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Concentration and Nurse Staffing Outcomes in the Healthcare Labor Market

Lizzy Crotty

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A thesis submitted in partial fulfillment of the requirement
for the degree of Bachelor of Arts in Economics from
William & Mary

by

Elizabeth Crotty

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Williamsburg, VA
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[1] I want to thank Professor McHenry for advising me on this thesis. I am very grateful for his valuable guidance. I would also like to thank Professors Mellor, Bakhtiari, and Qi for their input throughout the project.

Contents

Abstract

I investigate impacts to the nursing occupation from a perspective of market concentration. I measure the concentration of healthcare employment opportunities across the U.S. with a Herfindahl-Hirshman Index, finding moderate levels of concentration that vary greatly in markets with different population sizes and different locations. I use a Weighted Least Squares model to investigate how changing market concentration is affecting nurse employment. Analysis across different regions and different levels of urbanicity finds statistically insignificant heterogeneous effects with noisy zero estimates. The results are inconclusive evidence against monopsony presence in the nursing labor market.

Introduction

Research question

Markets have imperfections and almost no real-world market can fully satisfy the qualifications of perfect competition. This is especially true in the healthcare market where there is severe asymmetry of information and product differentiation. These imperfections in the healthcare industry pose unique questions about how to best support functionality and efficiency in the market.

The healthcare industry has been characterized by increasing market concentration which has gained interest from antitrust authorities beginning in the 1970s.[2] A common concern within the healthcare *labor* market is a shortage of nurses which causes poor quality of care, leading some states to mandate minimum staffing requirements in an effort to combat the shortage.[3] Lots of

[2] Martin Gaynor and William Vogt, "Antitrust and Competition in Health Care Markets," NBER Working Paper Series 7112 (May 1999): 2.
[3] Elizabeth Munnich, "The Labor Market Effects of California's Minimum Nurse Staffing Law," Health Economics 23, 935 (June 2013): 1.

attention has been paid to investigate nursing shortages, looking into the causes of the shortage, the impact on the nurses currently in the workforce, and strategies to combat the shortage. [4,5,6]

Economically, it is interesting to question why the market is failing to provide adequate nursing labor. A common suspect for labor shortages, especially in the nursing labor market, is high market concentration and subsequent monopsony power. If there are few employers in the market, workers become inelastic in their employment options and a monopsonist employer can take advantage of the vulnerability. With inelastic labor supply, a monopsonist employer can decrease wages and lower the level of employment without suffering the consequences seen in a perfectly competitive market.

Healthcare industry analysts estimate that from 2013 to 2017 nearly one in every five hospitals in the US was acquired or merged with another facility.[7] With increasing merger activity historically and more recently,[8] high concentration is a potential cause that could be keeping nurse employment down.

The research question is therefore two-fold. First, I am interested in measuring the level of concentration of nursing employment opportunities, across different geographic labor markets. Second, I use this measure of market concentration to investigate how changing industry organization affects employment. My hypothesis is in line with past literature and the monopsony model: the healthcare labor market experiences high and rising market

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[4] Barry Hirsch and Edward Schumacher, "Classic or new monopsony? Searching for evidence in nursing labor markets," Journal of Health Economics 24, 969-989 (March 2005): 1.
[5] Poghosyan et al., "Nurse Burnout and Quality of Care: Cross-National Investigation in Six Countries," Research in Nursing and Health 33, 288–298 (April 2010): 288.
[6] Daniel Wright, "Strategies for Addressing the Nursing Shortage: Coordinated Decision Making and Workforce Flexibility," Decision Sciences 41, 2 (May 2010): 1.
[7] "When Hospitals Merge," Healthiest Communities, US News & World Reports, June 28 2018, https://www.usnews.com/news/healthiest-communities/articles/2018-07-23/what-happens-when-a-community-hospital-is-sold-to-a-large-corporation.
[8] Gaynor et al., "Antitrust and Competition in Health Care Markets," NBER Working Paper Series 7112 (May 1999): 10.

concentration, which yields market power for employers which in turn lowers the level of employment in the market.

Background and Literature Review

The nursing occupation is regulated by the Board for Registered Nurses, which approves nursing programs to certify Registered Nurses. Requiring a Registered Nursing certificate as a qualification for employment sets minimum standards of nursing care, but also creates some level of homogeneity of skills in the market. There is not a lot of differentiation between registered nurses from the perspective of the employer. Moreover, at least 60% of all Registered Nurses work at hospitals, making the hospital industry the primary employer for the occupation.[9] Limited worker differentiation and a single, prominent employer cause the labor market for nurses to be used frequently as a textbook example of monopsony.

Leading labor economist Alan Manning describes the key idea of labor market power to be "that the labor supply curve to an individual employer is not infinitely elastic."[10] This means that employers have the ability to reduce wages by some amount and not immediately lose their employees to competitors, as would be predicted in perfect competition. In general, monopsony power can lead to lower wages and worse working conditions. Monopsony research has important implications for policy makers, especially involving minimum wage, antitrust, and income inequality. In the healthcare industry, monopsony power can lead to the exploitation of nurses. Understaffed and overworked nurses would mean patient conditions are not monitored

[9] United States Bureau of Labor Statistics. Occupational Employment and Wage Statistics. Available from https://www.bls.gov/oes/current/oes291141.htm

[10] Alan Manning, "Monopsony in Labor Markets: A Review," ILR Review (2020): 1.

as closely, response times fall, and quality of care diminishes as nurses become overwhelmed. Research has found a strong association between nurse burnout and lower quality of care.[11]

The literature on market concentration in healthcare labor markets primarily focuses on the effect of market consolidation on wage growth. Particular interest is paid to examining hospital mergers, with a common finding of increasing horizontal and vertical integration, especially with for-profit institutions.[12] The effects of increased market power from mergers likely doesn't differ between for-profit and not-for-profit hospitals, however. There is no evidence that non-profits are more likely to provide charity service than other hospitals after an increase in market power.[13] Investigating the nature and severity of market concentration opens a window to explore how changes to industry organization are connected to outcomes of workers in the market and patient care.[14] The results of these investigations typically find evidence that increasing consolidation has negative effects on wages, wage growth, employment, and quality of work.[15] Labor market power is a common culprit for suppressed wage growth following large increases in market concentration, especially in markets where workers' skills are specific or homogenous, such as the market for Registered Nurses.[16]

A common theme throughout the literature on the nursing occupation is nursing shortages. The original motivation for the present paper came from investigating the effects of minimum

[11] Poghosyan et al., "Nurse Burnout and Quality of Care: Cross-National Investigation in Six Countries," Research in Nursing and Health 33, 288–298 (April 2010): 289.
[12] Furukawa et al., "Consolidation Of Providers Into Health Systems Increased Substantially, 2016–18," Health Affairs 38, 8 (August 2020): 4.
[13] Capps et al., "Antitrust Treatment of Nonprofits: Should Hospitals Receive Special Care?" Economic Inquiry 58, 2 (July 2020): 1.
[14] Han et al., "Quality Competition and Hospital Mergers- An Experiment," Health Economics 26, 3 (February 2017): 5.
[15] Currie et al., "Cut to the Bone? Hospital Takeovers and Nurse Employment Contracts," NBER Working Paper Series 9428 (December 2002): 4.
[16] Elena Prager and Matt Schmitt, "Employer Consolidation and Wages: Evidence from Hospitals," American Economic Review 111(2), 397–427 (2021): 401.

staffing legislation in California passed in 2004 to combat apparent nursing shortages and falling standards of patient care in the 1990s. Nursing shortages are of valid concern for obvious reasons; understaffed nurses mean each patient gets less attention.

The causes for the apparent shortage of nurses are usually attributed to increasing demand for nursing care due to a growing population and the especially large and aging baby boomer's generation. Overall, per-capita nurse employment has declined.[17] The nursing workforce itself is aging. The average age of Registered Nurses was 42 in 2001.[18] By 2010, over 40% of Registered Nurses were over 50 years old.[19] Not only is there an inadequate number of nurses, but also inadequate numbers of nurse educators to help train the next generation of nurses.[20] Not enough new nurses are gaining the education and training required to replace the nurses who are approaching retirement. Problems within the nursing occupation are frequently attributed to this nursing 'shortage,' and are accompanied with calls for more legislative and fiscal support for nurses. However, classic economic theory would predict increasing wages in response to a shortage of workers in order to attract more labor and raise the level of employment in the market to meet demand. The fact that there are prolonged and recurring problems relating to shortages within the nursing occupation probably indicates there are more constraints to the market than a traditional labor shortage. I investigate the nursing occupation from a perspective of market concentration.

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[17] Heinrich, "Nursing Workforce, Emerging Nurse Shortages Due to Multiple Factor" Report to the Chairman, Subcommittee on Health, Committee on Ways and Means, House of Representative (2001).
[18] "The nursing shortage: causes, impact, and innovative remedies:" hearing before the Committee on Education and the Workforce, House of Representatives, One Hundred Seventh Congress, first session, Washington, DC, September 25, 2001.
[19] Heinrich, "Nursing Workforce, Emerging Nurse Shortages Due to Multiple Factor" Report to the Chairman, Subcommittee on Health, Committee on Ways and Means, House of Representative (2001).
[20] Heinrich, "Nursing Workforce, Emerging Nurse Shortages Due to Multiple Factor" Report to the Chairman, Subcommittee on Health, Committee on Ways and Means, House of Representative (2001).

Further exploration into more nuanced effects of concentration in the healthcare labor market unveils potential irregularities about the effects of monopsony for nurses. Classic monopsony describes the situation where an employer derives market power from being the only employer, or one of very few employers, in the market, making workers inelastic to their employment opportunities and causing the labor supply curve to slope upward. "New" monopsony indicates that the labor supply curve could be upward sloping regardless of market structure and proof of inelastic labor supply need not be the strongest evidence of monopsony in the market. This is largely due to the fact that workers are relatively inflexible in the short-run to make changes to their employment.[21] The potential for upward sloping labor supply independent of market structure is a challenge when testing monopsony theory. Employment level analyses are a better strategy than wage analyses for capturing long-run effects in the labor market.[22] The employment level analysis I conduct could capture the effect of market concentration on employment levels in the long-run, when workers are less constrained by the sunk costs of making changes to employment in the short-run.

Beyond uniqueness to the nature of monopsony in the nursing labor market, another layer to the discussion is the difference between the urban and rural labor markets, especially in the industry of healthcare. Facilities that are in remote areas are often designated as Critical Access Hospitals (CAHs) in order to benefit from increased Medicare and Medicaid support for communities that would otherwise not have emergency care. The CAH designation helps to sustain access to care for individuals in sparsely populated regions. Facilities qualify as CAHs if

[21] Barry Hirsch and Edward Schumacher, "Classic or new monopsony? Searching for evidence in nursing labor markets," Journal of Health Economics 24, 969-989 (March 2005): 400.
[22] Barry Hirsch and Edward Schumacher, "Classic or new monopsony? Searching for evidence in nursing labor markets," Journal of Health Economics 24, 969-989 (March 2005): 400.

they have at most 25 beds and are also no less than 35 miles from another facility.[23] From 2011-2016, over 11% of hospitals in rural areas were involved in a merger, usually due to low profitability and inability to cover debt.[24]

High concentration in rural healthcare labor markets is much more common than in urban markets, and is usually not a result of anticompetitive practices but instead just a natural result of the sparse population. Sustaining access to care for remote communities is difficult and unprofitable; focusing on increasing competition for these facilities is probably not the best strategy for increasing quality of care.

The association of naturally lower levels of demand for healthcare in sparser localities with lower levels of employment suggests the same correlation could exist in localities even with larger populations. While it is entirely possible and likely that employment levels are affected by market power as a result of increasing industry consolidation, natural changes to the level of healthcare demand unrelated to market concentration would also affect the level of nurse employment and suggest potential reverse causality in the relationship between market concentration and employment levels.

Data Summary

The primary data used for the analysis come from the Centers for Medicare and Medicaid Services' (CMS) Provider of Services Current Files (POS). The data are self-reported from healthcare facilities through CMS regional offices. The POS file contains observations that extensively describe each facility, workers at each facility, the type of care provided, among other details, from 2011 to 2020. The file is updated quarterly with data from the last month of

[23] "Critical Access Hospital," Machine Learning Network, Centers for Medicaid and Medicare Services (July 2019).
[24] Williams et al., "Rural Hospital Mergers Increased Between 2005 and 2016—What Did Those Hospitals Look Like?" The Journal of Health Care Organization, Provision, and Financing 57, 1-16 (2020): 1.

each quarter, i.e. March for Q1, June for Q2, September for Q3, and December for Q4. Starting in Q2 of 2011, POS files were extracted from the Quality Improvement Evaluation System (QIES). Previous data came from the Online Survey Certification & Reporting System (OSCAR). The POS files are separated into a "CLIA" file and an "OTHER" file for each quarter of observations. The "CLIA" files include facilities under the Clinical Laboratory Improvement Amendments (CLIA) federal standards for health facilities that test human specimens for health assessment, however do not provide any insight into employment. The "OTHER" files, which have data including employment information from facilities of eighteen other provider types (non-CLIA facilities), are used as the data for this analysis.

The POS data are at the facility-level, where facilities are identified by a unique six-digit CMS Certification number. Each facility lists the average number of employees in each occupation at the facility at the time of each survey. The location of each facility is identified by street address, and state and county FIPS codes.

Collecting facilities into their respective commuting zones, I am able to measure concentration in each regional labor market over time through a Herfindahl-Hirshman Index (HHI). Commuting zones are localities designated by the United States Department of Agriculture that are good measures of local economies, instead of the more political boundaries of counties.[25] Commuting zones reflect the range of reasonable transportation within a community, which make them good definitions of local labor markets because they include all potential employers within the market. Combining the HHI concentration measure with the employment data from the POS, I am able to isolate the effect of changing regional market concentration on the level of employment. Because the analysis is necessarily conducted at the

[25] United States Department of Agriculture Economic Research Service, "Commuting Zones and Labor Market Areas": https://www.ers.usda.gov/data-products/commuting-zones-and-labor-market-areas/

commuting zone level, USDA commuting zone data is also integral to the project. The most recent commuting zones defined in 2000 are used. Defining the local labor market at the commuting zone level also requires that the data are restricted to facilities located in the 50 states, because commuting zones are not defined for U.S. territories.

Early on, an issue was identified of multiple observations in the POS for what appeared to be a single facility. A lot of effort was put forth to investigate the cause of this issue, and to find if the multiple observations are in fact duplicates or otherwise. Most interestingly, there are no duplications of CMS Certification Numbers in the data. Instead, the potential duplicates were identified by similar facility names and addresses.

The nature of the duplicates is important to the accuracy of the analysis. Facility-level employment is used to calculate market shares within commuting zones as an input for the HHI. Knowing if the duplicates are parts of the same facility, different measurements of the same facility, or direct duplicates is integral to calculating an accurate HHI. The facility-level duplicates need to be summed, averaged, or simplified such that there is only one observation for each facility for the calculation. Making an incorrect judgement of the apparent duplicates would lead to overestimation or underestimation of market concentration.

Insight from a number of different sources offered a solution to the apparent duplicates issue. First, CMS's Dovid Chaifetz and Thomas Kress informed that provider numbers from previously terminated facilities remain in the data. So, apparent duplicate observations are usually a result of outdated provider numbers that have remained in the dataset. A provider number that has an associated termination date likely represents a facility that has undergone a change and, if it is still operating, is doing so under a new provider number. These changes are commonly due to a merger with another facility or a change of the type of facility, such as

designation from critical access to general hospital as a facility and its surrounding population grows in size.

The out-of-date facilities in the data need to be identified and deleted. The best solution for this comes from the Quality, Safety, & Oversight Group (QSOG) within CMS. The QSOG has accessible rosters of CMS Certification Numbers for all active hospitals, in each month of each year. Because of the lack of accuracy of reporting in the POS, this roster is relied upon as the most up-to-date record of active facilities in each year of the analysis. Any facility that appears in the POS but not on the QSOG roster is assumed to be a duplicate observation and is dropped from the data. There is a small subset of observations that are in the QSOG roster but not in the POS, and so do not have original employment information.[26] The employment at these few facilities is imputed as the average level of employment within the respective commuting zone.

I supplement the POS dataset with US Census data for population controls. Controlling for commuting zone population and changes in population should separate the effect of demand shocks from the effect of market concentration on nurse employment. I also use the Census data to make an urbanicity measure, in order to distinguish between commuting zones based on rural and urban characteristics, measured by population levels. My urbanicity measure follows similar methodology as the USDA's Rural-Urban Continuum Codes (RUCCs), and assigns a commuting zone to one of five categories of population size. The largest category is Major Metro, with a minimum population of 5 million residents in the commuting zone. Only the largest 8 commuting zones fill this category: Los Angeles, New York, Chicago, Houston, San Francisco, DC Metro Area, Boston, and NJ. I then categories commuting zones by the size of city. Large

[26] About 20-30 facilities, out of almost 5,000, in each year of the analysis are on the QSOG roster of hospitals but not found in the POS.

cities are commuting zones with a minimum of 1 million residents, such as Portland, Oregon or Denver, Colorado. Medium cities have a minimum commuting zone population of 500,000, such as Knoxville, Tennessee, and small cities have populations over 50,000, such as Santa Fe, New Mexico. Any commuting zones with less than 50,000 residents are classified as rural.

A part of the RUCCs methodology that my urbanity codes do not use is adjacency. The RUCCs assign a higher code to a county that has a micropolitan population with an adjacent metropolitan county, than to a county with a micropolitan population but with no adjacent metropolitan county. According to RUCCs, adjacency implies that there is meaning to if an area is micropolitan but with easy transportation to a metropolitan area.[27] My urbanicity measure does not incorporate adjacency because the labor markets in my analysis are defined at the commuting zone level, which already includes the limits of reasonable transportation between adjacent communities.

Past literature uses varying ranges for population thresholds between rural and urban, which range anywhere between 2,500 and 50,000.[28] I choose the upper estimate of 50,000 as the maximum population for a rural commuting zone, in an effort to create a larger subset of the data qualify as rural. This should provide a wider gap between high concentrated markets that are a result of sparse populations (usually occurring in rural commuting zones) and high concentrated markets that are anticompetitive. When separating rural and urban commuting zones for analysis, this will ensure the more dynamic urban markets are distinct from the rural markets.

The analysis aims to capture the effect of market concentration on nurse employment. I define nurse employment as the number of Registered Nurses employed at hospitals. The data

[27] United States Department of Agriculture Economic Research Service, "Rural Urban Continuum Codes" (2021): https://www.ers.usda.gov/data-products/rural-urban-continuum-codes//.
[28] United States Department of Agriculture Economic Research Service, "Rural Classifications" (2021): https://www.ers.usda.gov/topics/rural-economy-population/rural-classifications/

are restricted to facilities defined as hospitals by CMS, which are "institutions(s) primarily engaged in providing, by or under the supervision of physicians, inpatient diagnostic and therapeutic services or rehabilitation services."[29] The hospital facilities in the POS dataset include short term, long term, psychiatric, rehabilitation, children's, transplant, and critical access hospitals. Similarly to defining the commuting zones as the local labor market, defining the occupation in the market as Registered Nurses employed at hospitals narrows the analysis and makes the inferences drawn from the results more specific, due to potential differences in type of work for nurses employed at other facilities, such as schools or public health departments.

Using the POS dataset for my analysis only provides the opportunity to test the monopsony hypothesis through employment levels, as there is no information about wages, benefits, or hours worked in the data. Of course, we know that wage and level of employment should have a direct relationship in a traditional market model. However, monopsony could have different effects on level of employment and wages separately, especially through the sustained effects in the market in the short- and long-runs. Wage analyses are more likely to capture short-run effects of changes to market concentration while long-run effects are more apparent in wage levels.[30] Testing the effect of concentration on nurse employment levels is a unique contribution to the literature rather than the more common wage analyses.

There is still room to investigate how concentration and possible monopsony power allows employers to exploit workers through other various ways, such as increasing nurse-to-

[29] Centers for Medicare & Medicaid Services, "Hospitals" (2021): https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/CertificationandComplianc/Hospitals.
[30] Barry Hirsch and Edward Schumacher, "Classic or new monopsony? Searching for evidence in nursing labor markets," Journal of Health Economics 24, 969-989 (March 2005): 969.

patient ratios, having poor or dangerous working conditions, or holding down the number of hours worked per worker.

Empirics

Herfindahl-Hirshman Index

A prerequisite to measuring the effect of changes to industry organization is to have an accurate measure of market concentration. A commonly used concentration measure is the Herfindahl-Hirshman Index (HHI). HHI is widely utilized as an index for calculating market concentration, and is used by the Department of Justice and Federal Trade Commission in reviewing mergers. HHI is often central to the arguments for and against mergers to predict the effect of such acquisitions on market structure and market power. The 2010 Horizontal Merger Guidelines state "the higher the post-merger HHI and the increase in the HHI, the greater are the Agencies' potential competitive concerns."[31] The Herfindahl-Hirshman Index is defined as the sum of the squared market shares of all firms in the market.

$$HHI_{ij} = \sum_{k=1}^{N} s_k^2$$

In order to calculate the index as the definition describes, a number of aspects of the calculation must be specified. As previously explained, the relevant labor market is for the analysis defined as the labor market for nurses within a commuting zone (j). Market shares (s) for each hospital facility (k) are calculated as the number nurses in an occupation (i) at each facility, such as Registered Nurse or Licensed Practical Nurse, in relation to the total number of

[31] Department of Justice, "Horizontal Merger Guidelines" (August 2010): 19.

nurses in the commuting zone. Because HHI is constructed in this way, the entirety of the analysis is conducted at the commuting zone level, although the Provider of Services dataset is originally at the facility-level.

Table 1

Registered Nurse Labor Market Characteristics for Commuting Zones by Urbanicity in 2019

	# of CZs	Average HHI	Median HHI	Avg. Population
All CZs	564	2,067	1,239	576,081
Major Metro	8	316	335	8,563,165
Large City	63	1,189	945	2,234,500
Medium City	65	2,592	2,198	734,016
Small City	362	5,155	4,614	181,579
Rural	66	9,212	10,000	33,150

HHI is calculated with the average RN employment at hospitals in 2019. Population is all persons, adults and children, within a commuting zone. Calculations are weighted by commuting zone population in 2019. Centers for Medicare & Medicaid Services. Provider of Services Current Files. [September, 2020].

Figure 1

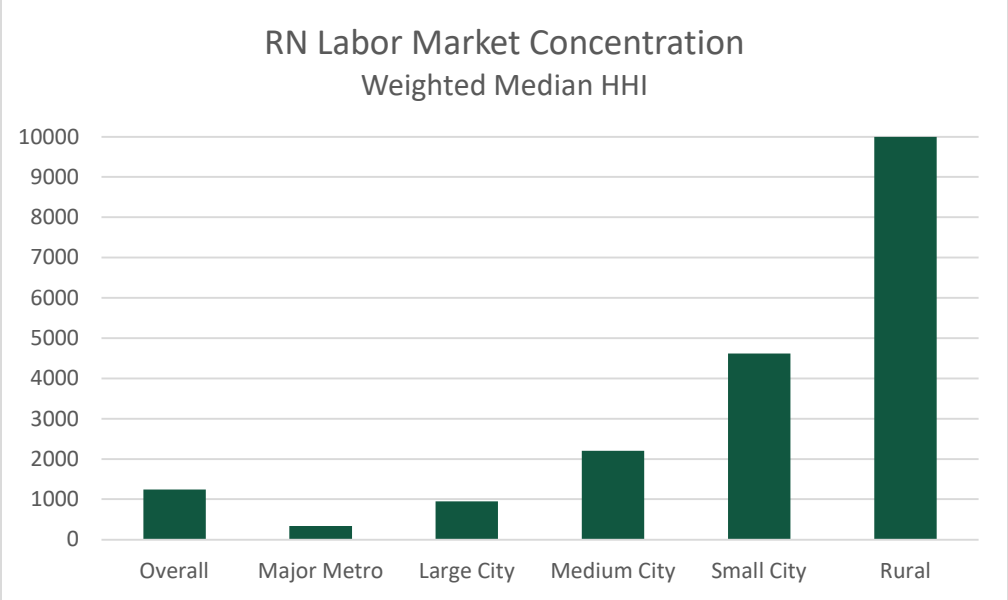


Table 1 describes the nursing labor market at the commuting zone level in 2019, and Figure 1 represents the median HHI visually. Typically, more populous commuting zones experience a lower level of market concentration, and rural commuting zones are particularly

highly concentrated. The median HHI for rural commuting zones is 10,000, a labor market with only one employer.

From Table 1, we see that the median HHI measure for nursing labor markets in the US is about 1,200. The Horizontal Merger Guidelines classify standards for levels of concentration in a market and standards for changing market concentration, in terms of HHI. Unconcentrated markets have an HHI measure below 1500, moderately concentrated markets are between 1500 and 2500, and highly concentrated markets are above 2500. From these guidelines, with an HHI measure of 1200, the average commuting zone in the US has an unconcentrated labor market for nurses which does not follow the expectation that the healthcare labor market generally has higher levels of market concentration overall. However, as commuting zone population decreases, HHI increases. Medium cities, small cities, and rural areas have HHI measures that indicate highly concentrated markets.

The measurements in both Table 1 and Figure 1 are weighted medians of HHI in an effort to best represent the labor markets in which most RNs work. My investigation is interested in how increasing market concentration is affecting nurses. Rural commuting zones with very highly concentrated markets do not have a large effect on nurse employment because very few nurses live in these areas. To prevent overstating the impact of rural areas, I down weight very small, unpopulated yet highly concentrated markets and upweight the more populous commuting zones to more accurately reflect the nursing population. I weight commuting zones by their relative populations, using population levels from the US census, all measured in 2011. The same estimation methodology is applied to the regression models for similar reasons.[32]

[32] Solon et al., "What Are We Weighting For?" NBER Working Series 18859 (February 2013).

The two histograms below, Figures 2 and 3, demonstrate the intuition for weighting. Figure 2 is the unweighted histogram, showing the distribution of HHI by frequency in commuting zone, for all 50 states. It appears that most commuting zones fall well above the standard of 2500 for a highly concentrated market. In fact, the median observation in this figure is an HHI of 4973. The spike at the high end of the index comes from the frequency of small, rural commuting zones that have very few or only a single hospital facility. Of the total 710 commuting zones, 126 are rural communities with only a single hospital facility. These 126 rural commuting zones when measured by HHI and compared to the DOJ standards, appear to be very highly concentrated and of great anticompetitive concern, however a very small portion of the US population lives in these regions because they are so remote and the high market concentration is not a result of anticompetitive behavior but instead a natural result of very low demand for healthcare.

Figure 2

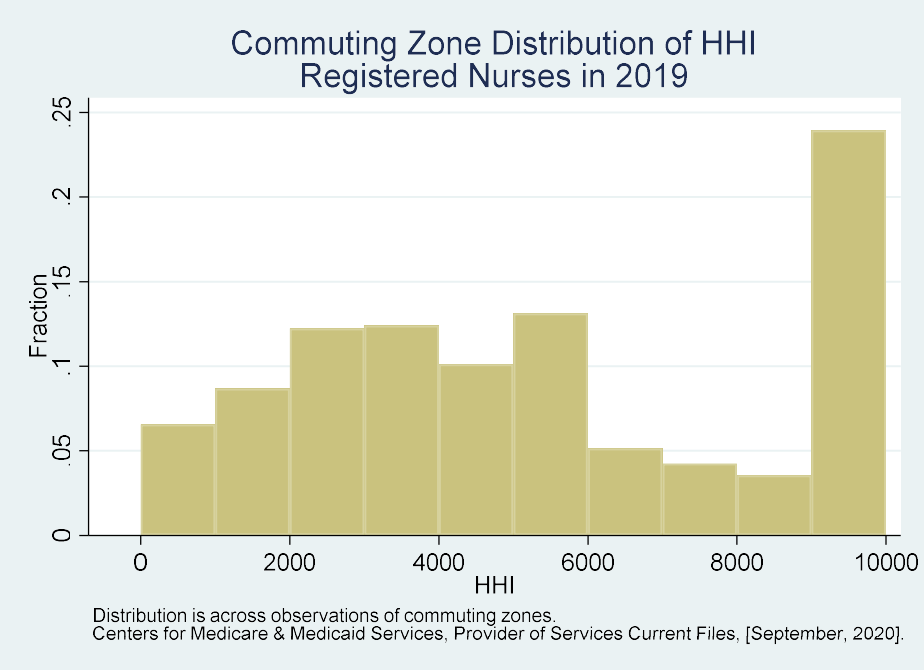
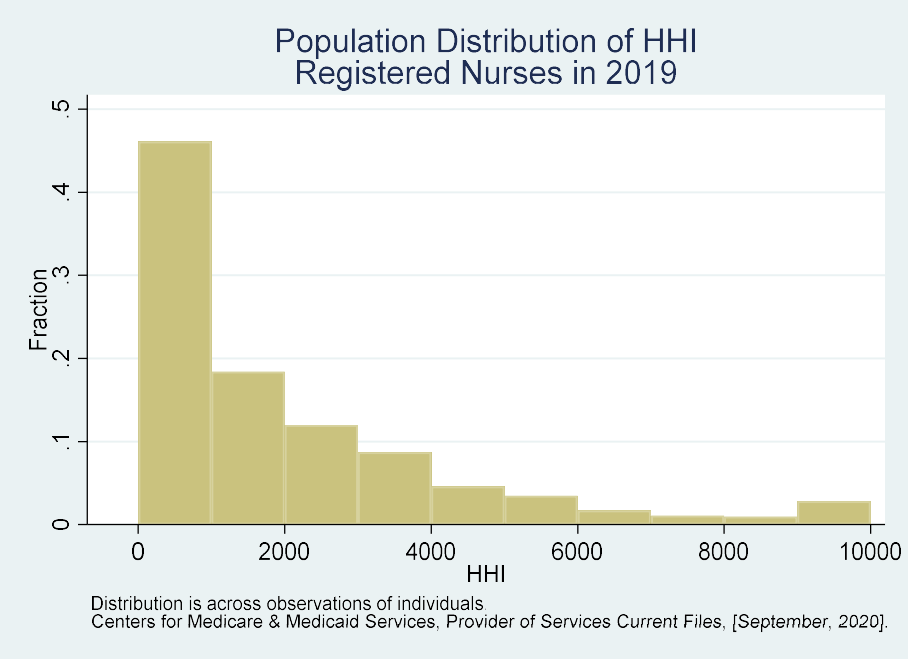


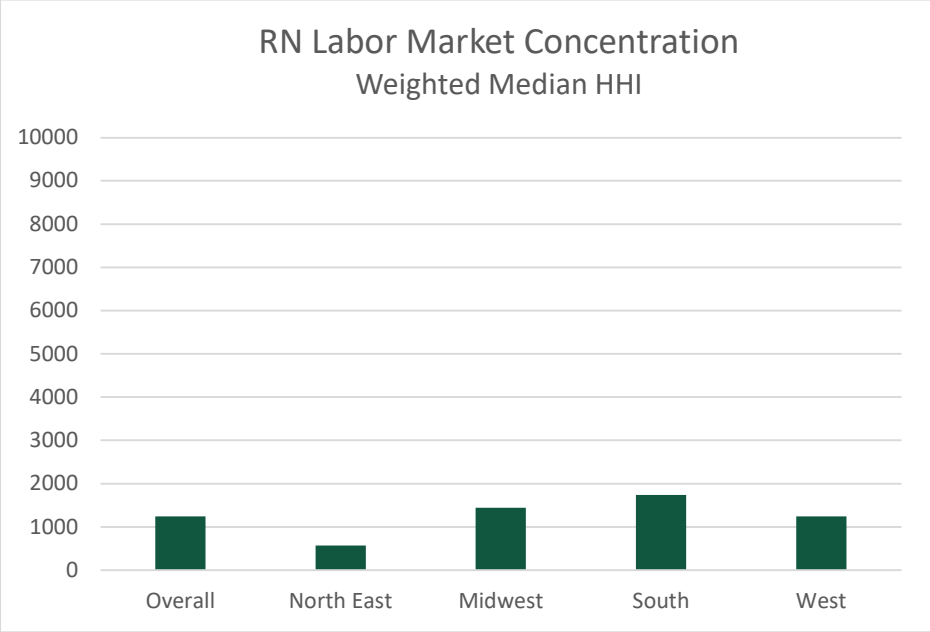
Figure 3 is the weighted histogram, and shows the HHI distribution across the population which more accurately represents the reality of market concentration for the population of Registered Nurses in the US. The majority of the population lives in commuting zones that have an HHI measure toward the lower end of the index, and the median individual lives in a commuting zone with an HHI measure of about 1200, unconcentrated. Half the population lives in commuting zones below this median measure, in nurse labor markets that are even less concentrated, and half live in commuting zones with HHI above the median measure, reaching into moderate- to highly-concentrated nursing labor markets.

Figure 3



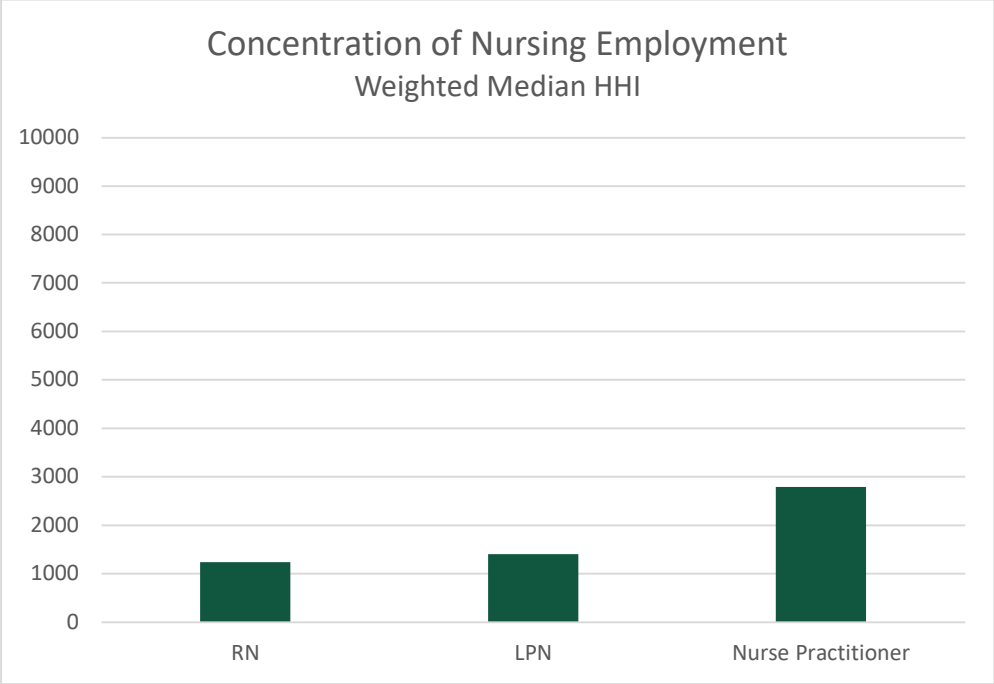
I also measure the concentration of nursing employment opportunities across regional groupings of commuting zones, for the Northeast, Midwest, South, and West. The median HHI measures for these subcategories are in Figure 4. There is less variation regionally than across the urbanicity subcategories of commuting zones. The Northeast has the lowest concentration and the South the highest.

Figure 4



I also calculate market concentration across different occupations within the broader umbrella of nursing, displayed in Figure 5. Registered Nurses and Licensed Practical Nurses have very similar concentrations, however the market for Nurse Practitioners is more concentrated. Licensed Practical Nurses have fewer qualifications than Registered Nurses, and require less education. Conversely, Nurse Practitioners require more training and education than both RNs and LPNs, and hospitals typically employ fewer Nurse Practitioners overall. So, there are fewer employment opportunities for Nurse Practitioners and their labor market is also more concentrated.

Figure 5



When measuring pre- and post-merger HHI, the Horizontal Merger Guidelines set standards of changes in HHI and their effect on market concentration. A small change of less than 100 does not present any meaningful change to market structure. However, potential competitive concerns arise from a change in HHI of at least 100, and especially a change in HHI of 200. From this policy standpoint, I use a change in HHI of 200 as a reasonable treatment effect to measure the effect on nurse employment from a meaningful change in market structure.

The policy implications from the DOJ's Horizontal Merger Guidelines are very informative for analyses of market concentration, however the direct application of them to the healthcare labor market should be taken lightly. These standards for concentration and changes of concentration are intended most directly for application in output markets, especially those affected by horizontal mergers. It is possible that the levels for high concentration, medium concentration, and unconcentrated markets differ when measured by HHI in a labor market,

although HHI is still a useful and relevant statistic to measure concentration even in a when applied outside a traditional output market.[33]

Table 2 presents the frequency of a commuting zone experiencing an increase or decrease in HHI, the average change in HHI respectively, and the associated change in employment. About half of commuting zones over 2011 to 2019 experienced an increase in market concentration, however average change in level of employment in these commuting zones was positive. Monopsony theory would predict as market concentration increases, level of employment should decrease. The twenty-three commuting zones that experienced a market consolidation yielding only one employer in the market (HHI of 10,000) do follow that expectation. The average changes in HHI within the 2011 to 2019 time period are greater than the DOJ's policy standpoint 200 HHI, and changes to market concentration closer to 1000 are not uncommon. I use both 200 and 1000 as treatment effects when drawing inferences from the model.

Table 2

Non-linear Marginal Effects of Market Concentration and RN Employment, 2011-2019

Change to CZ Market Concentration, by HHI	Average Change in HHI	Average Change in RN Employment	# of CZs
Increase	995	295	267
Increase to 10,000	3711	-14	23
Decrease	-721	226	174
Decrease from 10,000	-4355	-2	8
Unchanged	n/a	1	123

Calculations are unweighted. 123 commuting zones did not experience an increase or decrease in HHI, out of the total 564. RN Employment is measured as number of nurses, not in log form.
Centers for Medicare & Medicaid Services. Provider of Services Current Files. [September, 2020].

[33] US Bureau of Labor Statistics, "Measuring occupational concentration by industry" (February 2014): https://www.bls.gov/opub/btn/volume-3/measuring-occupational-concentration-by-industry.htm

Overall, there is a lot of variation in concentration for nursing employment in the hospital industry across commuting zones with different characteristics such as urbanicity and regionality. There is generally low to moderate concentration for the majority to the US population, however remote areas experience very highly concentrated markets, which should be a natural result of the low demand for health care in sparsely populated localities.

Model

I use a Weighted Least Squares model to estimate the effect of market concentration on nurse employment. I run four separate regressions, all with the same specifications. First, I estimate a cross-section regression in the years 2011, 2016, and 2019, separately.

$$(1)\ ln(emp)_{ij} = \beta_0 + \beta_1 HHI_{ij} + \beta_2 \ln(pop)_j + \varepsilon_{ij}$$

Here, $ln(emp)_{ij}$ is the natural log of the level of employment of occupation (j) in commuting zone (i). Again, the analysis is focused primarily on the outcomes of Registered Nurses, but also looks at the markets for Licensed Practical Nurses and Nurse Practitioners for comparison and a more comprehensive analysis. The parameter of interest is β_1 which measures the effect of market concentration on employment. The natural log of total population in each commuting zone, pop_j, is introduced as a control against potential demand shocks, to control for growing or shrinking populations that would in turn cause an increase or decrease in nurse employment independently from changes in market structure.

Both the control population variable and dependent employment variable are taken as natural logs to allow the relationship to be non-linear. The effect can be interpretated as a percent change of employment from an increase in the market concentration index HHI or a percent change of population. The parameter β_2 will capture the effect on nurse employment

from the percent change of population in the commuting zone, separate from the effects of market structure.

The model was checked for robustness by sequentially adding population as a control, both in the weighted and unweighted models. The weighted model with both HHI and population as independent variable (specification 4) is the preferred model. The regression is run within the different urbanicity categories and regional categories to investigate potential heterogeneous effects across different geographic labor markets.

The control variable $ln(pop)_j$ is introduced to separate the effect of demand shocks from the effect of market concentration on nurse employment. Facilities make employment decisions in relation to demand, and smaller populations need less medical care. This is an effect on healthcare employment that would not be captured by regressing HHI directly on level of employment. Total commuting zone population should be sufficient as a control because the demand shock would have to be large enough and sustained over time to actually affect nurse employment. An isolated event, such as a natural disaster, could increase demand for healthcare services for a limited amount of time, but is unlikely to have a meaningful effect on nurse employment due to delays and friction in the labor market. A growing, or shrinking, population would cause a change in demand for healthcare, and subsequently the number of nurses needed at facilities in that commuting zone, and would be captured with the implemented population control. A further extension that may be helpful for future investigation is the average age of the population. An increase in demand for healthcare services would be associated with an aging population, such as the large and aging baby boomer's generation. As some commuting zones experience an aging population relative to other commuting zones with a lower average age,

their hospitals may need to hire more nurses, an effect uncaptured by total population and market concentration.

A weighted model is preferred over traditional OLS due to differences in relative sizes of commuting zones, in terms of population, and the effect of these differences on the analysis. Many rural communities have highly concentrated labor markets, but also very few residents in the commuting zones. This causes the analysis to place a lot of importance on these small commuting zones, and overstates their effect on the total population of nurses. This is visually very apparent between the weighted and unweighted histograms, Figures 1 and 2.

The decision to weight the analysis was taken with care and informed by the empirical research on the uses of weighted estimation data.[34] A primary reason in favor of weighting is to "make the analysis sample representative of the target population," especially when calculating descriptive statistics.[35] My analysis is conducted at the commuting zone level; however, each commuting zone does not represent an equal part of the nursing population across the US. I weight each commuting zone by its population level to avoid overstating the importance of less populous commuting zones and understating the importance of more populous commuting zones. Utilizing population weights better supports the main interests of the project, investigating nurse staffing outcomes, and not just the general distribution of concentration across commuting zones.

The cross-section model is somewhat intentionally weak. It is far more interesting and statistically convincing to use a first-differenced model. The remaining three regressions are differenced over the following time periods: 2011-2016, 2016-2019, and 2011-2019. It is very likely that commuting zones have individual-specific characteristics that influence nursing employment but are not captured by HHI or population, and are therefore left in the error term in

[34] Solon et al., "What Are We Weighting For?" NBER Working Series 18859 (February 2013).
[35] Solon et al., "What Are We Weighting For?" NBER Working Series 18859 (February 2013): 22.

the cross-section regressions. Such fixed effects could include local legislation about staffing requirements that affects only a subset of commuting zones, or a strong nursing union that is active in only one region. The commuting zone-specific fixed effects will bias the results of the cross-section model. By differencing, I drop such characteristics that do not change over time and can instead isolate how changing market concentration, controlled by changing population, affects nurse employment.

$$(2)\ \Delta ln(emp)_{ij} = \beta_0 + \beta_1 \Delta HHI_{ij} + \beta_2 \Delta \ln (pop)_j + \varepsilon_{ij}$$

It is important to note that all independent and dependent variables differenced across the time period in the first-differenced models, but the commuting zone population weights are maintained as levels. This follows my initial decision to weight the estimation by relative sizes of commuting zones, and not by the relative growth of commuting zones which would be the case if the weight was differenced. The population weights are used from the first year of each time period to avoid any potential endogeneity within the time period between population level and nurse employment.

The same subcategories of analysis are used for the first-difference model as in the cross section; the regressions are run to the different nursing occupations, different levels of urbanicity in commuting zone, and regionally.

The time periods of the differenced models were chosen with the policy effects of the Affordable Care Act in mind. The ACA greatly increased the number of insured adults and their subsequent access to care increased, which was experienced similarly across population groups. It is estimated that the legislation increased the number of adults with health insurance by 20 million.[36]

[36] Uberoi et al., "Health Insurance Coverage and the Affordable Care Act, 2010-2016," ASPE Issue Brief (March 2016): 1.

The ACA was signed into law in March of 2010, and increased in implementation through early 2016. This immense increase of insured adults potentially had an effect on the health care industry and relative demand through its rollout, however the effects are not captured by the HHI or population variables. Instead, to control for the policy effect, the broader time period of all available data is broken into two shorter time periods, 2011-2016 and 2016-2019, for robustness checks to accommodate for the policy effects of the ACA.

The same intuition for the population control from the cross-section model is applied to the differenced model. In the case of the differenced model, the logged population control captures the effect of changing population, represented in percent.

Differencing excludes commuting zone-specific unobserved heterogeneity and is an improvement from the cross-section model in that the unobservables that can bias the results are dropped. While the first-difference model is an improvement on the cross-section model, it does not address potential reverse causality in the effect of market structure and level of employment. Intuitively, larger populations need more healthcare than smaller populations. So, as a population naturally grows or shrinks in terms of population, the nursing workforce will follow the same pattern of growth.

As a population decreases and their hospital industry naturally decreases and consolidates, the model would represent this as a decrease in level of employment due to the increasing market concentration. The lowering level of employment in this situation would not be a result of anticompetitive market power. This is a natural correlation between demand for healthcare and population, violating assumptions of strict exogeneity between independent

variables required for a differenced model. The first-difference model yields better results than the cross-section model, but is still victim to potential bias and reverse causality.[37]

A lag in time between changes to market structure and the effect on employment forces the model to measure the employment effect *as a result of* changes to market structure. Specifying subsequent time periods for the independent and dependent variables isolates the effect to be measured within a specific time as a result of a change during a previous time period.[38]

$$(3)\ \Delta ln(emp)_{ij,t+1} = \beta_0 + \beta_1 \Delta HHI_{ij,t} + \beta_2 \Delta \ln (pop)_{j,t} + \varepsilon_{ij}$$

The lagged first-difference model uses the same variable specification as both the cross-section and first-difference models. The crucial difference is in the time period in which HHI is measured and the time period in which nurse employment is measured, which only require exogeneity between the subsequent time periods for unbiased estimates. I limit the HHI measurement to the first period available in the data, from 2011 to 2016, again to be sensitive to the rollout of the Affordable Care Act. Nurse employment is measured across the entire time period of data available, from 2011 to 2019. This lag forces the model to measure the effect of changes in market concentration from 2011-2016 on nurse employment from 2011-2019 captured in β_1, separate from demand shock effects.

Results

The results of the cross-section regression with the preferred specification can be found in column (4) of Table 3. Columns (1) through (3) show the results from the regressions comparing the effects when weighted or unweighted, and with and without the population

[37] Leszczensky et al., "How to Deal with Reverse Causality Using Panel Data? Recommendations for Researchers Based on a Simulation Study," Sociological Methods & Research 29, 1 (2019): 11.
[38] Leszczensky et al., "How to Deal with Reverse Causality Using Panel Data? Recommendations for Researchers Based on a Simulation Study," Sociological Methods & Research 29, 1 (2019): 11.

control. In general, the coefficients are relatively large with small standard errors and are typically statistically significant at least at the .01 level.

Table 3

Effect of Market Concentration on Registered Nurse Employment in 2019

2019	log(RN employment)			
	(1)	(2)	(3)	(4)
	OLS	WLS	OLS	WLS
HHI	-0.000408***	-0.000561***	-5.96e-05***	-6.13e-05*
	(1.43e-05)	(3.90e-05)	(1.97e-05)	(3.49e-05)
log(population)			1.041***	0.955***
			(0.0410)	(0.0503)
Constant	8.492***	9.690***	-6.165***	-5.020***
	(0.0833)	(0.163)	(0.591)	(0.771)
Observations	562	562	562	562
R-squared	0.601	0.666	0.848	0.909

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 Analytical weights are commuting zone populations in 2019. Effect is measured at the commuting zone observation level.
Centers for Medicare & Medicaid Services. Provider of Services Current Files. [September, 2020].

Following the DOJ's policy that a 200 increase in HHI raises competitive concerns, a treatment effect of 200 points in this model predicts an 1.23% decrease in employment. The effect is magnified with an even greater change to market structure, such as an increase in 1000 points. A 1000 difference in HHI would indicate a decrease in nurse employment by 6.13% in the higher concentrated market. Between two commuting zones with a difference in market concentration of 1000 points in HHI, the more concentrated market would have 6% less nurses, all else constant- a pretty stark difference.

Table 4

Employment Effects from Market Changes in 2019

Change in HHI	RN employment effect[39]
200	-1.23%
1000	-6.13%

Effects are statistically significant at the ***p<.01 level, measured at the commuting-zone observation level.

[39] A one-unit increase in HHI increases the dependent variable by 100*[exp(beta)-1] percent.

These results are very much in line with classic monopsony theory; as market concentration increases, employers gain monopsony power and are able to decrease the level of employment in the market. This model would be very appealing to opponents of hospital mergers, and appears to be strong evidence for the presence of monopsony power in the nursing labor market and market power for employers to decrease the level of employment of nurses.

Like previously stated, a first-difference model offers a stronger statistical opportunity to investigate how changes in market concentration affect employment. Again, I stress how differencing drops any commuting-zone specific characteristics that are not controlled for in the model but potentially affect nurse employment. The first-difference model should eliminate concerns of bias from violation of strict endogeneity between the independent variables.

The differenced model was conducted over the longest time period available, 2011 through 2019, to more broadly capture changes to industry organization and the effect on employment, especially as hospital mergers may take a few years to be fully realized, as well as to avoid potential autocorrelation. The results of the differenced model can be found in Table 5.

Table 5

Effect of Changing Market Concentration on Registered Nurse Employment from 2011 to 2019

2011-2019	Δ log(RN employment)			
	(1)	(2)	(3)	(4)
	OLS	WLS	OLS	WLS
ΔHHI	-4.45e-06	1.77e-05	-2.24e-06	2.61e-05
	(3.30e-05)	(8.89e-05)	(3.31e-05)	(8.95e-05)
Δ log(population)			3.90e-07***	2.81e-07***
			(9.73e-08)	(5.80e-08)
Constant	0.0563***	0.106***	0.0441*	0.0563***
	(0.0217)	(0.0213)	(0.0232)	(0.0203)
Observations	562	562	562	562
R-squared	0.000	0.001	0.006	0.035

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Analytical weights are commuting zone populations in 2011. Effect is measured at the commuting zone observation level.
Centers for Medicare & Medicaid Services. Provider of Services Current Files. [September, 2020].

The differenced model predicts that an increase in market concentration of 200 points in HHI would in fact not decrease nurse employment, as is the expectation of monopsony theory and the prediction from the cross-section model. The baseline effect from the differenced models predicts a small, yet positive effect on employment, although statistically insignificant. The small positive effect is at odds with my hypothesis and traditional monopsony theory, however because the findings are not statistically significant, the inferences drawn from them should be limited.

Table 6

Employment Effects from Market Changes from 2011 to 2019

Change in HHI	RN employment effect[40]
200	0.52%
1000	2.61%

Effects are statistically insignificant, measured at the commuting-zone observation level.

The confidence interval of 95% outlines the limits of the largest potential effect within the statistical interval. Following a 200-point change in HHI, the confidence interval from the first-difference model predicts the largest possible effect to be increasing RN employment by 4.04% and the smallest to be decreasing RN employment by -3%. Both of these possibilities would be significant effects in the labor market by either increasing or decreasing the number of nurses, and very noticeable by the workforce of nurses and patients alike. Either of these possibilities would have an impact on the quality of care provided to patients.

The wide confidence interval also includes a reasonable effect. The lower limit of -3% outlined by the confidence interval could mean monopsony power in the market is holding nurse employment down, which is in line with my initial hypothesis. However, the wide interval

[40] A one-unit increase in HHI increases the dependent variable by 100*[exp(beta)-1] percent.

includes an even larger positive possible effect of 4% and neither effect can be statistically distinguished from the possible zero effect. Because the model predicts very small coefficients that are within a very large confidence interval including zero, the model's estimates are "noisy" zeros. The small yet positive coefficients may appear as evidence against the presence of monopsony, but the conclusions that can be drawn are weak in their interpretation.

The time period of 2011-2019 of the first-difference model is split into two smaller sections, before and after 2016, in order to control for potential policy effects of the Affordable Care Act through increased demand following the increase of 20 million newly insured adults. The coefficient in the second period, 2016-2019, is significantly larger than both the first period, 2011-2016, and the overall period 2011-19. These are displayed in Table 7. The larger estimate follows the intuition from the proposed increase in demand from the ACA, however the effect is somewhat unbelievably large. The effect is measured in the smallest time period of the differenced models and is possibly too short for the differenced model to accurately represent the effect.

It is unclear why the estimated effect is so much larger in the period 2016-2019. It is possible the time period specifications around 2016 are not enough to control for the implementation of the ACA, or that the real effect of the new legislation is affecting the market differently than as a demand shock as I predict. Beyond increasing demand for healthcare by greatly increasing the number of insured adults, the ACA could have had an effect on how hospitals approach the hiring and firing of their staff. Another potential influence in this period is the slow and prolonged economic recovery that started in 2011 following the crash in 2008.

Table 7

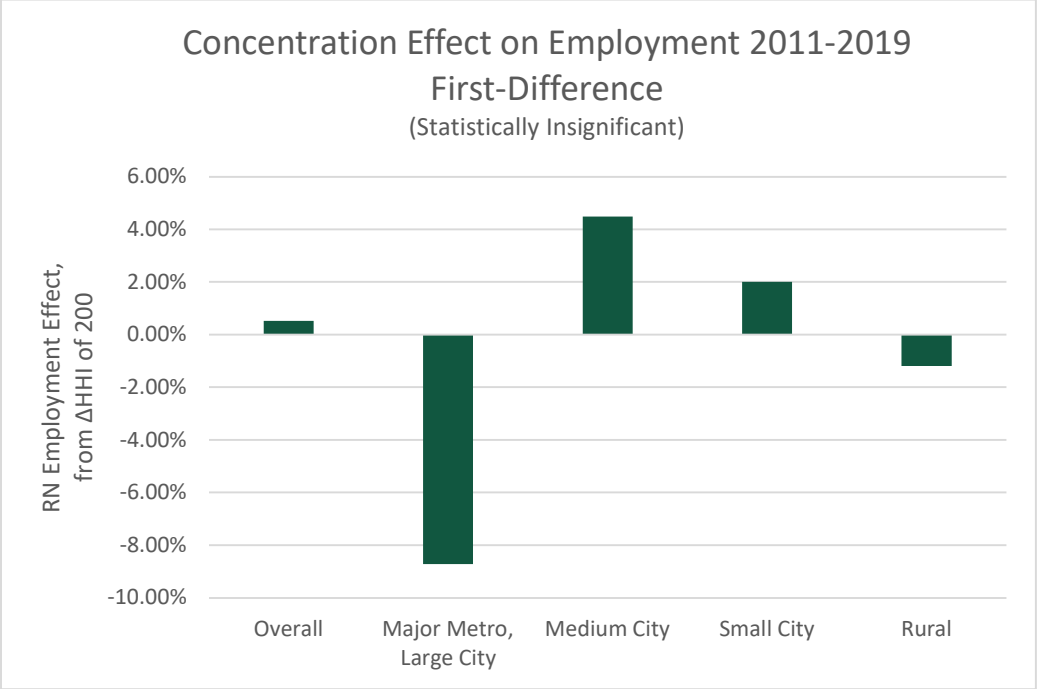
Time Period Comparisons of the Effect of Changing Market Concentration on Registered Nurse Employment from 2011 to 2019

2011-2019	Δ log(RN employment)		
	(1)	(2)	(3)
	2011-2016	2016-2019	2011-2019
ΔHHI	1.98e-05	7.34e-05	2.61e-05
	(4.97e-05)	(0.000169)	(8.95e-05)
Δ log(population)	2.57e-07***	2.84e-07	2.81e-07***
	(6.81e-08)	(2.02e-07)	(5.80e-08)
Constant	0.0708***	-0.0158	0.0563***
	(0.0156)	(0.0200)	(0.0203)
Observations	569	561	562
R-squared	0.030	0.022	0.035

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Analytical weights: commuting zone population in 2011. Effect is measured at the commuting zone observation level.
Centers for Medicare & Medicaid Services. Provider of Services Current Files. [September, 2020].

The analysis is also conducted over additional subcategories to control for differences in the effect across different labor markets. Figure 6 below shows the visual comparison of effects as predicted by the first-difference model with a 200 HHI treatment effect across different urbanicities of commuting zones.

Figure 6

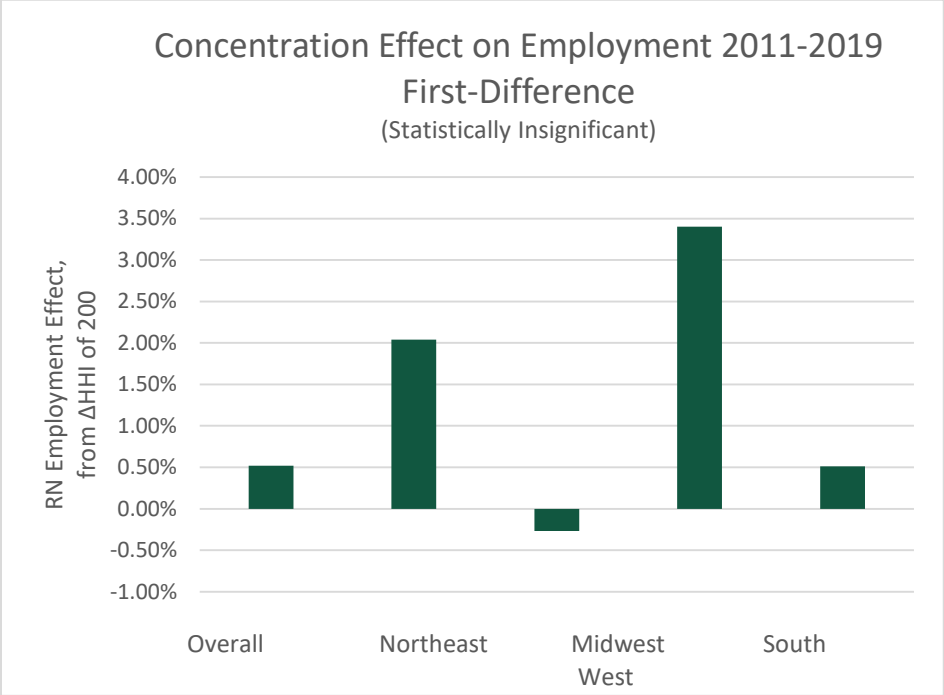


Commuting zones classified as Major Metro are combined with Large City because the eight commuting zones that qualify as Major Metro make too small a sample size for an individual regression. Combining the two categories should not be problematic because both categories have very large populations, all over 1 million, and low HHI measures, shown in Figure 1.

There is obviously a lot of variation in the effect across the urbanicity categories. Major Metro and Large City have a very negative coefficient; however, all the results of the first-difference model are statistically insignificant. The difference in effect across the markets with some experiencing a negative predicted effect means some markets could be experiencing effects in line with the prediction, however not in every market. There is also not an obvious connection between size of population and the predicted effect, as both the largest, least concentrated markets and the smallest, most concentrated markets both have a negative effect while the markets not on the extreme ends of the urbanicity categories have positive effects.

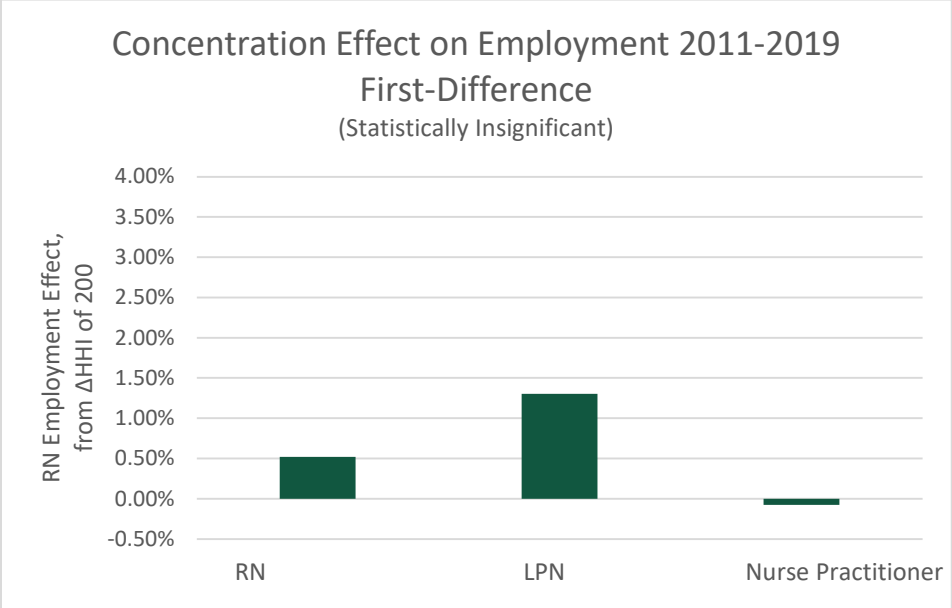
The first-difference model is also conducted across regional categories. Predicted effects following a change in HHI of 200 are displayed in Figure 7. There was less variation in HHI measures across the regional categories, seen in Figure 4, so it is interesting that the FD still predicts heterogeneous effects. There are likely more unique conditions across different commuting zones and across time that are not captured by the model. The Midwest is the only category with a negative effect, and the positive effects in the Northeast, South, and West vary greatly in their magnitude. Again, these results are statistically insignificant.

Figure 7



The first-difference model was also conducted using different nursing occupations to measure the concentration of employment opportunities, for Registered Nurses, Licensed Practical Nurses, and Nurse Practitioners. The main similarity across all the different subcategories of analysis is that there is wide variation of the predicted effects. The effects are positive for both RNs and LPNs, however negative and very close to zero for Nurse Practitioners.

Figure 8



The first-difference model addresses unobserved commuting zone characteristics affecting nurse employment by dropping the time-invariant fixed effects. While the first-difference model is an improvement from the cross-section model, it does not address potential reverse causality between the effect of market structure and level of employment. The lagged first-difference model isolates the effect on nurse employment from 2011 to 2019 from changes in market concentration in 2011 to 2016. The lagged model results are in Table 9, with the same variable specification as both the cross-sections and first-difference model.

Table 8

Lagged Effect of Changing Market Concentration in 2011-16 on Registered Nurse Employment from 2011-19

	Δ log(RN employment)			
	(1)	(2)	(3)	(4)
	OLS	WLS	OLS	WLS
ΔHHI 2011-16	-4.33e-05	-1.76e-05	-3.93e-05	-4.64e-06
	(2.71e-05)	(4.88e-05)	(2.71e-05)	(4.90e-05)
Δ log(population)			1.014***	0.933***
2011-19			(0.290)	(0.255)
Constant	0.0610***	0.108***	0.0417**	0.0604**
	(0.0207)	(0.0237)	(0.0209)	(0.0248)
Observations	562	562	562	562
R-squared	0.009	0.001	0.024	0.024

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Analytical weights are commuting zone populations in 2011. Effect is measured at the commuting zone observation level.
Centers for Medicare & Medicaid Services. Provider of Services Current Files. [September, 2020].

An increase in market concentration in the first period is predicted to have a negative effect on nurse employment overall, although the prediction is still statistically insignificant. The negative predicted effect is in line with my original hypothesis and monopsony theory. The lagged model also experiences a similar wide confidence interval as the first differenced model. With the intuition that the lagged model better accounts for bias and reverse causality, the negative effects are another piece of evidence pointing toward increasing market concentration lowering nurse employment levels, however weak due to the statistically significance and wide confidence intervals. The RN employment effects, following the same treatment effects of a change in HHI, are in Table 9. The effects from the lagged model are smaller in magnitude than the first-difference model.

Table 9

Lagged Employment Effects in 2011-19 from Market Changes from 2011-16

Change in HHI	RN employment effect[41]
200	-0.09%
1000	-0.46%

Effects are statistically insignificant, measured at the commuting-zone observation level.

Conclusion

From the specific characteristics of the nursing labor market, the occupation provides a good opportunity to examine the effects of mergers and increasing industry consolidation, and to test the monopsony hypothesis. Overall, I find a statistically insignificant effect of changing market concentration on nurse employment. I find wide variation in market concentration and employment effects across different commuting zones. The variation and difference in results indicates the market and its imperfections may not be as straight forward as it might first appear.

Pooling all commuting zones together, labor market employment opportunities for nurses at hospitals are moderately to minimally concentrated. Filtering commuting zones by level of population and urbanicity reveals a natural relationship that as population increases, market concentration decreases. Regional groupings of commuting zones have less variation and are fairly similar in the levels of concentration for employment opportunities. Within the general nursing occupation, Registered Nurses and Licensed Practical Nurses face similar market concentrations while Nurse Practitioners experience a more concentrated market.

The cross-section model findings indicate that a higher level of market concentration does cause lower levels of employment, even when controlling for population demand shocks,

[41] A one-unit increase in HHI increases the dependent variable by 100*[exp(beta)-1] percent.

and is held with statistical significance, although we know the results are most likely biased due to unobserved fixed effects.

Contrastingly, the first-difference models indicate that the change in HHI in fact does not have a negative effect. The statistical insignificance of the differenced models warrants caution when drawing conclusions from these findings. Although the predicted coefficients are very close to zero, the confidence interval includes an effect in line with my initial hypothesis, that in response to a moderate change in market structure, nurse employment could decrease by up to -3%. These weaker zeros in the differenced regressions appear to be evidence, though inconclusive, against the presence of monopsony power in the nursing labor market. The evidence is further weakened by the large confidence intervals and noisy zeros, which makes the possible reasonable effect statistically indistinguishable from zero.

Further addressing endogeneity and bias, the lagged first-difference model isolates the effect on nurse employment from a change to market concentration within a prior fixed time period. Necessarily requiring the effect to be measured sequentially combats potential reverse causality in the relationship between market structure and the level of employment. The lagged model yields negative estimates, however also statistically significant with wide confidence intervals as in the original first-difference model. The lagged model has the strongest statistical intuition for measuring changes to nurse employment from a change in market concentration, and is in line with my initial hypothesis with negative estimates, however does not provide compelling support for the conclusion because it is statistically indistinguishable from zero and so the true effect is still ambiguous.

There are many potential reasons behind the statistical insignificance of the results. A strong assumption in my analysis restricts the RN labor market to include only hospitals. In

reality, nurses have more mobility to choose between other employment options such as nursing homes, home health agencies, doctor's offices, schools, or different occupations altogether. It is reasonable to restrict the analysis to hospitals as the main employment of Registered Nurses at 60% of the market, to have specificity for the implication for nursing employment only at hospitals, but hospitals will still face competition from the remaining 40% of the market. Assuming hospitals are the sole employers of nurses in the labor market ignores the pressure on wages and employment level from the remaining potential employers in the commuting zone. This assumption possibly causes the analysis to be less accurate leading to statistical insignificance and noisy zeros. Further research should consider the possibility of widening the defined market to include nursing homes and other employment opportunities for Registered Nurses, which may be a more realistic representation of the nursing labor market.

The POS data used here only contain averages of nurse employment at hospitals, and the results from the model using this data are weak. A more precise measurement of employment could include number of hours worked. The active facilities in the CMS POS data need to be verified with an outside source to identify outdated facilities in the data. This begs the question of sampling error in the data, if the employment statistics in the POS data are truly reflective of the reality of nurse employment over the time period of analysis. Recreating the HHI with a different measure of employment could improve the strength of the measure of market concentration. Improving the employment measure would provide a stronger foundation of HHI to study the effect on nurses.

The wide variation of the effect across different commuting zones reveals how markets are influenced by constraints that are probably unique and specific to each commuting zone, and are uncaptured in the data. Some commuting zones may be more vulnerable to bias and reverse

causality than others. Some commuting zones may have the specific conditions such that the market is decreasing in competition anticompetitively, and employers use this situation to exploit nurses by lower levels of employment. Without an identifiable distinguishing factor between these commuting zones, the effect I predict could be occurring in some commuting zones but is inseparable in the data from commuting zones without anticompetitive concerns.

The result of the analysis does not follow expectations of a traditional monopsony model, and is at odds with my initial hypothesis. There would be value in future research that investigates why the results deviate from the prediction and theory. Future work should investigate other outlets for the effects of high or increasing concentration in the nursing labor market. Such other outlets could include changes to nurse-to-patient ratios, meaning employers increase the work load per nurse during shifts, requiring more productivity from each of their workers. Facing inelastic labor supply, a monopsonist could also choose to manifest their market power by lowering the quality of working environment for the nurses, which is an outlet of market power uncaptured by wage or level of employment analyses, but a potential effect of monopsony nonetheless. Lowering the number of hours worked per nurse and decreasing benefits are also other potential outcomes of the presence of monopsony in the labor market.

Measuring healthcare employment opportunities in the U.S. geographic labor markets, I find the nursing labor market to be moderately to minimally concentrated. However, increasing concentration is not predicted to have a meaningfully negative impact on nursing employment. In fact, the models predict heterogeneous effects, some positive and others negative, with noisy zero estimates and statistical insignificance. There is value in future work to strengthen these results in order to confirm the presence of market power in healthcare labor markets and specify how the potential market power affects nurse employment.

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