Heterogeneous Effects of Economic Downturns on Health Care Labor Supply and Care Consumption

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The health care sector has been a persistent source of aggregate job creation, including during and after the recent financial crisis. However, less is known about the labor supply responses to economic downturns across the variety of health occupations, which vary in skill and scarcity. We estimate short- and long-run supply changes for a dozen occupations following a worsening local economy. We find consistent reductions among middle-skilled workers (e.g., registered nurses, occupational/physical therapists, and psychologists)—though, rural areas lose physicians and physician assistants with a rise in unemployment. Supplementary analyses demonstrate increased emergency department reliance in these same areas for health problems linked to these provider types. (JEL I11, J21, J44)

Keywords: health care workforce, health care providers, recession, Great Recession, business cycles

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1. Introduction

Many have taken note of the US health care sector’s employment resilience during the worst economic crisis in nearly a century as well as its consistent role as a source of new job creation in recent years (Turner et al. 2017). From 2007 to 2017, nearly a third of all new US jobs originated in the sector, and currently, the Department of Labor anticipates another 2 million health care positions being added by 2026.¹ Health care also became the largest source of jobs in the US during 2018, surpassing manufacturing and retail (Thompson 2018). These trends and forecasts bode poorly for reigning in national medical spending (Baicker and Chandra 2012; Skinner and Chandra 2018); however, they simultaneously suggest an attractive attribute of health care-based work: implicit protection against an unfavorable labor market.

Notwithstanding these workforce facts and projections, empirical studies of a worsening economy’s direct effects on health care occupations are few. They are also largely confined to fields of nursing. For instance, it is known that registered nurses (RNs) demonstrated countercyclical employment patterns over the course of the most recent recession in the aggregate (Buerhaus and Auerbach 2011; Sardenberg-Hersh Tellez et al. 2013; Yoo et al. 2017; Li, Richards, Wing 2019), and Baughman and Smith (2012) likewise observe stronger job attachment during a weaker economy for some of the lowest skilled direct care workers (i.e., those typically providing very low-level nursing care to the chronically ill elderly). The evidence has been more mixed within the nursing home industry, however. Stevens and colleagues’ (2015) find positive associations between state-level nurse staffing and prevailing unemployment rates over the 1990-2006 period. Yet, Konetzka et al. (2018) show relatively stable quantities of nurse labor and instead a shift in composition, whereby these long-term care firms rely more on nurses with fewer

¹ These and related labor market and macroeconomy details can be found here: https://www.stlouisfed.org/on-the-economy/2018/may/health-care-future-job-growth as well as here: https://www.bls.gov/ooh/healthcare/home.htm.
educational qualifications during a downturn. And in the lone study of physician labor markets, Chen, Lo Sasso, and Richards (2018) find comparable job prospects for new entrants during the Great Recession relative to cohorts graduating into times of economic expansion.

The aforementioned studies each contribute to an otherwise sparse area of economic research and often align with the macro data and associated interpretations. But the health care sector is also home to a wide variety of occupations—far greater than what are accounted for in existing empirical work. The various provider types differ in skill and availability as well as the specific patient needs they fulfill. Moreover, heavily aggregated analyses (e.g., national trends) may mask potentially important differences in health care supply evolutions across disparate markets. If provider responses to local economic conditions are stronger within areas already challenged by access issues, for example, then recession-induced changes can exacerbate pre-existing inequalities in care consumption and overall health (Dickman et al. 2016). Economists and policymakers, in turn, have an incomplete view of how the business cycle impacts the supply of health care workers over the short- and long-run, which can challenge predictions of future demand-and-supply imbalances as well as policy decisions over training investments and supply-side regulations.

We aim to partly fill this gap by exploiting a detailed and seemingly underutilized health care workforce data resource from the state of North Carolina. As described next, North Carolina has long tracked the number of various health care professionals holding an occupational license within the state, which generates a unique opportunity to examine aggregate labor supply responses over a period of considerable macroeconomic turbulence. To do so, we implement two identification strategies. Using variation in unemployment levels within a county over time, our first strategy relies on standard panel estimation techniques common to the existing literature.
Because of the longstanding challenges of provider recruitment and retention in rural areas, as well as the well-known financial solvency concerns for rural health care firms, we additionally allow for differential impacts of the economic downturn across the rural-urban divide. (e.g., see Bahensky, Jaana, and Ward 2008; Hancock et al. 2009; Hunsberger et al. 2009; Knapp and Hardwick 2000; Kuthy et al. 2009). Our second strategy introduces a novel approach that allows us to more directly and transparently quantify transient, as well as persistent, labor supply effects from the Great Recession. Specifically, we compare counties that were more heavily affected by the financial crisis fallout to those that were relatively shielded. Leveraging this variation in recession “treatment intensity”, coupled with our long time series, generates a quasi-difference-in-differences design. Both empirical strategies are undertaken for each of twelve health care occupations, which substantively vary in terms of training requirements and scarcity.

Our empirical results consistently show reductions in the aggregate quantity of licensed health care professionals relative to the surrounding population with a worsening local economy; however, there is considerable heterogeneity across occupations and geographic environments. Relative to urban areas, rural areas, specifically, suffer a disproportionately larger fall in their provider-to-population ratios for RNs, physicians, and physician assistants. With each 1-percentage point increase in the local unemployment rate, urban areas experience negligible changes, whereas rural areas experience 3% to 7% reductions in adjusted population-adjusted supply across these three occupations. Additionally, areas most heavily impacted by the Great Recession experience provider-to-population losses for RNs, psychologists, optometrists, and physical therapists. The reduction is particularly severe for psychologists, with a full 14% decline from the pre-recession level. Only the optometry occupational group demonstrates a clear rebound with the economic recovery among these harder hit areas. These findings therefore display both
transient and persistent consequences of the financial crisis for several key sources of health care labor.

Given the observed changes in supply for specific provider types, we then implement supplementary empirics focused on patients’ emergency department (ED) consumption patterns. The analytic data reflect the universe of ED encounters across the state and lend themselves to empirical approaches closely aligned with those used in the workforce analyses. The results reveal greater ED reliance in areas experiencing a worsening economy, and more specifically, areas suffering provider losses due to the Great Recession witness a larger ED burden for plausibly-linked health problems. For example, people living in areas with the highest recession-induced decline in supply of psychologists per capita increased their mental health-related ED encounters by as much as 25 percentage points over those living in the least supply-affected areas. To our knowledge, this is the first paper to empirically connect these supply and ED consumption changes tied to economic downturns, as well as widen our understanding of the negative consequences from severe recessions.

2. Data

While existing work has considered the effects of the recession on RNs, licensed practical nurses (LPNs), nurse aids, and physicians, supply and demand for the health workforce differs significantly across skill types (Konetzka et al. 2018; Chen, Lo Sasso, and Richards 2018). For example, demand is projected to outstrip supply for ophthalmologists, but the opposite is forecasted for optometrists (with a doctorate of optometry degree) and ophthalmology physician assistants.² Other work highlights the potential for much of the predicted new jobs to be tailored

² These statistics are from the National Center for Health Workforce Analysis (2016 a,b) and can be found here: https://bhw.hrsa.gov/sites/default/files/bhw/nchwa/projections/visionoccupations.pdf and here:
toward those with more limited educational backgrounds and clinical credentials (Frogner 2018; Frogner et al. 2015). We therefore leverage the breadth of North Carolina health care workforce data available to us to estimate the effects of a worsening macroeconomy on the labor supply of 12 different components—including nurses (LPNs, RNs, and Nurse Practitioners), those with doctoral level training (dentists, optometrists, pharmacists, and physicians), therapists (occupational therapists, physical therapists, and psychologists), chiropractors, and physician assistants. Importantly, these dozen different occupations span the gamut of skill levels as well as provider scarcity levels.

Our primary data come from the North Carolina Health Professions Data System (HPDS), which is maintained by the Program on Health Workforce Research and Policy of the University of North Carolina at Chapel Hill. The state’s Area Health Education Centers Program and independent licensing boards for health professionals help contribute to and maintain the database. County-level health professional counts reflect active workers holding the specific state license as of October 31st in a given calendar year and simultaneously reporting a given county as their primary practice location. In this way, the data capture the contemporary stock of health care workers net of all inflows and outflows from the previous year. The data admittedly cannot separate entry and exit behaviors for a given labor type, however.

3. Empirical Strategy

We apply two separate analytic strategies to the data in order to compare inferences across approaches and to more precisely capture the direct effects of the most recent financial crisis and its subsequent recession. This latter element is accomplished via a methodology that we believe is

both novel to the most closely related literature and credible in our analytic context. The following subsections describe each empirical strategy in detail.

3.1 County-level unemployment rate changes

Our first empirical approach closely follows Konetzka and colleagues’ (2018) recent contribution that uses microdata from the state of California’s nursing home industry to explore the effect of business cycle fluctuations on the supply and skill types of employed nurses. In a similar fashion, we use our North Carolina workforce data to implement a standard two-way fixed effects model that exploits the annual variation in county-level unemployment rates publicly provided by the US Bureau of Labor Statistics (BLS).

A sense of the within-year as well as temporal variation in county-level unemployment rates can be gleaned from Figure 1. In 2008, few North Carolina counties had unemployment rates at or above 10%, but the distribution shifts right following the financial crisis (i.e., 2010 and 2012 plots in Figure 1) with far greater dispersion across the state. For example, the median North Carolina county has an unemployment rate greater than 10% in 2010, and some counties have nearly a fifth of their potential workforce without a job in that year. However, by 2015, the state has largely recovered from the downturn.

The corresponding regression model is straightforward:

\[ Y_{ct} = \delta Unemployment_{c(t-1)} + \eta_t + \lambda_c + \epsilon_{ct} \]  

The outcome (\(Y\)) captures the aggregate number of licensed professionals belonging to a given occupation scaled by the county’s total population (i.e., transformed into a per 10,000 population measure) in a county-year pair. Our key right-hand side variable is the county-level unemployment rate modeled with a one-year lag—making the \(\delta\) parameter our focal coefficient. We include full
vectors of year ($\eta$) and county ($\lambda$) fixed effects and believe the lagged structure for the unemployment rate variable best aligns with the annualized nature of our data and how macroeconomic shifts are likely to transmit through the state licensing process for health care professionals.

As previously mentioned, we can enrich the model belonging to Equation 1 by introducing a county-level rural indicator. The resulting specification is:

$$Y_{ct} = \delta Unemployment_{c(t-1)} + \phi Rural_c + \gamma (Unemployment * Rural)_{c(t-1)} + \eta_t + \lambda_c + \varepsilon_{ct} \quad (2)$$

The $\delta$ parameter recovers the unemployment rate effect on our labor supply outcomes for non-rural counties; meanwhile, the $\gamma$ parameter provides our statistical test for rural area heterogeneity, which can be added to $\delta$ to calculate the full economic downturn effect on rural health care workforce labor supply.

Note that the Rural indicator variable in Equation 2 is time invariant by construction and therefore subsumed by the county fixed effects when estimating the model. We have also deliberately avoided common demographic covariates in our estimating equations since their inclusion risks placing potential outcomes (i.e., “bad controls”) on the right-hand side, which would subsequently bias our key estimates in unknown directions. Our estimates therefore capture the total effects of the recession on provider supply, as opposed to the partial effects conditional on demographic shifts and their effects on provider supply. All standard errors are clustered at the county level throughout the analyses (100 counties in total for the state).

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$Rurality$ is defined using county-level information from the Area Health Resources File (AHRF) on the percent of the population categorized as living in a rural area. For ease of interpretation, we create a fixed indicator for being rural, which is defined as a county in the top quartile of all North Carolina counties in terms of the share of population classified as rural in 2000 (the initial year of our analytic data). Of note, using the 2010 information (all provided in the AHRF data file) instead of 2000 information generates an alternative rural indicator with 79% agreement with our chosen approach. Thus, rurality ranking appears quite persistent in the state over time.
3.2 Financial crisis shock heterogeneity

Our second analytic strategy aims to more directly model the effects of the recent Great Recession. An immediate challenge of this empirical exercise is the fact that no county in the state is likely to be unaffected by the financial crisis and its subsequent fallout. This precludes a simple difference-in-differences (DD) research design; however, we implement a tractable estimation approach that is similar in spirit by leveraging the considerable heterogeneity in the depth of the downturn across different areas within the state.

The variation in the Great Recession impact (or ‘treatment intensity’) is evident in Figure 2, which displays the unemployment rate change from 2007 (the year immediately preceding the financial crisis) to 2010 (arguably the labor market’s nadir—e.g., see Figure 1) for each North Carolina county. Much of the state experienced an aggregate employment decline of 5- to 8-percentage points; however, subsets of counties experienced a relatively lighter economic downturn (e.g., less than 4 percentage points) while others suffered much worse (e.g., more than 10 percentage points).

Next, we stratify the distribution of recession-induced unemployment rate changes into quartiles and plot the corresponding average unemployment rates per quartile in Figure 3. The counties most severely impacted by the recent recession also have higher unemployment rates prior to the financial crisis (i.e., from 2000 to 2007), on average. But importantly, these differences in average unemployment rates across strata are virtually constant prior to the timing of the national recession. It is not until 2009 and 2010 that the unemployment rate trends differentially diverge between the most and least affected counties. The unemployment rate is approximately 50% higher in those counties experiencing a sharper decline during the midst of the recession and
remains elevated over the pre-period differential until well into the recovery period (i.e., 2014 and 2015).

Given these facts from the data, we can exploit the pre-recession fixed differences across county types (i.e., those facing a relatively severe versus weak downturn) and variation in treatment intensity from the Great Recession in order to implement a quasi-difference-in-differences estimation strategy. We limit the sample to the first and fourth quartiles in terms of recession impact from Figure 3 and compare the two quartiles using both a two-by-two DD and an event study setup. The former is estimated by:

\[ Y_{ct} = \zeta \text{HardHit}_c + \theta \text{Post}_t + \delta (\text{HardHit} \ast \text{Post})_{ct} + \lambda_c + \varepsilon_{ct} \]  

(3)

The outcome \( Y \) of interest is again our rate (per 10,000 population) measure of health care labor supply for a given county-year. The time invariant HardHit binary variable is equal to one for those counties belonging to the fourth quartile in terms of Great Recession bite and zero for those in the first quartile. Post is equal to one for the years 2009-2015 in order to demarcate the post-financial-crisis period.\(^4\) We maintain our county fixed effects (\( \lambda \)), and the \( \delta \) parameter in Equation 3 generates our quasi-DD estimate of interest. More specifically, the quasi-DD estimate captures any differential changes in the local health care workforce (per 10,000 population) as a consequence of experiencing a more severe economic downturn following the financial crisis.

To strengthen the credibility of this approach and our resulting inferences, we exploit our extensive time series, which spans well-before the Great Recession and many years after. We adapt the quasi-DD estimation from Equation 3 to the following event study model:

\[ Y_{ct} = \zeta \text{HardHit}_c + \sum_{j=2000}^{2015} \kappa_j \text{Year}_{(c-j)} + \sum_{j=2000}^{2015} \delta_j (\text{HardHit} \ast \text{Year})_{c(t-j)} + \lambda_c + \varepsilon_{ct} \]  

(4)

\(^4\) Recall, Lehman Brothers filed for bankruptcy in September of 2008.
The analytic intent and coefficient interpretations for Equation 4 closely follow Equation 3. The key modification is that we allow for individual year differentials in health care workforce supply across the counties most and least impacted by the recession. Each of these differential estimates is relative to 2007—the year just prior to the financial crisis and start of the downturn. We subsequently use the yearly estimates over the 2000-2006 period to ascertain that the respective labor supplies are trending in parallel prior to the Great Recession, which is required for a strong DD design. Moreover, parallel labor supply tracking across groups from 2000-2006 would align with the stable average unemployment rate trends demonstrated in Figure 3 and therefore support new divergence in the provider workforce as a recession-driven change. Additionally, the 2008-2015 estimates have the benefit of revealing any evolutions in labor supply outcomes over the short- and long-run since our analytic window includes both the recession and recovery periods. This allows us to separate out transient versus more permanent downstream consequences for the local health care workforce as well as reflect any dynamic effects belonging to the business cycle. We again cluster our standard errors at the county level throughout.

4. Results

4.1 Effects of local business cycle fluctuations

Table 1 displays the business cycle results for our first estimating equation (Equation 1). The effect of a 1%-percentage point change in the prior year’s local unemployment rate only corresponds to statistically significant declines in the provider-to-population ratios for some middle-skill groups (i.e., RNs and psychologists) and ancillary provider types (i.e., occupational therapists and optometrists). Any supply fluctuations within the other clinical provider groups (i.e., LPNs, NPs, PA, dentists, physicians, pharmacists, physical therapists, and chiropractors) appears to be in
proportion to contractions or expansions in the local population size. In terms of relative magnitude, a 1-percentage point increase in the unemployment rate corresponds to a 1.2% fall in the supply of RNs per capita relative to the analytic sample mean. Likewise, the relative availability of occupational therapists and psychologists declines by 2.6% and 5%, respectively. Given evidence of increased mental health concerns during recessions (Cagney et al. 2014; Frasquilho et al. 2016), as well as the mental and behavioral health shortage problems commonly reported, the reduction in psychologists is particularly noteworthy. The optometrist supply measure is also reduced by 2.2%, on average, but the coefficient is less precisely estimated (column 12, Table 1).

The estimation and results belonging to Table 2 allow for any heterogeneity in business cycle effects within rural areas (i.e., using Equation 2 from Section 3). Interestingly, the effect of a worsening economy on RN supply per capita largely localizes to more rural areas. Urban areas demonstrate a less than a 0.1% decline while rural areas experience a 3% decline with each 1-percentage point increase in the local unemployment rate (column 2, Table 2). Columns 4 and 5 in Table 2 (physician assistants and physicians, respectively) reveal that results in Table 1 masked some substantive losses of physicians per capita and physician assistants per capita in rural areas experiencing an economic downturn. Physician availability drops by 4.2% after a 1-percentage point increase in the unemployment rate while physician assistant availability is nearly 7% lower, which suggests greater sensitivity to business cycle fluctuations for labor that is likely complementary to physician care. There is also suggestive evidence of fewer pharmacists per

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5 Throughout the analysis, supply estimates per capita are measured per 10,000 population.
7 Recall, the total effect for rural areas is the constitutive term coefficient added to the interaction term coefficient.
8 Physician assistants would not practice independent of physician oversight, for example.
capita working in rural areas with a worsening economy (column 7, Table 2)—though the coefficient is not tightly estimated. There is no detectable heterogeneity for the occupational therapist or psychologist provider types, which also have a vanishingly small presence in rural areas overall.

4.2 Effects of the Great Recession

We now move to our second empirical strategy (i.e., the quasi-DD approach) in order to model the effects of the Great Recession more directly and transparently. Table 3 offers basic summary characteristics (for the 2007 year) for our two groups of North Carolina counties used in the subsequent estimation. The percentage point change in the average unemployment rate between 2007 and 2010 is approximately 70% larger for the hardest hit counties when compared to counties more lightly affected by the financial crisis (i.e., mean of 8.3 relative to 4.9). At the same time, these quasi-treated counties tend to have smaller but also more insured populations, with less of their residents located in designated rural areas.

Table 4 presents the simple two-by-two quasi-DD estimates for RNs, psychologists, optometrists, and physical therapists.\(^9\) While the provider-to-population ratios are either stable or growing over time in less recession-impacted counties (as indicated by the “Post Recession” coefficients in Table 4), they are increasing more slowly, if not declining, among North Carolina counties disproportionately harmed by the Great Recession. The quasi-DD estimate for RNs suggests a post-period increase in the ratio that is less than half as large for these areas—though the coefficient lacks sufficient precision. Likewise, the provider-to-population ratio for physical therapists only improves by about half as much within hard-hit counties. Importantly, the

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\(^9\) No compelling effects emerge for the other health care occupations available in the data (results available by request).
corresponding ratios for psychologists and optometrists demonstrate negative per capita supply changes following the recession (columns 2 and 3, Table 4). The net losses are 14% and 10%, respectively, for these health care occupations.

Figures 4 and 5 offer the corresponding event study results. All four occupations demonstrate stable pre-recession trends across these two sets of North Carolina counties, with annual differentials that are never statistically different from zero during the 2000-2006 timeframe. The RN-to.population ratio has a growing decline within the hardest hit areas that eventually stabilizes by 2012 (Figure 4). However, the negative recession effect on the psychologist-to.population ratio in Figure 4 persistently worsens during the post-period within counties most impacted by the financial crisis. The pattern suggests a substantive long-run consequence for mental health care delivery in these areas. Within Figure 5, The recession effects on optometrists more closely follows the business cycle. During the period of economic contraction, the quasi-DD estimates show differential declines in the provider-to.population ratio in hard-hit areas, but the divergence disappears with the economic recovery (i.e., over the 2013-2015 period). Conversely, these same counties experience a recession-driven reduction in the physical therapist-to.population ratio that fails to reverse during the macroeconomy’s expansionary period.

5. Supplementary Analyses: Emergency Department Discharge Data

Existing empirical research finds links between health care consumption and health outcomes with the business cycle (e.g., see Cutler, Huang, and Lleras-Muney 2015; Lusardi, Schneider, and Tufano 2015; Maclean 2013; McInerney, Mellor, and Nicholas 2013; Ruhm 2000, 2003, 2007, 2015; Tefft and Kageleiry 2014). However, there is little or no work exploring if, and how, changes in the local provider supply could moderate these relationships. We consequently build off of the
insights gleaned from the supply-side results in Section 4 to see if access to care indeed worsens in these same geographic areas.

5.1 Data
To assess the impacts of recession-induced changes in provider supply, we turn to health outcomes constructed from the North Carolina Hospital Discharge Data from 2007 to 2013. Reporting to a Statewide Data Processor, all hospitals in North Carolina are required to provide information on the universe of emergency department (ED) visits, including patient characteristics, clinical information such as diagnosis and procedure codes, length of stay, payer information, charge information, and admission source. Of note, data are not available prior to 2007, and we construct each county-level ED visit volume time series to be at the annual level to mirror the workforce data analyses. However, for the event study model discussed next, we take advantage of the finer-grain time dimension to analyze the data at the half-year (biannual) level in order to have a greater number of pre-Great Recession observations.\(^\text{10}\)

To create a mapping between our health care workforce results and ED care utilization, we focus on ED visits for health problems that are plausibly linked to the typical services a given, skill-specific occupation is likely to supply to the market. These include ED visits for mental and behavioral health (psychologists), musculoskeletal conditions (occupational/physical therapists), and eye-related health problems (optometrists). ED encounters are categorized using the recorded ICD-9 codes attached to a given discharge record that reflect the primary reason for seeking care

\(^{10}\) The North Carolina ED discharge records classify a given encounter as emergent, urgent, or newborn/pregnancy related. We exclude the latter group of ED visits at the outset. Each year of data includes ED visits from the fourth quarter of the prior year to the third quarter of the current year. As such, we observe 100% of claims from 2006Q4 to 2013Q3, and our biannual data is therefore available from the beginning of 2007 to 2013 (2007H1 – 2013H1).
within the ED. For all three measures, we transform the levels into a per-100 population rate based on the patient’s county of residence, which we further use to link to local unemployment rate activity at the county-level. Our implicit assumption is that disease-specific increases in ED use can serve as a reasonable proxy for suboptimal management of or unmet need for the underlying health conditions. EDs are often seen as the last resort for individuals suffering from mental and behavioral health, for example, and recent trends suggest that the situation is, if anything, worsening.

5.2 Empirical approaches
We begin by re-estimating Equation 1, Equation 2, and Equation 4 from Section 3. The first two sets of estimates will identify how ED utilization rates change with an incremental increase in the local unemployment rate and if there is any heterogeneity across urban-rural geographies. The latter set of estimates will capture whether areas more strongly impacted by the Great Recession, relative to those least affected, experience a differential increase in ED reliance. We again use this quasi-DD setup to more directly quantify the influence of the Great Recession, specifically, and assess the degree of alignment with our corresponding health care workforce estimates.

Finally, we employ an alternative modeling strategy by slightly modifying Equation 3 to focus on counties within the fourth quartile of recession-driven supply per capita reductions. More specifically, we calculate changes in *predicted* healthcare supply (per 10,000 population)—as estimated from Equation 3—from the recession start in 2007 to its peak in 2010 ($\frac{Y_{2010}}{Y_{2007}}$) and

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11 We classify mental and behavioral health ED visits with ICD-9 codes 290-319 and ICD-10 codes F01-F99; musculoskeletal-related ED visits with ICD-9 codes 710-739 and ICD-10 codes M00-M99; and eye-related ED visits with ICD-9 codes 360-379 and ICD-10 codes H00-H59.

then define $SupplyHit_c$ as a time-invariant dummy equal to one if the recession created a relatively large supply (per capita) reduction in 2007. To capture corresponding changes in ED consumption, we next estimate:

$$Y_{ct} = \gamma SupplyHit_c + \theta Post_t + \delta(SupplyHit \ast Post)_{ct} + \lambda_c + \epsilon_{ct}$$ (5)

The $Post$ variable is equal to ‘1’ from the start of the Great Recession. The $SupplyHit$ variable is a binary (time-invariant) indicator for the subset of counties predicted to experience a relatively large supply per capita shocks starting in 2008. The delta parameter is the coefficient of interest, which we can then compare against the immediately prior estimation approaches. The standard errors are calculated using a county-level cluster bootstrap procedure.

5.3 Findings

Table 5 offers the results from our two-way fixed effects models. ED visits per capita increase by 2% with each 1-percentage point rise in the local unemployment rate, with the magnitude slightly smaller (1.7%) within more rural areas.\(^{13}\) Similar patterns emerge for specific ED encounters linked to mental health and musculoskeletal health problems. A worsening local economy corresponds to a 6.5% increase in ED reliance for mental health issues (column 3) and a 3% increase due to musculoskeletal problems. Again, there is either no rural-specific heterogeneity in the business cycle effect, or the impact is softer along these margins of care seeking behavior. This is perhaps not surprising since proximity to an ED can be considerably different for rural residents—likely making the transportation and time costs markedly higher. There is no detectable

\(^{13}\) Recall, throughout the discharge records analysis, ED visits per capita are measured per 100 population according to the patient’s county of residence.
association between greater unemployment and more ED visits for eye-related issues, however. All estimates in columns 7 and 8 lack sufficient precision in order to draw meaningful conclusions.

Figure 6 provides the event study results when using our quasi-DD approach that closely parallels the estimation underlying Figures 4 and 5 (Section 4). For ease of viewing and direct comparison, we have also superimposed the corresponding provider supply event study coefficients from Section 4. Consistent with the two-way fixed effects’ findings in Table 5 as well as the constellation of evidence from Section 4, we observe statistically significant and differential increases in ED use for the relevant disease groups among North Carolina counties disproportionately impacted by the financial crisis. Importantly, the effects grow with the declining economy before beginning to stabilize at higher relative levels in 2012 and onward, which aligns well with our results for psychologist labor supply (Figure 4) and physical therapist labor supply (Figure 5). Although eye-related ED encounters do not demonstrate strong differential changes in consumption patterns in the economically hard-hit areas, they do show a transient spike during the period of largest optometrist supply losses in these areas (Figure 5). This is, at least, suggestive of a corresponding short-run implication.

Finally, in Table 6, we present the findings from our alternative and complementary empirical approach (Equation 5), which further reinforce the interpretations from Table 5 and Figure 6. Local areas predicted to suffer the largest declines in the availability of relevant provider types simultaneously witness relatively larger reliance on ED-based care for mental health and musculoskeletal health problems. For instance, individuals living in areas with the smallest recession-induced supply reductions demonstrate increased ED visits by 32-38% post-recession, whereas individuals in areas with the largest recession-induced supply reductions show an additional 25 to 29 percentage point increase in ED visits. Taken together, residents of counties
unable to maintain (much less improve) their pre-recession provider-to-population ratios seem to be turning more often to emergency departments to meet their medical needs.

6. Discussion
Leveraging unique data and multiple estimation strategies, we show procyclical supply changes for a variety of health care occupations that differ in skill levels and scarcity. Given the prevalence of employer-sponsored health insurance among the under-age 65 population in the US, it is perhaps unsurprising that higher uninsured rates, which can lower demand and provider revenues, tend to be associated with softer labor markets for certain health care professionals.\footnote{Note, a series of studies have shown the direct link between a weaker economy and the prevalence of uninsured status within the US—e.g., see Cawley, Moriya, and Simon (2015), Cawley and Simon (2005), and Holahan (2011).}

Rural areas, in particular, suffer substantive losses of physicians and physician assistants as the surrounding unemployment rate rises, which may compound other contemporary access issues, such as rural hospital closures.\footnote{A recent report from the Kaiser Family Foundation on rural hospital closures can be found here: https://www.kff.org/report-section/a-look-at-rural-hospital-closures-and-implications-for-access-to-care-three-case-studies-issue-brief/.} Moreover, negative consequences that localize to rural areas is even more troubling in light of new evidence highlighting gaps in health care access among rural Americans—e.g., 25\% cannot report an inability to access needed care often because of insurmountable distances to providers.\footnote{A copy of the relevant report from NPR, RWJF, and the Harvard T.H. Chan School of Public Health can be found here: https://media.npr.org/documents/2019/may/NPR-RWJF-HARVARD_Rural_Poll_Part_2.pdf. A related news article is available here: https://www.npr.org/sections/health-shots/2019/05/21/725059882/poll-many-rural-americans-struggle-with-financial-insecurity-access-to-health-ca.} Our results also indicate that psychologists appear highly sensitive to fluctuations in the local economy, across each of our modeling approaches. For instance, areas most affected by the recent Great Recession witness a growing negative impact during the financial crisis fallout, with an average post-period decline of as much as 14\% when compared to 2007 ratio levels. Given that job loss is a significant personal stressor (e.g., Coope et
al. 2015) and recent US trends in “diseases of despair” (Case and Deaton 2015a,b), this suggests a potentially large and harmful imbalance between supply and demand related to mental illness.

Interestingly, we also tend to observe drops in the RN workforce across our different empirical approaches. Previous research points to countercyclical employment patterns for nurses during a worse economy, however (Beurhaus and Auerbach 2011; Staiger, Auerbach, and Buerhaus 2012; Yoo et al. 2007; Li, Richards, and Wing 2019). An explanation that reconciles these seemingly incongruent findings is the measurement of supply. Prior studies are focused on direct employment in the nursing field whereas our data capture the contemporary stock of RN professionals—who may be working full-time, part-time, or not at all in the moment. It seems possible that while the overall stock declines with a worsening economy (our findings) due to out-migration and/or restrained new labor entry, those that choose to remain are willing to work more (past findings) in order to smooth household consumption during a downturn. Our constellation of empirical results also supports closely related work that argues much of the health care sector’s employment resilience, and perhaps future growth, rests on lower skilled jobs. Middle- to high-skill occupations appear more responsive to the local business climate, which may reflect their generally higher-priced services and/or greater relative scarcity—and hence job mobility.

Our supplementary analyses using the North Carolina ED discharge data help illustrate the potential downstream ramifications of shrinking provider supply following a recession. For our provider types demonstrating the strongest sensitivity to the financial crisis, patients in those areas, who would likely rely on their services in normal times, appear to shift toward ED settings for care delivery. Doing so can burden EDs with excessive demand and also lead to inefficient medical spending—as EDs are known for being a highly expensive and often inappropriate setting for care.
Although we cannot quantify how much of the change in ED utilization is directly attributable to provider supply declines, the findings are compelling and mirror each other well.

As the US is believed to be late in the current business cycle, policymakers may once again be forced to grapple with a substantive economic downturn. Our results highlight the need to pay careful attention to geographic heterogeneity in a recession’s impact, and relatedly, how it can influence the availability of different health care providers. Subsequent distortions between health care supply and demand can be welfare reducing for local patients via unmet care needs and may drive inefficient downstream allocations of health care dollars (e.g., financing greater use of ED-based care, rather than more cost-effective alternatives).

References


Figure 1: North Carolina County-Level Unemployment Rate Distributions for Select Years

Notes: Data are publicly available and from the Bureau of Labor Statistics.
Figure 2: Variation in County-Level Changes in the Unemployment Rate Between 2007 and 2010

Notes: Data are publicly available and from the Bureau of Labor Statistics. The measure is a simple difference calculation for a given North Carolina county between 2007 and 2010.
Figure 3: Trends in Unemployment Rates Among Quartiles of Great Recession Impact

Notes: Quartiles are established according to the 2007-2010 unemployment rate change distribution shown in Figure 2.
Figure 4: Differential Changes in Provider-to-Population Ratio by Recession Bite

Notes: These are event study estimates, measured relative to year 2007, with 95% confidence intervals based on Equation 4 in Section 3.
Figure 5: Differential Changes in Provider-to-Population Ratio by Recession Bite

Notes: These are event study estimates, measured relative to year 2007, with 95% confidence intervals based on Equation 4 in Section 3.
Figure 6: Great Recession Differential Changes in ED Encounters (per 10,000 population) Tied to Specific Health Problems Linked to Specific Provider Types

Mental Health (Psychologists)

Musculoskeletal (Physical Therapists)

Eye-Related (Optometrists)

Notes: Data are from the universe of North Carolina emergency department (ED) encounters 2007-2013. The analytic strategy parallels that belonging to the labor supply results. The lines denote ED event study estimates, relative to 2007H2, with 95% confidence intervals. Each figure additionally displays the provider-specific event study coefficients from Figures 4 and 5. The mean ED discharge in 2007 for “hard hit” areas are 4.7, 4.1, and 0.5, respectively.
Table 1: Local Unemployment Rate Effect on Aggregate Provider Supply (Per 10,000 Population)

<table>
<thead>
<tr>
<th></th>
<th>LPN</th>
<th>RN</th>
<th>NP</th>
<th>PA</th>
<th>Dentist</th>
<th>Physician</th>
<th>Pharmacist</th>
<th>OT</th>
<th>PT</th>
<th>Pysch</th>
<th>Chiropractor</th>
<th>Optometrist</th>
</tr>
</thead>
<tbody>
<tr>
<td>UE (t-1)</td>
<td>-0.07</td>
<td>-0.90**</td>
<td>-0.07</td>
<td>-0.04</td>
<td>0.00</td>
<td>-0.12</td>
<td>-0.03</td>
<td>-0.05***</td>
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<tr>
<td></td>
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<td>(0.08)</td>
<td>(0.05)</td>
<td>(0.02)</td>
<td>(0.04)</td>
<td>(0.03)</td>
<td>(0.02)</td>
<td>(0.01)</td>
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<td>1,500</td>
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<tr>
<td>Sample Mean</td>
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<td>3.1</td>
<td>14.3</td>
<td>7.1</td>
<td>1.9</td>
<td>3.4</td>
<td>1.2</td>
<td>1.1</td>
<td>0.9</td>
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*** P value at 0.01 ** P value at 0.05 * P value at 0.10, standard errors clustered at the county level
Table 2: Local Unemployment Rate Effect on Aggregate Provider Supply (Per 10,000 Population) with Rural Heterogeneity

<table>
<thead>
<tr>
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<th>LPN</th>
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<th>Dentist</th>
<th>Pharmacist</th>
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<th>PT</th>
<th>Pysch</th>
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<td>-0.01</td>
<td>-0.05</td>
<td>-0.01</td>
<td>-0.05***</td>
<td>-0.04</td>
<td>-0.05**</td>
<td>-0.02</td>
<td>-0.02</td>
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<td>-0.76**</td>
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<td>-0.10**</td>
<td>-0.24***</td>
<td>0.04***</td>
<td>-0.06*</td>
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<td>Year FE</td>
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<td>1,500</td>
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<td>1,500</td>
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<td>1,500</td>
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<tr>
<td>Nonrural Mean</td>
<td>20.5</td>
<td>80.5</td>
<td>2.9</td>
<td>2.9</td>
<td>16.8</td>
<td>3.5</td>
<td>8.0</td>
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<td>3.8</td>
<td>1.4</td>
<td>1.3</td>
<td>1.0</td>
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<tr>
<td>Rural Mean</td>
<td>17.6</td>
<td>45.7</td>
<td>2.5</td>
<td>1.6</td>
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<td>2.0</td>
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<td>2.2</td>
<td>0.5</td>
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*** P value at 0.01 ** P value at 0.05 * P value at 0.10, standard errors clustered at the county level
Table 3: 2007 Summary Characteristics for the Bottom and Top Quartiles in Terms of Great Recession Impact

<table>
<thead>
<tr>
<th></th>
<th>Weakest Hit Counties</th>
<th>Hardest Hit Counties</th>
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<tbody>
<tr>
<td>Population</td>
<td>100,058</td>
<td>60,044</td>
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<tr>
<td>Share Rural (%)</td>
<td>24.0</td>
<td>17.4</td>
</tr>
<tr>
<td>Uninsured (%)</td>
<td>20.0</td>
<td>17.5</td>
</tr>
<tr>
<td>UE 2007-2010 Change (ppt)</td>
<td>4.9</td>
<td>8.3</td>
</tr>
<tr>
<td>No. Counties</td>
<td>25</td>
<td>23</td>
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Table 4: Quasi-Difference-in-Differences Estimates for Changes in the Provider-to-Population Ratio According to the Great Recession Impact

<table>
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<tr>
<th></th>
<th>RN</th>
<th>Psych</th>
<th>Optometrist</th>
<th>PT</th>
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<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Post Recession</td>
<td>8.46***</td>
<td>0.35***</td>
<td>0.06</td>
<td>1.13***</td>
</tr>
<tr>
<td></td>
<td>(2.83)</td>
<td>(0.13)</td>
<td>(0.04)</td>
<td>(0.19)</td>
</tr>
<tr>
<td>Hard Hit * Post Recession</td>
<td>-4.73</td>
<td>-0.42***</td>
<td>-0.14*</td>
<td>-0.51**</td>
</tr>
<tr>
<td></td>
<td>(3.27)</td>
<td>(0.15)</td>
<td>(0.08)</td>
<td>(0.25)</td>
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<tr>
<td>County FE</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>768</td>
<td>768</td>
<td>768</td>
<td>768</td>
</tr>
<tr>
<td>Hard Hit 2007</td>
<td>67.4</td>
<td>0.5</td>
<td>0.8</td>
<td>2.5</td>
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</table>

*** P value at 0.01 ** P value at 0.05 * P value at 0.10, standard errors clustered at the county level. Analytic data restricts to the first and fourth quartile in terms of 2007-2010 changes in unemployment rate. “Hard Hit” counties are those in the top quartile (i.e., suffering the worst of the Great Recession). “Post Recession” is equal to one for the 2009-2015 period.
Table 5: Local Unemployment Rate Effect on Aggregate ED Encounters (Per 10,000 Population)—Overall and by Health Problem

<table>
<thead>
<tr>
<th>Underlying Health Problem</th>
<th>All</th>
<th>Mental Health</th>
<th>Musculoskeletal</th>
<th>Eye-Related</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>UE (t-1)</td>
<td>1.12***</td>
<td>1.31***</td>
<td>0.75***</td>
<td>0.79***</td>
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<tr>
<td></td>
<td>(0.38)</td>
<td>(0.39)</td>
<td>(0.19)</td>
<td>(0.19)</td>
</tr>
<tr>
<td>UE (t-1) * Rural County FE</td>
<td>-0.52***</td>
<td>-0.11</td>
<td>-0.25***</td>
<td>-0.01</td>
</tr>
<tr>
<td></td>
<td>(0.24)</td>
<td>(0.13)</td>
<td>(0.08)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Obs. (N)</td>
<td>700</td>
<td>700</td>
<td>700</td>
<td>700</td>
</tr>
<tr>
<td>Sample Mean</td>
<td>53.0</td>
<td>53.0</td>
<td>11.6</td>
<td>11.6</td>
</tr>
<tr>
<td>Nonrural Mean</td>
<td>55.3</td>
<td>12.3</td>
<td>12.3</td>
<td>11.1</td>
</tr>
<tr>
<td>Rural Mean</td>
<td>46.3</td>
<td>9.8</td>
<td>9.8</td>
<td>9.2</td>
</tr>
</tbody>
</table>

*** P value at 0.01 ** P value at 0.05 * P value at 0.10, standard errors clustered at the county level. Analytic data are from the universe of North Carolina emergency department (ED) data and are at the biannual level. County-level unemployment rates are matched to patients’ county of residence. Mental Health, Musculoskeletal, and Eye-Related ED encounters are determined by the associated ICD-9 or ICD-10 codes listed as the primary reason for the patient’s ED visit.
Table 6: Alternative Estimation for Excess ED Burden (per 10,000 population) Due to Great Recession Health Care Labor Supply Shock

<table>
<thead>
<tr>
<th>Underlying Health Problem</th>
<th>Mental Health</th>
<th>Musculoskeletal</th>
<th>Eye-Related</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Post Recession</td>
<td>2.010***</td>
<td>1.413***</td>
<td>0.134***</td>
</tr>
<tr>
<td></td>
<td>(0.315)</td>
<td>(0.563)</td>
<td>(0.0267)</td>
</tr>
<tr>
<td>Post Recession * Predicted Strongest Supply Shock</td>
<td>1.538***</td>
<td>1.004***</td>
<td>0.0207</td>
</tr>
<tr>
<td></td>
<td>(0.589)</td>
<td>(0.395)</td>
<td>(0.0516)</td>
</tr>
<tr>
<td>Unique Counties</td>
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<td>50</td>
</tr>
<tr>
<td>Observations (N)</td>
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<td>650</td>
<td>650</td>
</tr>
<tr>
<td>Predicted Strongest Supply Shock</td>
<td>5.2</td>
<td>4.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Shock Mean 2007</td>
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</table>

*** P value at 0.01 ** P value at 0.05 * P value at 0.10, standard errors are cluster bootstrapped at the county level. Analytic data are from the universe of North Carolina emergency department (ED) discharge records, 2007-2013. “Predicted Strongest Supply Shock” is equal to one for counties within the first quartile of predicted health care workforce supply change— for psychiatrists, physical therapists, and optometrists in columns 1-3, respectively—between 2007 and 2010 identified from variation in the Great Recession impact across the state.