects				
% White Non-Hispanic	0.0002	0.000	0.0000	0.831
% HS diploma, no 4-yr degree	-0.0006	0.000	0.0011	0.000
% 4-year degree	-0.0003	0.007	0.0013	0.000
% Income below FPL	0.0003	0.000	0.0000	0.722
% Speaking English only	0.0002	0.043	-0.0006	0.000
Product				
Broad PPO	*omitted*		*omitted*	
Narrow Network	0.001	0.545	0.008	0.000
Medicaid	-0.486	0.000	-0.576	0.000

Table 3, continued –Total and Professional Price Index Regressions

	Total Price Index		Professional Price Index	
	Coef	p-val	Coef	p-val
Attributed Clinic System				
Acq1	-0.105	0.000	-0.093	0.000
Acq2	-0.122	0.000	-0.105	0.000
Acq3	-0.121	0.000	-0.108	0.000
IDS1	*omitted*		*omitted*	
IDS2	-0.059	0.000	-0.062	0.000
IDS3	0.135	0.000	0.186	0.000
IDS4	-0.050	0.000	-0.016	0.000
IDS5	-0.068	0.000	-0.091	0.000
MS1	-0.016	0.000	-0.097	0.000
MS2	-0.128	0.000	-0.118	0.000
PC1	-0.106	0.000	-0.107	0.000
PC2	-0.144	0.000	-0.132	0.000
General Trend				
2006	*omitted*		*omitted*	
2007	0.033	0.000	0.033	0.000
2008	0.063	0.000	0.059	0.000
2009	0.098	0.000	0.090	0.000
2010	0.123	0.000	0.105	0.000
2011	0.145	0.000	0.149	0.000
Constant	1.185	0.000	1.107	0.000
R^2	0.374		0.491	
N	795,546		796,053	

Table 4 – Unit Price Regressions for a Sample of Professional Procedures

	99213: OV estab patient low complexity		99214: OV estab patient moderate complexity		99395: well exam 18-39 yrs		99396: well exam 40-64 yrs		20610: Inject/drain joint/bursa	
	Coef	p-val	Coef	p-val	Coef	p-val	Coef	p-val	Coef	p-val
Acquisition Effect										
Acq1 2008	-4.992	0.000	-7.514	0.000	-4.467	0.000	-5.947	0.000	-5.100	0.106
Acq1 2009	-2.795	0.000	-3.567	0.000	-0.480	0.403	1.012	0.037	-4.645	0.229
Acq1 2010	8.424	0.000	12.043	0.000	18.040	0.000	27.386	0.000	7.897	0.123
Acq1 2011	11.089	0.000	16.696	0.000	25.525	0.000	37.000	0.000	-0.033	0.995
Acq2 2008	-6.670	0.000	-9.333	0.000	0.163	0.861	-0.343	0.605	3.229	0.566
Acq2 2009	2.898	0.000	5.946	0.000	11.331	0.000	16.358	0.000	10.752	0.068
Acq2 2010	8.714	0.000	13.968	0.000	16.696	0.000	26.007	0.000	11.631	0.026
Acq2 2011	7.503	0.000	11.564	0.000	16.795	0.000	28.218	0.000	24.661	0.000
Acq3 2008	-17.233	0.000	-30.999	0.000	-21.809	0.000	-39.953	0.000	-11.333	0.015
Acq3 2009	-8.392	0.000	-17.303	0.000	-13.263	0.000	-25.699	0.000	-0.769	0.870
Acq3 2010	8.115	0.000	4.744	0.000	15.447	0.000	13.979	0.000	15.492	0.001
Acq3 2011	12.805	0.000	12.157	0.000	24.081	0.000	26.134	0.000	11.006	0.128
IDS1 2008	-4.505	0.000	-7.342	0.000	-10.052	0.000	-13.651	0.000	-14.222	0.000
IDS1 2009	-3.707	0.000	-5.327	0.000	-6.956	0.000	-10.253	0.000	-8.121	0.003
IDS1 2010	2.990	0.000	4.481	0.000	5.783	0.000	5.388	0.000	-9.688	0.001
IDS1 2011	8.618	0.000	13.083	0.000	13.670	0.000	17.261	0.000	-3.077	0.339
IDS2 2008	-5.396	0.000	-8.342	0.000	-5.580	0.000	-6.710	0.000	-6.740	0.009
IDS2 2009	-5.394	0.000	-6.451	0.000	0.409	0.251	0.954	0.001	-1.519	0.635
IDS2 2010	2.321	0.000	5.351	0.000	10.696	0.000	13.479	0.000	-2.171	0.515
IDS2 2011	2.749	0.000	5.127	0.000	12.172	0.000	16.057	0.000	-3.872	0.329
Age										
18-22	*omitted*		*omitted*		*omitted*		*n/a*		*omitted*	
23-29	0.093	0.491	0.480	0.089	0.474	0.006	*n/a*		5.414	0.054
30-44	-0.078	0.525	0.870	0.001	1.328	0.000	*omitted*		4.728	0.043
45-59	0.185	0.146	1.485	0.000	*n/a*		0.948	0.000	5.356	0.021
60+	-8.025	0.000	-13.755	0.000	*n/a*		1.873	0.000	-10.428	0.000
Female	-0.939	0.000	-1.544	0.000	-4.061	0.000	-2.534	0.000	2.585	0.012
Prior Year Health Status										
No Valid Diagnosis	-1.107	0.000	-2.806	0.000	-0.593	0.012	0.022	0.913	-10.785	0.000
Healthy User	*omitted*		*omitted*		*omitted*		*omitted*		*omitted*	
Low Risk	0.004	0.965	-0.228	0.269	-0.175	0.306	0.007	0.967	-3.823	0.078
Moderate Risk	-0.089	0.310	-0.415	0.020	0.032	0.834	0.252	0.056	-0.910	0.587
High Risk	-1.101	0.000	-2.601	0.000	1.017	0.000	0.196	0.293	-4.868	0.007
Very High Risk	-3.517	0.000	-6.740	0.000	-0.434	0.532	-0.011	0.971	-7.189	0.002
Neighborhood Effects										
% White Non-Hisp	-0.0157	0.003	-0.0143	0.171	-0.0255	0.002	0.0016	0.834	-0.2765	0.000
% HS dipl, no 4-yr	-0.0501	0.001	-0.0660	0.030	-0.0889	0.000	-0.1495	0.000	0.1262	0.462
% 4-year degree	-0.0079	0.527	-0.0179	0.496	-0.0214	0.222	-0.0752	0.000	0.0726	0.630
% Inc below FPL	0.0146	0.05	0.0157	0.318	0.0061	0.561	0.0445	0.000	-0.0309	0.735
% Speak Engl only	0.0344	0.000	0.0518	0.001	0.0235	0.049	0.0598	0.000	0.2850	0.002

Table 4, continued – Unit Price Regressions for a Sample of Professional Procedures

	99213: OV estab patient low complexity		99214: OV estab patient mod complexity		99395: well exam 18-39 yrs		99396: well exam 40-64 yrs		20610: Inject/drain joint/bursa	
	Coef	p-val	Coef	p-val	Coef	p-val	Coef	p-val	Coef	p-val
Product										
Broad PPO	*omitted*		*omitted*		*omitted*		*omitted*		*omitted*	
Narrow Network	-0.753	0.000	-0.940	0.000	-1.948	0.000	-1.667	0.000	0.356	0.786
Medicaid	-70.215	0.000	-107.078	0.000	-116.900	0.000	-128.439	0.000	-58.226	0.000
Servicing Clinic System										
Acq1	-7.867	0.000	-13.218	0.000	-18.994	0.000	-25.717	0.000	-16.256	0.000
Acq2	-11.200	0.000	-16.702	0.000	-23.227	0.000	-35.204	0.000	-28.033	0.000
Acq3	-7.496	0.000	-5.134	0.000	-13.132	0.000	-11.119	0.000	-22.730	0.000
IDS1	*omitted*		*omitted*		*omitted*		*omitted*		*omitted*	
IDS2	-4.337	0.000	-7.027	0.000	-11.107	0.000	-18.068	0.000	-18.020	0.000
IDS3	6.981	0.000	13.921	0.000	10.432	0.000	11.666	0.000	5.200	0.008
IDS4	-7.541	0.000	-9.405	0.000	-13.636	0.000	-18.298	0.000	-18.271	0.000
IDS5	-9.707	0.000	-16.038	0.000	-15.624	0.000	-22.846	0.000	-27.173	0.000
MS1	-17.886	0.000	-26.370	0.000	-24.284	0.000	-32.596	0.000	-34.670	0.000
MS2	-19.601	0.000	-29.101	0.000	-29.681	0.000	-39.725	0.000	-37.039	0.000
PC1	-20.472	0.000	-31.192	0.000	-27.650	0.000	-36.961	0.000	-42.067	0.000
PC2	-22.516	0.000	-34.263	0.000	-35.573	0.000	-44.827	0.000	-43.649	0.000
General Trend										
2006	*omitted*		*omitted*		*omitted*		*omitted*		*omitted*	
2007	3.861	0.000	5.676	0.000	5.078	0.000	6.523	0.000	2.123	0.080
2008	18.926	0.000	26.767	0.000	7.978	0.000	10.257	0.000	14.255	0.000
2009	24.266	0.000	32.616	0.000	10.385	0.000	13.358	0.000	19.266	0.000
2010	23.326	0.000	30.932	0.000	10.631	0.000	14.289	0.000	24.393	0.000
2011	31.330	0.000	41.872	0.000	16.466	0.000	20.964	0.000	31.823	0.000
Constant	92.231	0.000	142.520	0.000	169.609	0.000	186.768	0.000	110.731	0.000
N	954,483		723,150		106,521		174,476		17,644	
R^2	0.774		0.759		0.896		0.822		0.434	
Mean unit cost	$86.68		$132.05		$143.99		$177.75		$116.46	

Table 7 - Hospital Admission Price Index Regressions

	With Psych/ Substance Abuse		Without Psych/ Substance Abuse	
	Coef	p-val	Coef	p-val
Acquisition Effect				
IDS1 Hospital 2008	-0.047	0.017	0.004	0.806
IDS1 Hospital 2009	-0.014	0.449	0.000	0.981
IDS1 Hospital 2010	-0.028	0.160	-0.057	0.000
IDS1 Hospital 2011	0.046	0.078	0.011	0.541
IDS2 Hospital 2008	-0.016	0.575	0.024	0.421
IDS2 Hospital 2009	0.018	0.443	0.043	0.047
IDS2 Hospital 2010	0.053	0.069	0.068	0.020
IDS2 Hospital 2011	0.156	0.000	0.160	0.000
Age				
18-22	*omitted*		*omitted*	
23-29	-0.048	0.000	-0.028	0.004
30-44	-0.031	0.016	-0.017	0.069
45-59	-0.008	0.593	0.020	0.068
60+	-0.263	0.000	-0.212	0.000
Female	-0.089	0.000	-0.058	0.000
Prior Year Health Status				
No Valid Diagnosis	0.001	0.962	-0.001	0.931
Healthy User	*omitted*		*omitted*	
Low Risk	-0.002	0.905	0.006	0.619
Moderate Risk	0.022	0.074	0.009	0.325
High Risk	0.025	0.076	0.005	0.585
Very High Risk	0.036	0.026	0.006	0.650
Neighborhood effects				
% White Non-Hispanic	-0.0006	0.105	-0.0010	0.001
% HS diploma, no 4-yr degree	-0.0026	0.011	-0.0028	0.001
% 4-year degree	-0.0012	0.181	-0.0019	0.012
% Income below FPL	0.0004	0.454	-0.0003	0.388
% Speaking English only	0.0013	0.023	0.0016	0.001
Product				
Broad PPO	*omitted*		*omitted*	
Narrow Network	-0.017	0.078	-0.017	0.039
Medicaid	-0.345	0.000	-0.349	0.000
Servicing Hospital System				
IDS1 Hospitals	-0.086	0.000	-0.080	0.000
IDS2 Hospitals	-0.076	0.000	-0.035	0.017
IDS3 Hospitals	-0.098	0.000	-0.065	0.000
Other Hospital System	*omitted*		*omitted*	
General Trend				
2006	*omitted*		*omitted*	
2007	0.032	0.000	0.029	0.000
2008	0.111	0.000	0.055	0.000
2009	0.134	0.000	0.091	0.000
2010	0.195	0.000	0.184	0.000
2011	0.212	0.000	0.198	0.000
Constant	1.269	0.000	1.263	0.000
R^2	0.059		0.088	
N	88,819		78,533	

References

1. Kocher R, Sahni NR. Hospitals' race to employ physicians--the logic behind a money-losing proposition. *The New England journal of medicine.* May 12 2011;364(19):1790-1793.

2. Kralewski JE, Dowd BE, Xu Y, Knutson D. *The organizational characteristics of best medical group practices.* 2011. A Robert Wood Johnson HCFO project, Grant Number 065450.

3. Madison K. Hospital-physician affiliations and patient treatments, expenditures, and outcomes. *Health services research.* Apr 2004;39(2):257-278.

4. O'Malley AS, Bond AM, Berenson RA. Rising hospital employment of physicians: better quality, higher costs? *Issue brief.* Aug 2011(136):1-4.

5. Shortell SM, Gillies RR, Devers KJ. Reinventing the American hospital. *The Milbank quarterly.* 1995;73(2):131-160.

6. Trybou J, Gemmel P, Annemans L. The ties that bind: an integrative framework of physician-hospital alignment. *BMC health services research.* 2011;11:36.

7. Burns LR, Muller RW. Hospital-physician collaboration: landscape of economic integration and impact on clinical integration. *The Milbank quarterly.* Sep 2008;86(3):375-434.

8. Hwang W, Chang J, Laclair M, Paz H. Effects of integrated delivery system on cost and quality. *The American journal of managed care.* May 2013;19(5):e175-184.

9. Gaynor M. Is vertical integration anticompetitive? Definitely maybe (but that's not final). *Journal of health economics.* Jan 2006;25(1):175-180.

10. Gaynor M, Town RJ. Competition in Health Care Markets. *National Bureau of Economic Research Working Paper Series.* 2011;No. 17208.

11. Cuellar AE, Gertler PJ. Strategic integration of hospitals and physicians. *Journal of health economics.* Jan 2006;25(1):1-28.

12. Ciliberto F, Dranove D. The effect of physician-hospital affiliations on hospital prices in California. *Journal of health economics.* Jan 2006;25(1):29-38.

13. Williamson OE. Transaction Cost Economics. In: Schmalensee R, Willig R, eds. *Handbook of Industrial Organization*: Elsevier Science Publishing Co. Inc.; 1988.

14. Gal-Or E. The profitability of vertical mergers between hospitals and physician practices. *Journal of health economics.* Oct 1999;18(5):623-654.

15. Minnesota Department of Health. Minnesota Health Care Markets Chartbook. 2011; http://www.health.state.mn.us/divs/hpsc/hep/chartbook/. Accessed September 6, 2013.

16. *A Snapshot of Health Care Market Concentration in Minnesota, presentation April 26, 2007* 2007.

17. Weiner JP, Starfield BH, Lieberman RN. Johns Hopkins Ambulatory Care Groups (ACGs). A case-mix system for UR, QA and capitation adjustment. *HMO practice / HMO Group.* Mar 1992;6(1):13-19.

18. U.S. Census Bureau. American Community Survey. 2012; http://www.census.gov/acs/www/.

19. Carlin CS, Dowd B, Feldman R. Changes in the Quality of Health Care Delivery Due to Vertical Integration of Hospital and Clinic Systems2013, Manuscript.