Physician Competition and Prices for Physician Services

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Abstract: Anecdotal evidence suggests that the organization of physician practices has changed substantively over the last decade, and provisions of the Affordable Care Act have likely accelerated these types of changes. Relatively little evidence exists, however, on how physician organization affects health care markets. In this paper, we examine the relationship between physician market concentration and the price of physician services. We construct measures of physician market structure using information from Medicare claims and measures of prices for physician services using the Truven MarketScan database. Using data from both sources from 2003 to 2010, we estimate models of the relationship between physician prices and market structure, using different sources of variation in market structure to identify the effect. We find a significant and large positive effect of concentration on prices. Any gains in efficiency in health care delivery resulting from larger group practices will be offset by inefficiency due to higher prices for physician services.

1. Introduction

Anecdotal evidence suggests that the organization of physician practices has changed substantively over the last decade, with physicians joining either single or multi-specialty groups and with physicians aligning with hospitals in different types of organizational forms (Liehaber and Grossman 2007; Berenson, Ginsburg et al. 2010). The Patient Protection and Affordable Care Act (ACA) has likely accelerated these types of changes through payment reform in the Medicare program promoting "accountable care organizations" (ACOs). Although the intent of these reforms is to increase health care quality and reduce its cost through better coordination of care, a potential negative consequence is higher prices for medical care services due to the development or enhancement of market power on the part of providers (Baicker and Levy 2013). The negative consequences of consolidation for prices are likely to affect the commercial market since Medicare prices are set administratively.

Despite the potential importance of these changes in the organization of health care delivery, there is relatively little evidence on either the extent or effects of concentration in physician markets. Most work on provider market structure in health care has focused on hospitals or, to a lesser degree, insurers, primarily due to a lack of comprehensive information on physician organization (Gaynor, Ho et al. 2014). As we discuss in the next section, there are some case studies and reports from selected markets about the size or concentration of physician practices, but a limited number of larger scale empirical analyses.

In this paper, we examine the relationship between physician market concentration and the price of physician services. We use Medicare claims to identify physicians practicing as part of a group based on the tax identification number (tax ID) of the physician identified on the claim. We identify physicians practicing in groups based on whether they bill under the same tax ID, and then, following the literature on hospital market structure (Kessler and McClellan 2000), use this information to construct market-level measures of physician consolidation using patient flow data from Medicare claims. We use the Truven MarketScan database to develop market-level measures of prices for physician services for commercially insured patients. Using data from both sources from 2003 to 2010, we estimate models of the relationship between physician prices and market structure, using several different sources of variation in market structure to identify the effect. We also estimate instrumental variable models that address the endogeneity of market concentration.

We document substantial differences across specialties in the extent of physician market concentration. As described in more detail below, we use the Hirschman-Herfindahl Index or (HHI) as our measure of market concentration. HHIs for generalists, such as internal medicine (1500) and family practice physicians (1800), are on the lower end of the distribution, while market concentration is quite high for many specialists, such as colorectal cancer surgeons (6600) and cardiac surgeons (6500). We do not find evidence of systematic increases over time in the level of market concentration during the period we study. We find a significant and substantial positive effect of concentration on prices.

II. Background

Most research on the effect of concentration in health care markets on prices has focused on hospitals, with many studies documenting that hospital consolidation increases hospital prices (Gaynor and Town 2012; Gaynor, Ho et al. 2014). In this literature, researchers have used reduced form, merger case studies and structural and semi-structural approaches to estimate to effects of changes in market structure on prices (Gaynor and Town 2012). Closest in spirit to our work are reduced form studies of large numbers of hospitals in large numbers of markets over many years using HHI measures for hospitals. These studies generally document a positive relationship between hospital concentration and prices and that this relationship is stronger either in markets with high levels of managed care activity or in time periods in which managed care organizations had a growing presence in health care markets (Gaynor and Town 2012).

Studies of the effects of consummated mergers provide further support for the positive relationship between market concentration and prices for hospital services. For example, Dafny (2009) finds very large price increases due to mergers. Her findings also point to the importance of accounting for selection bias in studying mergers and suggest that not doing so results in underestimates of the price effects of a merger. Synthesizing the literature, Gaynor and Town (2012a) conclude that, "when hospitals merge in already concentrated markets, the price increase can be dramatic, often exceeding 20%."

More recently, researchers have begun to investigate the effect of consolidation in health insurance markets on health insurance premiums. Dafny (2010) finds evidence that insurer market power increases premiums, and Dafny, Duggan et al. (2012), examining the effect on insurance premiums of a merger of two national insurers, find that premiums rose significantly in markets where there was an increase in concentration due to the merger.

There are fewer studies on the effects of physician market structure on physician prices. One study, using a single year of data from California, finds that physician but not health plan concentration is associated with the price of physician services (Schneider, Li et al. 2008). Using enrollment data from a commercial survey of provider organizations and health plans, Schneider, Li et al. (2008) create county-level physician organization and health plan HHIs for 42 California counties in 2000. Using MarketScan commercial insurance claims, they create an index of private payments to physicians. Restricting their analysis to 104 CPT codes which were billed by physicians in all 42 counties, they calculate the average payment for these codes, weighted by the quantity of services provided in the county, creating separate indices for 5 types of services (E&M, surgery, radiology, path/lab and medicine). They find that a 10% increase in physician concentration is associated with 1-4% higher prices for physician services, but find no evidence of an association between health plan concentration and physician service prices. While the study uses a unique data source which allows the researchers to measure both insurer and physician market structure, it has important limitations. Physician market structure is likely mis-measured since the sample is restricted to medical groups with at least six affiliated primary care physicians, thereby overlooking the competition provided by smaller groups. The study is relies on data from a single year from a single state, restricting identification to cross-sectional approaches comparing a relatively small number of geographic areas.

Using broader geographic data, (Dunn and Shapiro Forthcoming) examine the effects of physician consolidation on the price of cardiology and orthopedic services during the period from 2005-2008. They also use Marketscan commercial claims data from large employers and insurers from across the United States to measure the price of physician services, defining the service unit as an episode of care. Using a commercially-developed episode grouper, they aggregate physician claims into episodes of care for a particular patient and define the service price for the as the actual expenditure on the episode divided by the basket of services observed for the particular episode weighted by the national mean price for each service.

The authors create a distance- (travel-time) based HHI that accounts for physician group size using survey data from SK&A, a consulting firm, which identifies the location and practice size of approximately 95% of physicians in the U.S. They combine census tract-level information on population size with the SK&A data on physician locations to calculate the probability that consumers would choose particular physicians based on estimates of driving time and assumptions regarding the cost to consumers of driving time. Accounting for which physicians practice together in groups, they aggregate the predicted probabilities into census-tract level measures of physician market share and then aggregate these census-tract level- to county-level measures. In their preferred models, HHI is instrumented with a set of population-demographic measures and the unemployment rate.

The authors find that physician concentration is positively associated with service prices; a 10% increase in the HHI is associated with a 0.2 to 0.3% increase in prices and the IV estimates are approximately double those of OLS. These estimates imply that a physician in the 90th percentile market will charge 15 to 30 percent higher prices than one in the 10th percentile.

While the SK&A data is a valuable and rich source of data on physicians, it has one important limitation in this context. The idea underlying the distance-based measure of HHI is that the distance between providers and patients is an exogenous determinant of market structure. The SK&A data, however, include only data on physician locations so the market share constructed from these measures are based on assumptions regarding the locations of patients and how distance affects their choice of providers. Having information on patient locations and flows is necessary to construct more accurate measures of HHI.

Our study builds on this literature by developing measures of physician organization and practice concentration using Medicare claims data, which include information on patient location, physician location, and patient flows into particular physician groups. We also have multiple years of data and multiple specialties that allow us to examine the effects of changes in concentration over a relatively long time period and differences in concentration by specialty to identify the effects of interest. Finally, we address the endogeneity of market structure by estimating instrumental variables models using as instruments interactions of specialty with a specialty-specific measure of population based on the distance patients are willing to travel to see different types of specialists. We will discuss the instruments in much more detail below.

3. Methods

We construct measures of physician market structure by using information from Medicare claims to identify which physicians practice as part of a group and then using these indicators of group membership to construct county-level measures of physician concentration. To estimate the effect of market concentration on prices, we link these measures of physician concentration to information on prices from the Truven MarketScan data. In the following sections, we discuss how we construct each measure and the specification of the empirical models.

3.1. Measuring practice concentration

Our practice concentration measures are based on Medicare claims filed by physicians for the care of a 20% random sample of traditional Medicare enrollees during the years 2003-2010.[1] For every physician service billed to Medicare for these patients, the claims report, among other things, the tax identification number (tax ID) of the physician's practice, the physician's specialty, the ZIP code of the physician's practice, and the ZIP code of the patient's residence.

We identify physician groups based on the tax identification number on the claim; we classify physicians billing under the same tax ID as practicing in the same group. Solo practice physicians normally have their own unique tax ID. For larger practices, our approach will capture the types of practices normally referred to as "medical group practices," perhaps the most common and most integrated form of practice organization. Physicians working in a medical group typically share staff, are financially integrated (i.e. have a single bottom line) (Casalino 2006), and nearly always use the same tax ID. This approach follows other studies that have used tax IDs to identify physician practices (Pope, Tisolini et al. 2002; Pham, Schrag et al. 2007; Welch, Cuellar et al. 2013).

There are also other types of physician organizations that are not medical group practices, probably the most prominent of which are independent practice associations (IPAs). In these typically more loosely integrated organizations, individual practices retain their independent status and would normally each have their own tax ID. So, in this case, for example, we will classify the individual physicians who are members of an IPA as practicing

[1] Welch and Cuellar (2013) use the 100% Medicare sample and identify practices in the same way we do. Our estimates of practice size for the years that overlap the two samples are almost identical to theirs, giving us confidence that the 20% sample provides adequate coverage to identify physicians practicing in groups.

individually. Measuring physician consolidation based on groups, but not IPAs, is appropriate for this study since there are differences in laws and regulations governing these two organizational structures. Physicians in the same medical group are allowed by law to negotiate jointly over payment and other contract terms with health plans (Casalino 2006). However, physicians in more loosely integrated organizations like IPAs are generally prohibited from negotiating jointly for fee-for-service payments (Justice 1996).

We measure market concentration using the Hirschman-Herfindahl Index, or HHI, which is the sum of the squared market shares of providers serving a market. As has been noted in previous work on hospital concentration (Kessler and McClellan 2000), HHI estimates based on patient flows within markets defined using fixed boundaries – either geographic units such as MSAs or counties or a pre-defined radius around a particular provider - may be biased..There is no reason to think that fixed geographic boundaries define physician markets. For example, such fixed boundaries imply that a potential competitor is either “in or out” of a market area, introducing measurement error in the measure of a provider’s market.

To address these issues, we construct specialty-specific physician practice HHIs, adapting the method of Kessler and McClellan in the context of hospitals (Kessler and McClellan 2000) to the case of physician practices. We construct HHIs in three steps. First, we derive an HHI for each specialty in each ZIP code. We identify the set of doctors who provided services to patients residing in the ZIP code, and whose practice location was within 100 miles of the ZIP code, as determined by their provider ZIP codes. We then computed the market share of each tax-ID-identified practice as the total Medicare allowed claims by doctors in the practice for patients residing in the ZIP code, divided by the total Medicare allowed claims billed by all doctors for patients in the ZIP code.[2] The HHI for the ZIP code is the sum of the squared market shares of all practices serving the ZIP code. For example, a ZIP code in which the claims of all patients are from the same practice will have an HHI of 1. A ZIP code in which 50% of patient claims are from one practice, 25% from a second practice, and 25% from a third practice will have an HHI of 0.375 (0.50^2 + 0.25^2 + 0.25^2 = 0.375). We note that, by convention, the Federal Trade Commission (FTC) and the Department of Justice (DOJ) multiply the HHI as defined above by 10,000. In our empirical work, we use the measure on a scale of zero to one, although we use the conventional scaling of the measure when comparing our results to FTC/DOJ standards.

The second step is to create an HHI for each physician practice based on its observed market. We identify the market area of each practice (by specialty) as the smallest number of residence ZIP codes from which the practice draws 75% of its patients, following the FTC and DOJ recommendations for measuring competition for ACOs. We compute a composite HHI for the market area of the practice as the average of the ZIP code HHIs across the ZIP codes in its market area, weighted by the total number of claims provided by practice doctors to patients in each ZIP code.

The final step is to create county-level HHIs. As described below, the payment data we use in the study are county-level averages of payments to physicians located in the county by specialty. Therefore, we construct a parallel county-level measure of practice concentration. We identify all practices that had any physicians located in a given county, and computed the

[2] We are currently estimating models of choice of provider based only on distance between patient and provider. We will then construct zip-level HHIs using predicted provider choices in order to avoid bias that may be introduced by using actual patient provider choices.

county average practice HHI as the average of the HHIs for those practices, weighted by the claims from each practice in the county. The end result is a set of HHIs, by county by specialty, that measure the average competitiveness of the practices of physicians located in the county. These are merged with prices of services provided by physicians located in the county. This approach to constructing HHIs addresses each of the problems discussed above that are associated with simple HHIs.

In sensitivity analyses, we verified that the results are substantially similar using alternate measures of HHIs, including measures that use work RVUs as the unit of service rather than claims.[3]

3.2 Measuring Prices

We obtained data on payments to physicians from the Truven MarketScan [TM] Commercial Claims and Encounters database for 2003-2010. The MarketScan data contain information from adjudicated and paid claims filed for the care of privately insured individuals who obtain insurance through a participating employer. Though not representative of the entire U.S. population, the data cover more than 30 million individuals from around the United States. They have been used in previous studies to characterize patterns of payments across geographic areas (Dunn and Shapiro 2011; Baker, Bundorf et al. 2013).

We obtained from Truven the county-level number of claims and mean and variance of the allowed amount for services paid to doctors for services provided in offices, urgent care facilities, inpatient hospitals, outpatient hospitals, emergency rooms and ambulatory surgical

[3] The correlation between the HHIs based on claims as compared to RVUs exceeds 0.95.

centers in each year. The allowed amount is the amount the physician receives for the covered services provided to the patient, after the application of contractual discount provisions and other plan rules but before adjustment for patient copayments or deductibles. The physician may receive the allowed amount partly from the insurance plan and partly from the patient in the form of applicable copayments or deductibles.

The dataset was restricted to claims with a reported practice location and to claims paid by non-capitated plans. We requested these data for over 980 frequently billed procedure codes, representing the top 50 claims across all specialties based on number of claims or total allowed amount. When constructing specialty-specific measures of prices, we dropped certain specialties from the analysis including pediatricians, since the Medicare-based measures of market concentration are likely incomplete and geriatricians, since the price data not are likely not representative for this specialty. We also dropped radiation oncologists, radiologists and pathologists since claims for these specialties frequently included modifier codes making it difficult to identify comparable services across physicians. (Modifier codes are appended to CPT (Current Procedural Terminology) or "procedure" codes to provide additional information such as multiple procedures of the same type, some type of complication, or other specifics of the situation that might affect price.) We also excluded pain management and preventive medicine since they were relatively small and likely imprecisely coded during the period of our study and psychiatry due to concerns over whether each dataset adequately capture market dynamics.

Our price variable is a payment index. We computed the index for each county by specialty as the total (estimated) amount paid to doctors in the county over all CPT codes observed in the county, divided by the amount that would have been paid had the claims all been paid at the national average payment in that specialty for each type of service. Using c to index procedure codes, the index for county i and specialty s in year t is constructed as follows:

$$P_{ist} = \frac{\sum_c p_{istc} q_{istc}}{\sum_c \bar{p}_{stc} q_{istc}} \quad (1)$$

where p_{istc} is the average price for procedure code c for specialty s in county c during year t and $\bar{p}_{stc}$ is the national average price for each procedure code for specialty s in year t.

A payment index above 1 indicates a county where average payments exceed the national mean payments, and vice versa.

3.3. Endogeneity of HHI and Instruments

Decisions by physicians to form groups, merge groups, or to divide into smaller groups may be made in response to market forces and other unobservables that could also affect county-by-specialty prices. For example, bargaining dynamics or the degree of competition on quality may vary across specialties. In either of these cases, even our county by year fixed effects would not be an adequate control.

To address potential endogeneity of market concentration, we use an instrumental variables approach. Our instruments are motivated by the “entry threshold” concept of Bresnahan and Reiss (BR) (1991), which has been previously used in a health care market setting by Brasure et. al (1999). The BR model explains market entry in terms of the incremental increase in population (and therefore demand for services) required to support an additional provider. We expect that smaller populations will support fewer doctors. If increasing concentration requires costly organizational activities, achieving a high degree of concentration will be more difficult in markets with larger populations and thus more physicians.

We implement this instrument separately for each specialty for two reasons. First, the incremental increase in population required to support an additional entrant physician varies by specialty due to differences in demand and fixed costs (possibly among other things). Second, the relevant geographic area over which population should be measured may vary by specialty.

To create the population instrument for a given specialty we first measure the distance, D_{is}, that the 90th percentile patient in our Medicare data is observed to travel to see each physician i in specialty s, based on the centroids of the physician and patient ZIP codes. We then compute the mean D_s as the average D_{is} over all physicians in the specialty. Next, we calculate the population size for each physician as the sum of the population of all ZIP codes with centroids within D_s miles of the physician. For example, we may determine that the mean relevant distance for cardiologists is 20 miles, and we would then compute the population in ZIP codes within 20 miles for all cardiologists in the country. To match this to our county-level analysis file, we roll these measures up to the county level in the same way that we created county-level measures of the average HHI of practices in the county. The end result is a specialty-specific county-level measure of the average population within a specialty-relevant distance of each physician in the specialty in the county.

As argued above, this population-by-specialty instrument is expected to be predictive of HHI. It also seems unlikely that the instrument would have a direct effect on prices, conditional on county-by-year and specialty fixed effects. The population measure varies by specialty and county based on variation in travel distances by specialty and by population density. The relevant variation in HHI is relative to the mean HHI by specialty and the mean HHI in each county and year. The identification comes from variation in density of population within a specialty across counties and population size variation within counties across specialties. There is no reason to think those types of variation are correlated with possible sources of endogenity such as the degree of quality competition.

3.4. Study Sample

We restricted our analysis to urban counties, defined as counties within Metropolitan Statistical Areas (MSAs). MSAs are defined by the Office of Management and Budget to include urban centers of at least 50,000 people and adjacent areas that are socioeconomically tied to the urban center based on commuting patterns. While the MarketScan database increased in size during the years of our study, urban counties are well-represented in each year (Appendix Table 1). The number of claims per county, however, increases more dramatically. The physician concentration measures are available for most urban counties and their availability has relatively little effect on the overall sample size for our study. We further restrict the sample to counties which appear in the sample in each year of the study. The final study sample includes 1,043 counties. Table 1 includes sample descriptive statistics.

3.4. Empirical Model and Estimation

Using the panel of price indices and HHIs by county-specialty-year, we estimate two types of models. We first use the full dataset to estimate models of the following basic form:

$$P_{s,i,t} = \beta_0 + \beta_1 HHI_{s,i,t-1} + \beta_2 I_s + \beta_3 X_{i.t} + \beta_4 I_i + \beta_5 I_t + \varepsilon_{s,i,t} \qquad (2)$$

where s represents physician specialty, i represents county and t represents year. The dependent variable, P, is the price index for physician services and HHI is the concentration measure. We link one-year lagged concentration measures to payment measures since provider negotiations with insurers usually occur in the year prior to the year for which claims are made under a contract. The basic model also includes specialty and year indicators. In this model, the effect of concentration on prices is identified by cross-sectional as well as longitudinal variation in HHIs both within and across specialties. We then estimate a series of models adding county fixed effects, county indicators interacted with year indicators and county indicators interacted with specialty indicators to determine how the estimate of the effects of concentration on prices responds to different sources of identification. We also include controls for time-varying county characteristics in some models (population density, population under age 65, percent of total population covered by Medicare, and the number of physicians in a given specialty as well as a measure of concentration in insurer markets). We obtained HHIs for private PPOs from AMA publications that report competition measures for most MSAs by year. These competition measures are derived from HealthLeaders-Interstudy data on covered lives in private PPOs by market. We obtain information on county characteristics by year from the area resource file (ARF) and the number of physicians by specialty in each county from the Medicare claims. In some models, we also include the three components of the geographic practice cost index (GPCI) used by the Medicare program to set physician fees to measure differences across counties in the cost of care. These are available after 2003.

The effect of market consolidation may also depend on the degree to which the market is already concentrated. To explore this, we also estimate models of the relationship between changes in market concentration and changes in physician prices over the period 2003 to 2010. We are also concerned with possible measurement error, especially in year-to-year HHI changes. Contract renegotiations can be a lengthy process and prices may not respond immediately to changes in provider market share. The long-difference model will also mitigate measurement error in year-to year changes. The models are of the following form:

$$\Delta P_{s,i,03-10} = \beta_0 + \beta_1 \Delta HHI_{s,i,02-09} + \beta_2 HHI_{s,i,02} + \beta_3 \Delta HHI_{s,i,02-09} * HHI_{s,i,2002} + \varepsilon_{sit} \quad (3)$$

The dependent variable in these models is the specialty-county change in the price index between 2003 and 2010. The change in the HHI is the independent variable of interest. We include the 2003 level of the HHI to determine if price changes varied by the initial level of market concentration as well as the interaction of the level and the change to determine if the impact of changes in market concentration varied by the initial level.

We first report the associations we can measure with these models and explore how the estimates are affected by using different sources of variation in HHI to identify these effects. We next estimate an instrumental variables version of equation (2), using the population by specialty instruments described above. It is these instrumental variable models that we argue give us the preferred estimates of the causal effect of market concentration on prices.

In all models, we estimate robust standard errors to allow for heteroskedasticity in the error terms. Table 1 provides descriptive statistics for the study sample.

4. Results

Market Concentration

We find evidence of substantial differences across specialties but little evidence of trends over time within specialties in market concentration at the national level. In Table 2, we present the mean HHI for each year by specialty, weighted by population size. The table is sorted by the most to least competitive specialty in 2003. Market concentration varies substantially across specialties with concentration generally lower among generalists, such as internal medicine and family practice and higher among specialists. Nearly all specialties, however, are somewhat concentrated on average relative to the standard outlined by anti-trust authorities. As we note above, in anti-trust enforcement the Federal Trade Commission (FTC) and Department of Justice (DOJ) consider markets with HHIs of 1500 to 2500 to be moderately concentrated, and markets with HHIs of 2500 and higher to be highly concentrated (Justice 2010).

Within a specialty, however, the level of concentration varies across markets. In Figure 1, we plot the distribution of HHIs across counties by specialty for 2010. Although some specialties are more highly concentrated on average than others, for each specialty, the level of concentration varies across counties.

Somewhat surprisingly, given anecdotal evidence, we find little evidence toward greater concentration over this time period based on these measures.[4] Figure 2 demonstrates that underlying this stability over time in market concentration by specialty is heterogeneity within specialties across markets in the direction of the change in market concentration. While concentration is increasing within a specialty in some geographic areas, it is declining in others.

Prices and Market Concentration

Prices for physician services are positively associated with physician market concentration. In Table 3, we report the results of empirical models using different sources of variation to identify the effect. In these models, the HHI is measured on a scale from zero to

[4] In other work, we do find evidence of increases in physician practice size over this period, as do Welch and Cuellar (2013) using a shorter time frame.

one and the price index measures prices in a specific county relative to the national mean. Thus the coefficient on the HHI represents the percentage change in prices associated with a change in the HHI from 0 (perfectly competitive) to 1 (monopoly).

In model 1, which includes controls for only specialty and year, a one-unit change in HHI is associated with a 34% increase in prices. The results of column 2, however, suggest that much of this increase is driven by omitted characteristics of counties which are correlated with both physician market concentration and prices. Including county fixed effects lowers the estimate to 7.5%. This estimate of 7.5%, however, is not particularly sensitive to including time-varying county-level control variables. In column 3, we present the results of a model in which we control for population density, the supply of hospital beds, household income, the percent of county population covered by Medicare, physician supply, and the Medicare GPCIs. We note that physician supply also varies across specialties within a county unlike the other county-level control variables. The estimate of the effect of consolidation on prices increases to 8.0 percent which is driven in part by a change in the sample. (2003 is dropped from the sample since the GPCIs are not available for that year.) In column 4, we also add in a measure of insurer concentration – the HHI for PPOs as reported by the American Medical Association. While the advantage of having a control for insurer concentration is clear, there are also some known measurement issues with the AMA measure which is based on Interstudy data. (Dafny et. al. 2011). Because there are potential issues with the measure, especially in its time series variation, we do not emphasize this model; however, the coefficient estimate on HHI is of the same order of magnitude as before. It increases to 0.107, with the increase due to the change in the sample definition (we have AMA data only from 2008-2010 and there are also some missing values during those years).

The first four models may not adequately control for changes over time within counties that could be correlated with both prices and physician concentration. We are concerned, in particular, about the possibility that our measure of insurer concentration does not fully capture changes over time in insurer concentration or managed care penetration that could affect both physician market structure and prices at the county level. Therefore, we take advantage of having observations on multiple specialties per county and control for county by year interactions. This allows us to estimate a model where identification of the effect of concentration does not depend on county-level changes in prices and concentration. In this model, the effect of market concentration is identified by differences across specialties within counties as well as differences over time within specialties in market concentration. The estimate of the effect of concentration is 7.8%; it changes very little compared to models 2 and 3. In the last column in Table 3, we report the results of a model which includes specialty by county fixed effects. In this model, when the effect is identified by changes over time within markets by specialty, the effect of market concentration on prices essentially disappears. In summary, from this set of models, we find that differences within markets by specialty in their level of concentration relative to other markets are associated with differences in prices. Prices are approximately 8% higher when a specialty is a monopoly as compared to the same specialty in a market with perfect competition. Year-to-year changes within markets in specialty concentration, however, are not associated with changes in prices, though next we will present estimates from the “long difference” or “change” model that suggest that changes over time are important but that the effects differ with the structure of the market.

We explore this in Table 4, which presents the results of models of the change in prices over the entire study period, 2003 to 2010. This change or long difference model will alleviate any bias caused by measurement error in year-to-year HHI changes and will allow us to investigate whether the magnitude of the change in prices with a change in HHI depends on how concentrated the market was in 2003. In model (1), consistent with the results in Table 3 that use only variation over time for identification, we find no evidence that changes in concentration within specialties over the time period are associated with changes in prices. The results in column (2), however, indicate that underlying that lack of an estimated effect are differences in the effect by baseline levels of concentration. We use the Department of Justice focal points of 1500 and 2500, as our indicators for levels of concentration, allowing for different effects of change in HHI over the intervals 0-.15, .15-.25, and greater than .25.[5] Specifically, we find that more concentrated markets had larger increases in prices over the time period than the most competitive markets for a given HHI change. The coefficients on the categorical indicators of baseline market concentration, which measure the effect relative to the least concentrated markets (0-0.15), are a significant 1.9% in moderately concentrated markets and 2.5% in highly concentrated markets. Providers in more concentrated markets in 2003 were able to translate their 2003 market power into price increases.

Providers in the originally most competitive markets, however, experienced the largest increases in prices associated with changes in market concentration. The coefficient on the HHI change, which measures the effect of HHI changes on the omitted category of the most competitive markets is large (0.54) and statistically significant. This implies that a 0.1 increase in HHI over the period is associated with a 5.4% increase in prices in competitive markets. Changes in HHI translated into smaller increases in prices in more concentrated markets as demonstrated by the negative and statistically significant effects of the interaction terms. The implied effect of a 0.1 increase in HHI in markets that were moderately concentrated in 2003 is a 2.1% increase in prices. The HHI effect in markets that were already highly concentrated in 2003 is not significant.

In thinking about the market dynamics that could result in larger effects of increases in concentration in more competitive as compared to less competitive markets, it may be helpful to have some examples of what kinds of changes in market structure produce a 0.1 increase in HHI in competitive as compared to concentrated markets. Many different configurations of market structure can produce the same HHI but some examples may be illustrative nonetheless. Consider a competitive market with 20 competitors, each with equal market share. This market has an HHI of 0.05. If consolidation results in a market with 8 competitors, 7 with 10% of the market each and 1 with 30%, the HHI increases to 0.16. That consolidation required 14 former competitors to merge into 7 equally sized practices, and 6 others to merge into 1 larger practice. Now take that same market which, with consolidation, has just passed the threshold into the moderately concentrated category. That market will increase another 0.1 (approximately) if the largest practice remained at 30% market share and the 7 other competitors merged into 3 practices with 25%, 25%, and 20% of the market. Last, consider a highly concentrated market comprised of one practice with 70% of the market and 2 with 15%

each. That market's HHI increases by 0.1 simply by shifting the market share to 78%, 11% and 11%. The dynamics of consolidation in those markets, each of which experienced a 0.1 increase in HHI are likely to be very different.

Finally, in Table 5 we present our IV estimates. Again, we instrument HHI with specialty-specific population (where the geographic area differs by specialty based on the distance patients seeing physicians in that specialty travel to see those physicians) interacted with specialty. We find that models accounting for the endogeneity of market concentration produce estimates substantially larger than that those that do not. Column 1 of Table 5 reproduces the results from model 5 of Table 3 in order to show the analogous model not using IV. We see in column 2 that the IV estimates imply that a 0.1 increase in HHI results in a 6.8% increase in prices. Models 3 and 4 are analogous to 1 and 2 except we limit the sample to 2003 and 2010 in order to investigate whether year to year variation is playing an important role in producing larger estimates (although under most circumstances one might expect noisy year to year measures to bias estimates toward zero). The results using only 2003 and 2010 are very similar to the results using all 8 years of data. Results from the 2010 cross section and models using county controls (with and without insurer HHI) also produce similar results.

*** Further specification checks to be conducted. ***

Our results suggest very large effects of physician concentration on prices in physician markets. In our preferred specification, a 0.10 increase in HHI is associated with a 6.8% increase in prices. As we point out above, a 0.10 increase in HHI can be achieved through any number of changes in market structure and in further work we intend to explore differences in the HHI effect at different levels of HHI. In the long-difference model, we also find that the effect of HHI changes is larger in more competitive markets than in more concentrated markets.

V. Conclusion

Health care markets are likely to undergo major changes as health care reform progresses with new incentives, such as ACO provisions, and as markets adapt to increased demand by the newly insured. The evolution of markets could have an impact on health care costs, in both intended and unintended ways. Changes in the competitiveness of physician markets could be important yet there is currently little evidence on the effect of physician market concentration on physician prices.

This paper advances the small literature on the price effects of physician market concentration in several important ways. First, we provide a new way to calculate measures of physician concentration. Lack of such measures has been the primary barrier to empirical work in this area. We use Medicare claims to identify physician practices using the tax ID provided. We then use these claims to chart patient flows into provider practices to create HHI measures of physician concentration.

Our second main contribution is our approach to controlling for potentially endogenous changes over time within counties and across specialties that could bias our results. We introduce instruments for market concentration based on the model of Bresnahan and Reiss, arguing that the incremental demand necessary to support an additional physician varies across specialties, counties and time. This eliminates an important potential source of bias that is generally quite difficult to address.

Finally, we provide evidence on how baseline market structure influences the effects of changes in provider concentration on changes in prices. Our preferred models imply a significant and substantial effect of physician concentration on prices. We also find that changes in HHI have a larger effect on prices in counties that started out more competitive..

Prior research concludes that market concentration has important effects in hospital and insurer markets. Our findings suggest that the same holds true in physician markets. Economists and policymakers will need to carefully monitor the evolution in the structure of health care markets moving forward, and not only in highly concentrated markets. In particular, it will be important to determine if the benefits in the form of lower cost or higher quality care in the production of health care services generated by encouraging larger physician organizations outweigh the costs in the form of higher prices.

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Figure 1: Distribution of HHIs across Counties by Specialty, 2010

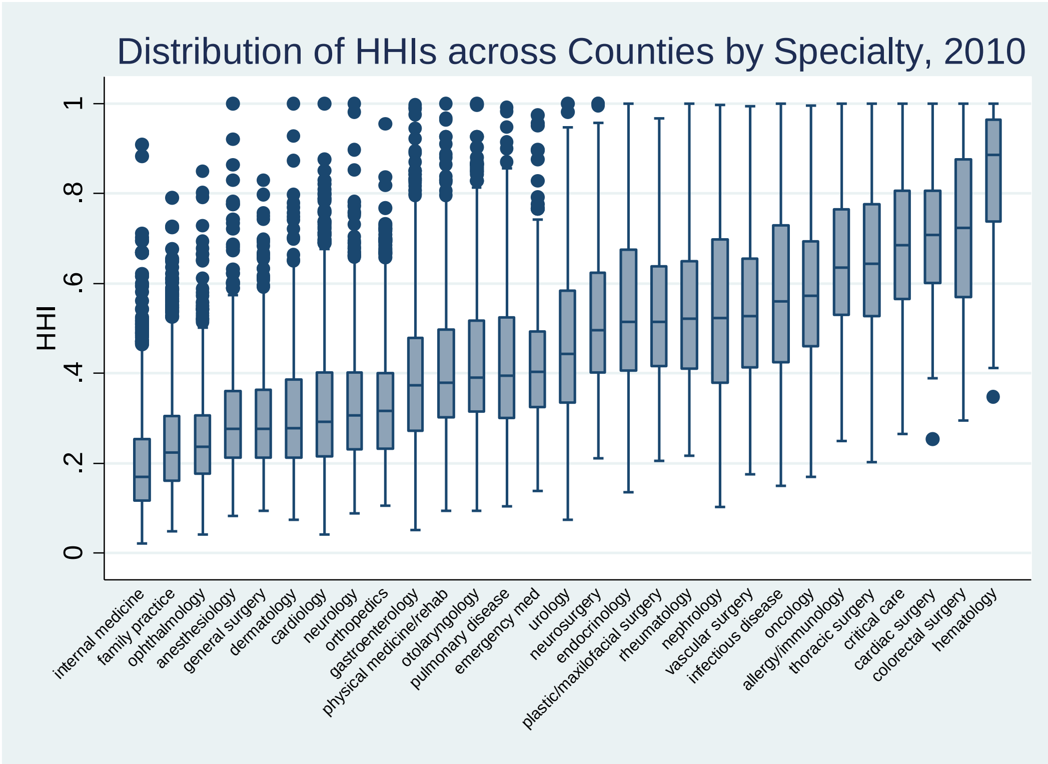

Figure 2: Distribution of Changes in HHI, 2003

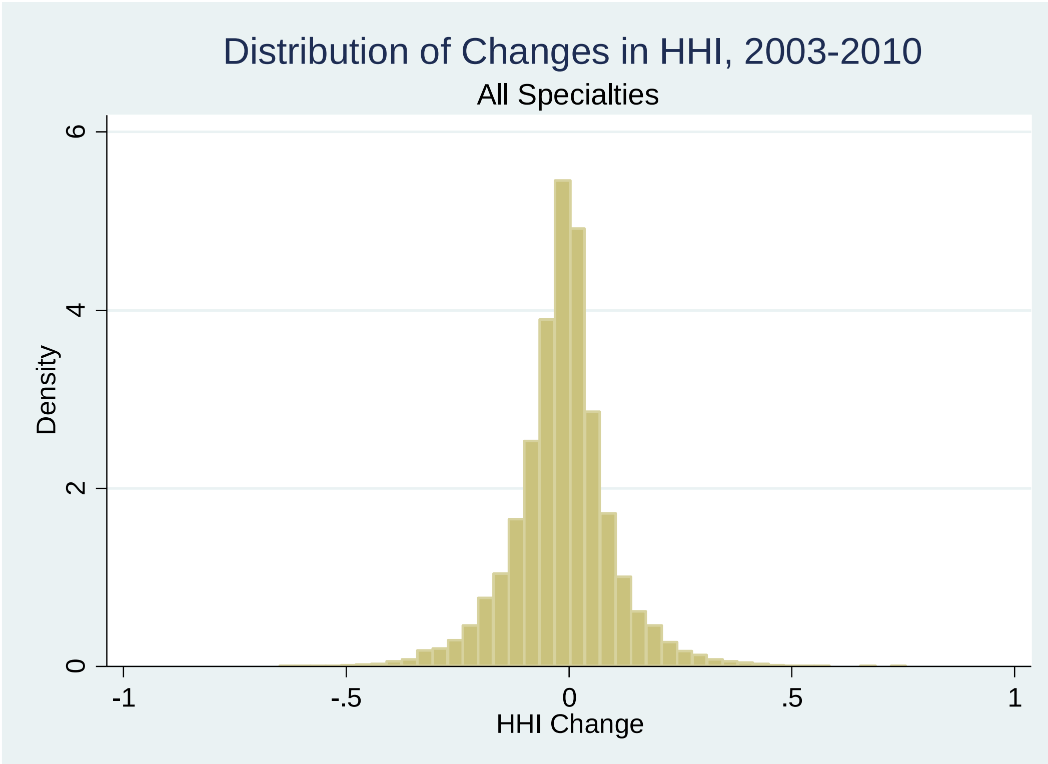

Table 1: Study Sample Descriptive Statistics

	Mean	S.D.
Price Index	1.02	0.26
HHI	0.42	0.21
Population Density	1.11	4.03
Population under 65	3.50	5.93
Hospital Beds per Capita	3,699.67	3,424.01
Median Household Income	49.48	12.61
Percent Medicare	0.12	0.03
Physicians per Capita	0.10	0.16
GPCI - Work	1.01	0.04
GPCI - Practice Expense	0.98	0.13
GPCI - Malpractice	0.91	0.40
allergy/immunology	0.03	
anesthesiology	0.04	
cardiac surgery	0.02	
cardiology	0.04	
colorectal surgery	0.01	
critical care	0.01	
dermatology	0.04	
emergency med	0.05	
endocrinology	0.03	
family practice	0.07	
gastroenterology	0.04	
general surgery	0.05	
hematology	0.01	
infectious disease	0.02	
internal medicine	0.06	
nephrology	0.03	
neurology	0.04	
neurosurgery	0.03	
oncology	0.03	
ophthalmology	0.05	
orthopedics	0.05	
otolaryngology	0.04	
physical medicine/rehab	0.03	
plastic/maxilofacial surgery	0.03	
pulmonary disease	0.04	
rheumatology	0.03	
thoracic surgery	0.02	
urology	0.04	
vascular surgery	0.02	
N	122,576	

Table 2: Trends in County-Level HHI by Specialty

Specialty	2003	2004	2005	2006	2007	2008	2009	2010
Internal Medicine	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Family Practice	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.18
Ophthalmology	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.19
General Surgery	0.23	0.23	0.22	0.23	0.23	0.23	0.24	0.24
Cardiology	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.25
Dermatology	0.25	0.24	0.24	0.24	0.24	0.24	0.23	0.23
Anesthesiology	0.26	0.26	0.26	0.25	0.25	0.25	0.25	0.25
Orthopedics	0.27	0.27	0.26	0.26	0.27	0.26	0.26	0.27
Neurology	0.28	0.27	0.27	0.27	0.27	0.27	0.26	0.26
Gastroenterology	0.31	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Otolaryngology	0.32	0.32	0.32	0.32	0.33	0.33	0.33	0.33
Urology	0.33	0.33	0.33	0.33	0.34	0.36	0.37	0.39
Pulmonary Disease	0.35	0.34	0.34	0.34	0.34	0.34	0.34	0.34
Emergency Medicine	0.36	0.35	0.35	0.36	0.37	0.37	0.37	0.37
Physical Medicine/Rehab	0.40	0.38	0.37	0.36	0.35	0.35	0.34	0.33
Plastic/Maxilofacial Surgery	0.45	0.44	0.45	0.45	0.46	0.47	0.47	0.47
Nephrology	0.47	0.47	0.46	0.44	0.45	0.44	0.44	0.44
Neurosurgery	0.49	0.48	0.47	0.47	0.47	0.47	0.46	0.45
Rheumatology	0.49	0.48	0.48	0.47	0.47	0.47	0.46	0.46
Endocrinology	0.50	0.49	0.48	0.47	0.47	0.46	0.45	0.45
Oncology	0.50	0.50	0.49	0.50	0.49	0.49	0.49	0.49
Infectious Disease	0.52	0.51	0.50	0.49	0.47	0.47	0.46	0.46
Vascular Surgery	0.52	0.51	0.50	0.49	0.49	0.49	0.48	0.47
Thoracic Surgery	0.54	0.53	0.54	0.55	0.55	0.56	0.56	0.58
Allergy/Immunology	0.60	0.59	0.58	0.57	0.57	0.57	0.57	0.57
Colorectal Surgery	0.66	0.65	0.64	0.64	0.62	0.62	0.62	0.62
Cardiac Surgery	0.70	0.67	0.65	0.64	0.64	0.64	0.64	0.64
Critical Care	0.74	0.73	0.70	0.67	0.67	0.65	0.63	0.62
Hematology	0.86	0.86	0.82	0.82	0.84	0.84	0.84	0.82

Weighted by County Population; Sorted by 2003 HHI

Table 3: Relationship between Prices and Market Concentration

Dependent Variable: Price Index

Variables	(1)	(2)	(3)	(4)	(5)	(6)
HHI	0.344***	0.075***	0.080***	0.107***	0.078***	0.001
	(0.005)	(0.005)	(0.006)	(0.009)	(0.005)	(0.009)
Population per Square Mile			0.055***	-0.016		0.056***
			(0.009)	(0.022)		(0.006)
Population under 65			-0.021***	0.007		-0.028***
			(0.003)	(0.009)		(0.002)
Hospital Beds per Capita			0.000	9.34e-07		0.000
			(0.000)	(2.97e-06)		(0.000)
Median Household Income			0.001***	-0.001		0.002***
			(0.000)	(0.001)		(0.000)
Percent Medicare			0.085	0.087		0.094**
			(0.056)	(0.126)		(0.046)
Physicians per Capita			0.005	0.007		-0.007
			(0.006)	(0.009)		(0.007)
GPCI - Work			0.326***	-1.200***		
			(0.095)	(0.281)		
GPCI - Practice Expense			-0.085***	-0.072		
			(0.019)	(0.047)		
GPCI - Malpractice			-0.011***	-0.018		
			(0.004)	(0.016)		
PPO HHI				4.62e-08		
				(1.10e-06)		
Constant	0.906***	1.082***	0.793***	2.421***	1.076***	0.971***
	(0.007)	(0.007)	(0.091)	(0.283)	(0.007)	(0.014)
Year FE	x	x	x	X	X	X
Specialty FE	x	x	x	X	X	X
County FE		x	x	X	X	X
Time-varying county chars			x	X		X
County by Year					X	
Specialty by County						X
Observations	122,567	122,567	107,247	37,785	122,567	122,567
R-squared	0.054	0.472	0.490	0.484	0.516	0.752

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Relationship between Changes in Prices and Changes in HHI

Dependent Variable: Changes in Prices, 2003-2010

Variables	(1)	(2)
HHI Change	0.004	0.535***
	(0.022)	(0.152)
HHI level in 2003		
HHI 2003 Level * HHI Change		
2003 HHI 0.15-0.25		0.019***
		(0.007)
2003 HHI > 0.25		0.025***
		(0.009)
2003 HHI .15-0.25 * HHI Change		-0.324**
		(0.162)
2003 HHI > .25 * HHI Change		-0.560***
		(0.154)
Constant	0.108***	0.082***
	(0.016)	(0.019)
County Fixed Effects	X	X
Specialty Fixed Effects	X	X
Observations	15,319	15,319
R-squared	0.282	0.284

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: IV Estimates Using Specialty by Population Instruments

Dependent Variable: Price Index

Variables	(1) No IV 2003-2010	(2) IV 2003-2010	(3) No IV 2003 & 2010 Only	(4) IV 2003 & 2010 Only
HHI	0.078***	0.677***	0.075***	0.597***
	(0.005)	(0.041)	(0.010)	(0.079)
Specialty FE	x	x	x	x
County by Year FE	x	x	x	x
Observations	122,567	122,348	30,641	30,567
R-squared	0.516	0.517	0.509	0.510
First Stage F-stat		93.55		23.34

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 1: Sample Selection

Year	Number of Urban Counties in U.S.	Market Scan Price Data		Merged with Medicare Data		Counties Continuously in Sample from 2003 to 2010	
		# Counties	# Claims	# Counties	# Claims	# Counties	# Claims
2003	1,166	1,091	33,653,149	1,074	33,137,369	1,043	32,923,690
2004	1,166	1,090	45,955,978	1,073	45,403,567	1,043	45,130,107
2005	1,166	1,091	56,089,098	1,071	55,418,240	1,043	55,056,408
2006	1,166	1,092	73,667,529	1,066	73,034,849	1,043	72,594,403
2007	1,166	1,092	81,680,164	1,066	81,001,395	1,043	80,457,970
2008	1,166	1,091	121,953,574	1,069	120,884,930	1,043	119,994,052
2009	1,166	1,094	132,011,778	1,063	130,803,550	1,043	129,857,476
2010	1,166	1,095	122,958,327	1,055	121,437,602	1,043	120,506,438