

NBER WORKING PAPER SERIES

OCCUPATIONAL LICENSING AND THE HEALTHCARE LABOR MARKET

Marcus Dillender
Anthony T. Lo Sasso
Brian J. Phelan
Michael R. Richards

Working Paper 29665
<http://www.nber.org/papers/w29665>

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
January 2022, Revised July 2022

We thank Sara Markowitz for her very helpful comments on an earlier version of this paper. Lo Sasso gratefully acknowledges a grant for acquiring the data used in this research from the Charles Koch Foundation. The views expressed herein are those of the authors and do not necessarily reflect the views of affiliated organizations or the National Bureau of Economic Research.

NBER working papers are circulated for discussion and comment purposes. They have not been peer-reviewed or been subject to the review by the NBER Board of Directors that accompanies official NBER publications.

© 2022 by Marcus Dillender, Anthony T. Lo Sasso, Brian J. Phelan, and Michael R. Richards. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

Occupational Licensing and the Healthcare Labor Market

Marcus Dillender, Anthony T. Lo Sasso, Brian J. Phelan, and Michael R. Richards

NBER Working Paper No. 29665

January 2022, Revised July 2022

JEL No. I11,J44

ABSTRACT

We examine the labor market impact of states easing occupational license requirements by expanding the scope of practice (SOP) for nurse practitioners (NPs), allowing them to practice without physician oversight. Using data on job postings, we find that employers increase their demand for NPs when states expand NP SOP. We then show that SOP laws also increase NP earnings and reallocate NPs across the healthcare sector, including increasing self-employment, but do not increase overall NP employment. Thus, expanding NP SOP has the potential to increase access to primary care, but inelastic NP labor supply has largely prevented this from occurring.

Marcus Dillender
Health Policy and Administration
University of Illinois at Chicago
1603 W. Taylor Street
Chicago, IL 60612
and NBER
modillen@uic.edu

Anthony T. Lo Sasso
Economics Department
DePaul University
1 East Jackson
Chicago, IL 60604
alosasso@depaul.edu

Brian J. Phelan
Department of Economics
DePaul University
1 East Jackson Blvd.
Chicago, IL 60604
bphelan2@depaul.edu

Michael R. Richards
Baylor University
Department of Economics
One Bear Place #98003
Waco, TX 76798
michael_richards@baylor.edu

1 Introduction

A growing number of occupations in the United States require workers to obtain a government-issued license that sets forth the tasks they are legally allowed to perform, with nearly 30 percent of American workers currently licensed by the government (Kleiner and Krueger 2013). Despite this growth, the effects of occupational licensing on market efficiency and outcomes remain unclear and likely vary across settings. Occupational licenses may harm market outcomes because they artificially limit the supply of workers—raising some workers’ wages, limiting output, and increasing consumer prices. However, occupational licenses could improve market outcomes because they help ensure some minimum level of service quality, which could increase consumer demand if there is customer uncertainty about service quality (Kleiner 2000).¹ In this regard, the benefits of licensing will be larger when service quality varies a lot across providers, when informational asymmetries about quality are high, or when the costs/benefits of service quality are substantial. Thus, the debate about occupational licensing often boils down to comparing the service quality improvements associated with licensing with the distortions created in the labor and product markets that result (Cramer and Krueger 2016).

Occupational licensing is particularly common in the healthcare sector, where more than 75 percent of non-physician practitioners are required to be licensed (Kleiner and Park 2010; Nicholson and Propper 2011). The ubiquity of licensing in the healthcare sector likely stems from the importance of providing quality healthcare services, the potential for large differences in service quality across providers, and the high degree of patient uncertainty about provider quality. Occupational licenses in the healthcare sector are also characterized by a clearly delineated “scope of practice” (SOP), which describes the set of actions that an occupational license allows the relevant healthcare provider to legally perform. The stated rationale for limiting non-physician SOP—like most occupational licenses—centers on the

¹Certifications are another way that the government can offer some quality control in a marketplace. Occupational licenses differ from certifications in that only licensed workers can be employed in occupations that require licenses while anyone can work in an occupation that has certifications (whether they have the certification or not). From a consumer’s point of view, licensing requires the consumer to purchase the service from a licensed provider while certification gives consumers the option of buying from a certified provider or not. See Kleiner (2000) for more details on this distinction.

need to ensure patient safety. That said, excessive licensing and overly restrictive SOP in the healthcare sector could unnecessarily limit access to medical care and contribute to rising healthcare costs (Kleiner and Park 2010; Wing and Marier 2014; Timmons 2017)—two problems that continue to plague the sector.

In this paper, we study the healthcare labor market impacts of states expanding nurse practitioners’ (NPs) scope of practice and allowing them to provide primary care without direct physician oversight.² The outright removal of an occupational license requirement would more directly affect labor supply since the license itself acts as a barrier to entry. However, the expansion of NP SOP should more directly affect labor demand for NPs as the new regulations simply increase the set of actions that an already licensed healthcare provider can legally perform.³ Thus, we examine how NP SOP laws affect labor demand and labor market outcomes for a range of healthcare professionals to better understand whether restrictive NP SOP laws are indeed limiting access to primary care and raising healthcare costs. Our emphasis on labor demand represents an important advance over previous research.

This paper fits into a broad literature evaluating the benefits and costs of restrictive SOP rules for healthcare professions. Physician organizations, in particular, have championed restricting the scope of practice for non-physician healthcare occupations and argue that expanding the scope of practice of non-physician providers harms patients’ health.⁴ However, research on the effect of expanded NP SOP on patients’ outcomes finds evidence that is inconsistent with this claim. Kleiner et al. (2016) find that laws expanding SOP for NPs did not impact the quality and safety of health services. Additionally, Alexander and Schnell (2019) find that expanded NP SOP is associated with improvements in self-reported mental health and decreases in mental health-related mortality.⁵

²Oversight in this context can take a variety of forms ranging from the co-provision of a given service to periodic reviews of NP care delivery and decision-making.

³See Markowitz and Adams (2022) for a discussion of the ways in which expanded NP SOP could impact labor supply for NPs.

⁴For example, see “Why Expanding APRN Scope of Practice Is Bad Idea,” by American Medical Association (AMA) reporter Andis Robeznieks, posted to AMA website on 10/30/20.

⁵Expanded SOP for other healthcare occupations has also shown no negative effects on health outcomes. For example, Markowitz et al. (2017) find that expanding SOP laws for certified nurse midwives did not impact maternal or infant health outcomes.

The potential downsides associated with restricting NP SOP are that it may inflate healthcare costs and limit access to primary care by maintaining physicians' centrality to the production process. Indeed, Perry (2009) and Kleiner et al. (2016) both find that expansion of NP SOP lowered physician earnings and raised NP earnings, suggesting that restraining NP substitutability raises demand for costly physicians, leading to elevated physician salaries and potentially higher primary care spending. Relatedly, Kleiner et al. (2016) also show that expanded NP SOP decreased the transaction price of well-child visits by 3-16 percent, consistent with the potential for expanded NP utilization to decrease primary care costs. Yet, there is limited information regarding the extent to which expanded NP SOP increases the number of primary care providers (and thus, access to primary care), and in particular the mechanisms behind such changes. Evidence on the impact of expanded NP SOP on access to primary care is more limited but consistent with expanded SOP increasing access. Traczynski and Udalova (2018) find that broadening SOP laws for NPs led to increased frequency of check-ups and reduced emergency room use; Poghosyan et al. (2019) find that states that expanded NP SOP provided greater intensity of care for Medicaid patients; and Alexander and Schnell (2019) find that the positive mental health effects associated with expanded NP SOP tend to be stronger in areas (and among populations) traditionally underserved by physicians, which is suggestive of increases in access to healthcare.⁶

While the existing literature finds largely positive effects of expanding NP SOP, much remains unknown. Our paper makes important contributions to this literature and the broader literature on occupational licensing by examining how expanding NP SOP affects labor demand for NPs and other health care professionals using data on job postings from Burning Glass Technologies (BGT). Our analysis of labor demand allows us to examine whether healthcare organizations truly view physician oversight of NPs as necessary to provide quality care—rather than having to rely on what physician groups with a vested interest say—and thus, whether expanded NP SOP has the potential to increase access to

⁶On the contrary, Smith (2022) finds that expanded NP SOP did not change the volume of patients nor the provision of low-value services performed by NPs at primary care practices, suggesting that expanded NP SOP did not increase the primary care duties of NPs. Moreover, Markowitz and Adams (2022) find no effects for NPs on employment probabilities, part-time work, holding multiple jobs, and relocation associated with earlier changes in NP SOP laws, but positive effects on self-employment for NPs. Luo et al. (2021), however, find that NP SOP laws were associated with an increase in hours worked.

primary care. In this way, our analysis of the labor demand response by employers is a litmus test for whether physician claims surrounding non-physician care are credible in this context. The BGT data also allow us to examine whether the effects on demand vary across geographic areas and whether the skill demands for NPs have changed as NPs are allowed to practice independently.

We then examine how this change in labor demand manifests itself into equilibrium outcomes using the American Community Survey (ACS) including overall employment and place of service. This two-pronged empirical approach allows us to disentangle labor demand effects from labor supply effects, which may be much slower to respond to changes in SOP given the significant time investments necessary to become a nurse practitioner. Thus, even if expanding SOP for NPs increases demand for NPs, it may not be enough to increase the number of primary care providers due to frictions associated with NP labor supply. That said, an increase in primary care providers could also come from reallocating NPs across the healthcare sector. For example, if NPs seek out different job settings when granted clinical independence, such as self-employment or shifting into privately-owned clinics, this reallocation could potentially reduce geographic access disparities, increase the number of NPs engaged in primary care, and encourage greater provider competition—even if the quantity of providers is unchanged.

Using a difference-in-differences research design over the period 2010-2019, we find that expanded NP SOP increases the number of job postings for NPs without affecting the number of job postings for primary care physicians (PCPs), physician assistants (PA), registered nurses (RN), or licensed practical nurses (LPN). The estimated effect is quite large with job postings for NPs increasing by about 30 percent. However, the effect occurs with a lag and only becomes evident beginning two years after SOP adoption. Interestingly, demand for NPs increases by similar proportions in both health professional shortage areas (HPSA) and non-HPSAs. Moreover, we do not find that expanded SOP substantively changes the skill demands listed in NP job postings. Thus, the more favorable regulatory environment did not lead to different types of NPs being desired by employers or alter employers' expectations about the tasks NPs would perform. Rather, the increase in job postings simply reflect an overall increase in demand for NPs.

This change in NP labor demand is also evident in the ACS analysis, where we find that expanding NP SOP increased earnings for NPs but did not change overall NP employment. Expanded NP SOP, however, does appear to reallocate NP employment across the healthcare industry, increasing self-employment among NPs and shifting the employment of NPs away from hospitals and towards outpatient care centers. This reallocation could be associated with an increase in the number of primary care providers, but we do not have the relevant data to make this case definitively. Taken together, our results imply that expanding SOP for NPs increases labor demand for NPs and thus, has the potential to increase the number of primary care providers. However, inelastic labor supply for NPs is largely preventing this from occurring, at least in the short-run.

Our work makes important contributions to the literature on occupational licensing in the healthcare industry. We expand upon the analysis in Kleiner et al. (2016) by quantifying how full clinical independence of NPs affects labor demand, place of employment, and ultimately access to primary care. Our findings speak to employers' beliefs about NP quality of care and the overall potential for NP SOP to increase access to primary care. In this way, our research sheds further light on the efficiency and effectiveness of the healthcare workforce (e.g., see Nicholson and Propper 2011). Our work also makes important contributions to the broader literature on occupational licensing – showing that it is not just the license itself but also restrictions within the license that matter, affecting labor and product market outcomes. Lastly, we show that occupational licenses, both generally and in terms of the specific requirements associated with them, have the potential to impact the industrial organization within a market including the geographic allocation of firms and number of competitors.

2 Background

Below we provide details on scope of practice laws as well as a basic conceptual framework for considering their effects on healthcare labor markets.

2.1 Scope of Practice Laws

The nurse practitioner profession began with a certificate program in the 1960s that aimed to provide nurses with the training to perform more healthcare tasks in response to concerns about healthcare capacity that arose as the creation of Medicaid and Medicare increased demand for medical care (IOM 2010). Since the 1960s, the number of NPs in the United States has grown, as has pressure to allow NPs to practice independently. NPs are currently the fastest growing type of primary care provider in the United States (Auerbach et al. 2020).

Like all licensed healthcare providers, NPs are governed by SOP laws that describe the set of actions that their license allows them to legally perform. SOP laws for NPs vary across states and largely govern the types of tasks for which NPs need physician oversight to perform. States with restrictive NP SOP laws require NPs to have formal agreements with physicians to oversee the care NPs provide. Depending on the state, NPs may need some version of physician involvement to prescribe medications, to order tests, and/or to admit patients to the hospital. In contrast, states with full practice authority for NPs allow NPs to practice without any degree of formal physician oversight or involvement in NP care delivery.

State legislatures have recently taken greater interest in NP SOP rules, with several states eliminating the need for any physician oversight. Specifically, from 2013 to 2017, nine states implemented laws to grant NPs full practice independence (“full SOP”). We draw from multiple sources to carefully classify and code state SOP regulations for NPs, including our own reading of the laws as well as McMichael and Markowitz (2021). Table 1 shows the states expanding SOP for NPs to full SOP during our study period along with the dates the laws became effective.⁷ As of 2020, nearly half of all states have granted full SOP to NPs. Purported reasons for the expansion of SOP include: meeting increased healthcare demand

⁷Three other states adopted full SOP over the 2011-2019 period. North Dakota and Vermont adopted full NP SOP in 2011. Thus, they are considered “always treated” in our analysis. Illinois adopted full SOP on January 1, 2018. However, there was a 1.5 year delay while the state finalized their administrative rules. See: <https://www.americanmedspa.org/news/456401/Illinois-Adopts-Rules-for-Full-Practice-Authority-for-APRNs.htm>, last accessed 11/3/21. Thus, Illinois is considered a control state for the job posting analysis, which runs through June 2019, and a treatment state in the ACS, which runs through 2019. Oregon had a smaller change in NP rules in 2013, but has long been a full SOP state. Lastly, Utah was still trying to pass its SOP law as of late 2021.

due to the Affordable Care Act’s (ACA) insurance expansions, reducing healthcare costs, and aligning NPs’ capabilities with their SOP.⁸

2.2 Conceptual Framework

The expected effects of expanding NP SOP on the healthcare labor market are numerous but would largely affect labor market outcomes through their effect on labor demand. This impact on labor demand results from the fact that expanded SOP for NPs does not change the need to be licensed, but instead changes the tasks that an already licensed NP is legally allowed to perform. Indeed, the change eliminates the costly need for co-production with a physician, thus increasing the net revenue associated with NP labor. Therefore, in this discussion, we focus on how full NP SOP would affect labor demand and the resulting changes in labor market outcomes that could occur.⁹

Easing SOP regulations for NPs should increase the labor demand for NPs. Under more-restrictive SOP laws, NPs require physician oversight, which imposes a cost on using NPs. As those costs are reduced through deregulation, the cost of delivering healthcare with NPs falls, increasing demand for NPs. Of course, if healthcare organizations truly believe that physician oversight of NPs is necessary to provide quality care (as physicians assert) or if patients now perceive NP care as lacking, then labor demand will not change—even as NP SOP expands. Thus, the adoption of full SOP has the potential to increase demand for NPs, but the ultimate impact depends upon beliefs about the importance of physician oversight.

If labor demand for NPs does increase, several changes in equilibrium outcomes are possible. First, how this increase in demand manifests itself in terms of higher wages and higher employment levels for NPs depends upon the elasticity of labor supply. In the short-run, we might expect that labor supply for NPs is not only inelastic but also unlikely to expand—as the additional training required to become an NP (compared to an RN) is fairly extensive, requiring a master’s degree in most states, and not all states have licensing

⁸In response to healthcare needs arising from COVID-19, a majority of the states that had not already granted nurse practitioners full practice authority temporarily expanded nurse practitioners’ SOP (AANP 2021). Some stakeholders have since pushed for these temporary expansions of nurse practitioner SOP to become permanent (National Academies of Sciences, Engineering and Medicine 2021).

⁹See Markowitz and Adams (2022) for a detailed discussion of its expected effects on labor supply.

reciprocity, which prevents NPs from quickly moving across state lines. Indeed, it is even possible that NP employment could fall in the short-run after NP SOP is expanded due to new training requirements frequently imposed on NPs and new administrative rules that must be approved by states before new NP licenses can be issued.¹⁰ To the extent that the supply of NPs is fixed in the short term, expanding NP SOP may have no impact—or even a negative impact—on equilibrium employment, but potentially increase earnings. Over longer time horizons, however, one would expect the labor supply curve to become more elastic, increasing the number of NPs and decreasing the NP wage gains.

Increased demand for NPs could also affect the allocation of NPs across employers in the healthcare industry since the costs associated with physician oversight may vary across employers. Healthcare firms that employ a large number of physicians, such as hospitals, may face the lowest costs of NP oversight because of the ready availability of physicians. Conversely, the costs of oversight can be higher in settings with few clinical providers, such as a small standalone clinic, due to less physician availability. Thus, expanding SOP laws should have a bigger impact on NP labor demand in places where physician oversight had been costly and a smaller impact where physician oversight had been cheaper and more plentiful. The extreme example is self-employment of NPs. Under restrictive SOP laws, the NP would need to bear additional costs to establish a formal arrangement with one or more physicians to satisfy the oversight requirements. Granting full NP independence, consequently, removes these added regulatory compliance costs and allows entrepreneurial NPs to pursue their own clinical business ventures (i.e., become self-employed practice owners), potentially increasing provider competition and geographic access in the local healthcare market.

Expanding NP SOP could also change how healthcare providers utilize NPs and thus, the desired skills of prospective NPs. Since NPs are now allowed to practice independently,

¹⁰Expanded NP SOP is often associated with new supervised work requirements that stipulate NPs must first practice under the supervision of a physician for a set number of hours (e.g. 2000 hours in Connecticut) before being able to practice independently. Some employers that previously used NPs may now be hesitant to hire new NPs as they expect many will leave once they are fully trained and able to practice independently. Additionally, expanded NP SOP creates a new administrative burden for states as they need to update their administrative rules for issuing NP licenses. In Illinois, for example, it took a year and a half after the passage of expanded NP SOP to write and approve the new administrative rules for issuing NP licenses. Over that time, no new NP licenses were issued.

employers might seek out NPs that specifically focus on primary care services as well as hold experience with or aptitudes for clinical leadership roles. At the same time, prospective employers may be less likely to seek out NPs to deliver non-primary care services, perform lower skilled clinical tasks, or carry out administrative support functions. If expanded NP SOP does change the skill demands for prospective NPs, this could further influence the growth of NPs providing primary care and the downstream impacts on care access and pricing. However, it may slow the reallocation of NPs into these primary care positions to the extent that the new skill demands introduce some degree of skill mismatch between existing NPs and the demands of prospective employers.

Lastly, expanding NP SOP could alter the labor demand for other healthcare occupations, depending upon whether NP demand does increase and the other occupations' substitutability or complementarity with NPs that practice independently. For example, removing the requirement of physician oversight for NPs likely makes NPs more substitutable and less complementary with primary care physicians (PCPs), which may decrease their demand—either because PCPs are no longer needed to oversee NPs or their set of clinical tasks is now further overlapping. Similarly, expanded SOP for NPs could increase the marginal productivity of NPs relative to registered nurses (RNs) and physician assistants (PAs), which would lead to healthcare employers substituting away from RNs and PAs towards NPs in their production processes. At the same time, expanding NPs' SOP also has the potential to make RNs and PAs more valuable to healthcare employers to the extent that RNs and PAs are complements to NPs. Over longer periods of time, expanded NP SOP could also decrease the supply of other healthcare occupations. For example, more RNs could opt to become NPs through continued training, rather than remain RNs. Thus, it is possible that the labor market outcomes of other healthcare occupations may be impacted by the targeted relaxing of NP SOP.

3 Data

Our empirical analyses use data from two different sources: data on job vacancy postings collected and distributed by Burning Glass Technologies (BGT) and data on the labor mar-

ket outcomes of healthcare workers from the American Community Survey (ACS). Below, we describe each of these data sources.

3.1 Burning Glass Technologies

Burning Glass Technologies (BGT) collects data on job posting from approximately 40,000 online job boards as well as company websites using a proprietary web-scraping procedure that removes duplicate job postings. For each job posting, BGT collects information about the occupation, desired applicant qualifications including skills, employer characteristics, the job location, and a precise calendar date associated with the posting (among other job characteristics). As such, the BGT database aims to be a near-universe of online job postings, with the company advertising that the data can be used to provide real time analysis on job growth, skill demands, and labor market trends. The BGT data, which are increasingly used in contemporary studies to capture important elements of labor demand (Lazear and Spletzer 2012; Faberman and Mazumder 2012; Deming and Kahn 2018; Hershbein and Kahn 2018; Dillender 2022), are an excellent data source to assess how expanding NP SOP affects the labor demand for NPs and other healthcare occupations.¹¹

We use the BGT data on all vacancies posted online from January 2011 through June 2019 with a work location in one of the 50 US states or the District of Columbia. We then limit the data to job postings for the following healthcare occupations using the Standard Occupation Classification (SOC) codes: nurse practitioners (NPs), primary care physicians (PCP), registered nurses (RNs), licensed practical and licensed vocational nurses (LPNs), and physician assistants (PAs).¹²

Our empirical analysis of the BGT data focuses on two main outcomes: the total number of job postings and the share of job postings that mention specific skills (both of which we aggregate to the state-quarter-year level for each occupation). These variables allow us to assess whether expanding NP SOP impacts overall labor demand for different healthcare occupations and whether employers respond to expanded NP SOP by demanding workers

¹¹As of 2016, BGT estimates that it captures roughly 85 percent of job openings (Hershbein and Kahn 2018). Because most healthcare employers post job advertisements on their websites, this share is even higher for the healthcare sector (Lancaster et al. 2019).

¹²PCPs include family and general practitioners, general internists, and general pediatricians.

with different types of skills. While the skills included in the BGT data are too numerous to analyze individually, we group the skills into the following eight skill groupings: general healthcare skills, specialized healthcare skills, emergency healthcare skills, mental healthcare skills, healthcare support skills, leadership skills, office support skills, and other skills. Appendix Table A1 presents the mapping between the 574 BGT skills, which they refer to as skill clusters, and our eight derived “skill groupings.”

Table 2 presents occupation-specific summary statistics for the average number of job postings per quarter as well as the growth in the number of postings from 2011 to 2018 (i.e., the full-year endpoints for our analytic window). As shown, while NPs are one of the smaller healthcare occupations (of those included in our analysis), they are one of the fastest growing over the most recent decade in terms of the number of job postings. This is consistent with Auerbach et al. (2020), which documents the rapid employment growth of NPs over the same time period. The table also presents summary statistics on the skills demanded in these job postings and how they map to our skill groupings. For NPs, the most frequently mentioned skills in job postings include general care skills (62 percent of postings), healthcare support skills (47 percent of postings), and specialized care skills (41 percent of postings).¹³ Reassuringly, the skills demanded for other healthcare occupations are largely in line with what one would expect. For example, general care skills are the most frequently mentioned skill for PCPs (74 percent of postings) while healthcare support skills are the most frequently mentioned skills for RNs and LPNs, 59 and 69 percent, respectively.

3.2 American Community Survey

We also analyze the effect of SOP laws on the labor market outcomes of NPs and other healthcare professionals using the American Community Survey (ACS). The ACS is a household-based survey administered by the US Census Bureau that collects economic and demographic information on one percent of the US population each year. While the survey is not specifically designed to analyze outcomes of healthcare workers, the large sample size

¹³This description excludes “Other Skills,” which are largely composed on an unspecified skill (“na”) in the BGT database. For example, “na” makes up 56 percent of all “Other Skills” for NPs and an identical percentage for PCPs.

and extensive labor market information make it a good data source to study the impact of NP SOP.¹⁴ Our ACS analysis complements the analyses of the BGT data because it allows us to assess how the change in labor demand (evident in job postings) manifests itself in terms of labor market outcomes, including earnings, overall employment, self-employment, and employment across the healthcare sector.

Table 3 presents summary statistics on the sample of healthcare workers aged 25-60 over the 2010-2019 analysis period from the ACS.¹⁵ We limit the sample to full-time healthcare workers employed as a NP, a physician, a RN, a LPN, or a PA, where we again identify these occupations using the SOC codes. However, the SOC codes used by the Census Bureau in the ACS are slightly more aggregated for NPs and physicians than in the BGT data.¹⁶ The sample includes 12,182 NPs as well as 68,755 physicians (MDs),¹⁷ 244,231 RNs, 63,050 LPNs, and 9,298 PAs. Relative to MDs, NPs are more likely to be female, non-immigrants, and white. They are also much less likely to be self-employed than physicians (three vs. 18 percent). When we classify healthcare workers' place of employment using Census Industry Codes, we see that the industrial employment of NPs (like MDs, PAs, and RNs) is highly concentrated in hospitals (40 percent) and physician's offices (26 percent). One difference is that NPs are much more likely to work in outpatient care centers than MDs or RNs (16 percent versus six and five percent, respectively). After these three industries, the

¹⁴Kleiner et al. (2016) also use the ACS to examine the impact of full NP SOP (over an earlier period 2001-2013) on the earnings of healthcare workers. In pre-2010 ACS data, the occupations were more aggregated than they currently are—with NPs combined with RNs, nurse anesthetists, and nurse midwives. Auerbach et al. (2020) also use the ACS to document trends in NP employment over the 2010-2017.

¹⁵Following Goodman-Bacon (2021), we exclude observations from those states that had previously expanded their NP SOP prior to the start of the 2010-2019 period; thus, our control group represents states without expanded NP SOP.

¹⁶We define a full-time employed worker as a worker who worked at least 40 weeks over the past year, averaged at least 30 hours worked per week, and reported positive earnings. The nurse practitioner occupation code in the publicly released ACS data also includes nurse midwives; however, there are few nurse midwives in relation to NPs. Additionally, there is no separate occupation code for primary care physicians in the ACS. Instead, we must use the occupation code for all physicians, which also includes surgeons. The inclusion of nurse midwives in our sample of nurse practitioners and surgeons in with our sample of physicians is unlikely to have a large effect on our estimates. According to the 2019 Occupation Employment and Wage Statistics (OEWS), nurse practitioners made up almost 97 percent of this combination and physicians made up more than 95 percent of this combination nationally.

¹⁷Physicians can be doctors of medicine (MDs) or doctors of osteopathic medicine (DOs). We use the term MD as shorthand for physician for simplicity and because more than 90 percent of physicians are MDs rather than DOs.

employment of NPs is fairly dispersed with Colleges and Universities representing the next most popular place of employment at two percent.

Table 3 also provides summary statistics on earnings by occupation. Earnings data in the ACS are top-coded where the largest two percent of earners in each state in each year have their actual earnings replaced with the average earnings of the highest two percent in the state-year. Top-coding rarely impacts NPs, RNs, PAs, or LPNs, but 29 percent of physicians have top-coded earnings. In our empirical analysis of earnings, we exclude top-coded earnings observations from the main empirical specification because the average earnings levels may be driven by large earnings levels for other (non-healthcare) occupations. We also winsorize the earnings data, excluding the observations with the highest and lowest two percent of earnings within each occupation-state.¹⁸ As shown in Table 3, this does not change the average earnings for NPs. Average earnings for full-time, non-top-coded, and winsorized NPs are \$94,000. PAs are paid similarly, but physicians are paid about a third more and RNs are paid a third less.

4 Empirical Methodology

4.1 Empirical Approach for Job Vacancies & Skill Demands

We analyze the effects of expanding NP SOP on job vacancies and skill demands in the BGT data using a two-way fixed effects generalized difference-in-differences estimation strategy, which we also adapt to an event study model. We first estimate:

$$Y_{st} = \alpha Lead_{st} + \beta ShortRun_{st} + \gamma LongRun_{st} + \lambda_s + \nu_t + \epsilon_{st}, \quad (1)$$

where *Lead* represents the period 1 year prior to policy adoption, *ShortRun* represents the period 0-2 years post SOP implementation, and *LongRun* represents the period more than 2 years following SOP implementation. Our regression models, which we estimate separately for our five healthcare occupations, also control for state (λ_s) and quarter-year (ν_t) fixed

¹⁸We present robustness estimates at the end of the paper that include both topcoded and winsorized earnings levels.

effects. Information from job listings, which is our outcome Y_{st} , is aggregated to quarter-years by state, where the specific outcomes we examine include the natural logarithm of the total number of job postings, the average number of skills/skill groupings per job posting, and the share of postings mentioning a specific skill grouping. That said, because expanded NP SOP can affect relative demand as well as absolute demand, we also use the ratio of the number of postings for nurse practitioners to job postings for other related healthcare occupations as an outcome variable. This approach will also help control for other trends affecting healthcare employment, such as the ACA. The coefficients α , β , and γ are the parameters of interest, where α helps assess the parallel trends assumption and β and γ describe the impact of expanding NP SOP.

We then adapt our two-way fixed effects estimation to an event study framework:

$$Y_{st} = \sum_{j=1}^J \alpha_j 1[t - T_s^* = j] + \lambda_s + \nu_t + \epsilon_{st}, \quad (2)$$

where T_s^* represents the time period that state s enacts the full NP SOP policy, $1[\cdot]$ is the indicator function, and the α coefficients are the parameters of interest. The model is otherwise identical to Equation 1, where we cluster our standard errors at the state level in both sets of estimates.

We are sensitive to the concerns raised in Goodman-Bacon (2021) regarding the potential biases associated with differences in treatment timing. Thus, we drop the always treated states, i.e. those states that had enacted full NP SOP prior to 2011, from our empirical analysis.¹⁹ Moreover, of the nine states that changed their SOP laws during our time period, most did so within a fairly narrow window, five in 2015 alone and seven within the two year period between the middle of 2014 and the middle of 2016 (see Table 1). Later in the paper, we present robustness tests showing the sensitivity of our results using different subsets of full NP SOP adopting states—including when imposing that our treatment group states implement their policy changes within a common time window.

¹⁹The following 17 states had expanded SOP laws in place over the entire 2011-2019 period: Alaska, Arizona, Colorado, District of Columbia, Hawaii, Idaho, Iowa, Maine, Montana, New Hampshire, New Mexico, North Dakota, Oregon, Rhode Island, Vermont, Washington, and Wyoming. In robustness estimates, we show that the results are very similar if we include these states in the control group.

4.2 Empirical Methods for Labor Market Outcomes

Our empirical approach analyzing labor market outcomes of healthcare workers in the ACS is almost identical to Equation 1 and Equation 2, except that the data are annual and at the individual level. Thus, the time fixed effect are year dummy variables (instead of quarter-year dummies) and we include basic demographic controls (X_{ist}) in the regressions. The specific control variables included in X are: a cubic in age and indicators for sex, race, ethnicity, education groupings, and immigrant status.²⁰ The outcomes we analyze in the ACS are also intentionally different and complementary to the insights offered from the BGT data. Specifically, we analyze the effect of full NP SOP on individual earnings, total occupational employment, self-employment probabilities, and employment across industries. We weight regressions using the ACS sample weights and, like the BGT analysis, we exclude always treated states and cluster our standard errors at the state-level. We also implement the same series of robustness checks for the ACS data (e.g., assessing any influence from differential timing in treatment).

5 Results

5.1 BGT Analysis

Table 4 presents our estimates of Equation 1 when the outcome is the natural logarithm of the number of job postings (per quarter). Looking first at NPs in column (1), we see that in the year prior to expanding NP SOP, jobs postings for NPs in full SOP adopting states tended to be somewhat less common than in non-adopting states, although the coefficient is not statistically different than zero. In the first seven quarters after full SOP adoption, there was no measurable change in the demand for NPs (measured as the number of online job postings). However, beginning two years after full NP SOP adoption, the number of job postings for NPs in full SOP adopting states increased by 0.27 (se=0.12) log points, representing a large increase in demand for NPs. Interestingly, this increase in demand for NPs

²⁰In the earnings regression, we also include indicators for weeks employed. The indicators follow the ranges of weeks that are reported in the ACS, where weeks worked is a categorical variable: 40-48 weeks, 49-50, and 51-52.

occurs without any corresponding change in the demand for other healthcare occupations including PCPs (column 2), RNs (column 3), LPNs (column 4), and PAs (column 5).²¹ Thus, the estimates imply that states that adopted full NP SOP experienced stronger demand for NPs without any subsequent weakening in demand for other credentialed healthcare professionals.

We also estimate Equation 1 using the ratio of total other healthcare job postings to total NP job postings as our outcome variable. These estimates, which we present in Table 5, will help address the negative (although statistically insignificant) leading coefficients across all occupations in Table 4 and better assess changes in relative demand. Under this approach, if the adoption of full NP SOP increases the relative demand for NPs compared to these other healthcare occupations, then the coefficients on the policy adoption variable should be negative, i.e., that this ratio falls. Indeed, this is precisely what we see. We again see no measurable differential between adopting and never adopting states prior to the deregulation event or in the first two years after the policy change, but the relative number of job postings for each of these occupations (compared to NPs) falls beginning two-years after full NP SOP adoption. To help assess the magnitudes of these changes in relative demand, we also include the average ratio at the bottom of each column. Interestingly, the decrease in the ratio for each occupation is about 30 percent—almost identical to the change in the number of NP job postings (see Table 4). Therefore, the changes in the ratio of job postings in Table 5 confirm our results in Table 4 that expanding NP SOP to allow NPs to practice independently has increased the labor demand for NPs without harming the labor demand for other healthcare workers. However, the effects appear to materialize with a lag, which may reflect several things including: underlying frictions in healthcare labor markets (e.g., if employers cannot instantaneously adjust clinical staffing and roles across labor types); state-level adjustment delays in SOP implementation for credentialing NPs as fully independent providers (e.g., incorporating supervised hours requirements and general updating of the NP licensing process in the deregulated practice environment); and/or that

²¹While all of the Long Run coefficients in Columns 2-5 are negative, almost all of the Long Run coefficients are actually larger than the pre-trend, i.e. the coefficient associated with job posting levels in the year prior to full SOP adoption, and none are statistically different than zero.

it takes time for healthcare providers (and/or patients) to learn that NPs can indeed provide quality healthcare services without physician oversight.

To better understand the timing of these effects on labor demand for NPs, we estimate the event study model in Equation 2, where we continue to use the ratio of job postings (total occupation job postings/total NP job postings) as our key outcome variables of interest. These results—estimated at the half-year level to reduce noise—are presented in Figure 1.²² The first dashed vertical line in each figure indicates the time period just prior to policy adoption, while the second dashed vertical line is just before the period two-years after NP SOP adoption. One thing to note across all figures is that the ratio of job postings is fairly steady in the quarters leading up to full NP SOP adoption offering additional support for the parallel trends assumption. This is especially the case in Panel B, which presents effects on the ratio of RN job postings to NP job postings. We again see that there is no immediate change in this ratio in the first year after adoption, but the ratio generally starts to decline after a year, and becomes statistically different than zero after two years. Appendix Figure A1 presents analogous event study estimates of the effect of full NP SOP adoption on the natural log of NP job postings.

Lastly, we examine geographic heterogeneity in the effect of full NP SOP adoption on the number of NP job postings. Previous research has shown that NPs are an important healthcare provider in traditionally underserved areas (Barnes et al. 2018). This analysis allows us to assess whether expanded SOP increases NP labor demand and thus, could improve access to primary care providers in Health Professional Shortage Areas (HPSAs). Interestingly, we see that full SOP adoption increases demand for NPs among employers located in HPSA as well as non-HPSA areas, with the magnitudes of the growth quite similar across areas (see Table A2).

We turn next to the impact of full NP SOP adoption on the skills demanded of NPs, which we present in Table 6. Column (1) and (2) show our estimates of full NP SOP adoption on the average number of BGT skills listed per job posting and the average number of skill groupings listed per job posting, where the difference between a “BGT skill” and a “skill

²²The data on the ratio of postings are still summed to the state-quarter-year, but we estimate the effects at the half-year level using half-year dummies that take the value of one for each of the two relevant quarters.

grouping” is that a BGT skill includes any of the 574 skills included in the BGT job postings (based on BGT’s own proprietary algorithm for classifying skills) and a skill grouping is one of our aggregated skill groupings—eight in total. We find that NP SOP adoption is not changing the average number of BGT skills or skill groupings among NP jobs posting (or PCP jobs postings, see Appendix Table A3). This is somewhat surprising since one might expect that full NP SOP adoption would cause NPs to focus more on tasks related to primary care services. These estimates, however, imply that full NP SOP adoption is not associated with any greater degree of skill specialization among NPs.

The effects of full NP SOP adoption on the proportion of jobs mentioning specific skill groupings are presented in Columns 3-10 of Table 6. Interestingly, we see essentially no change in the composition of skill demands in job postings.²³ Thus, full NP SOP adoption does not appear to be changing the specific skills employers are seeking out for their prospective NP hires. Instead, employers are simply demanding more NP clinical labor. These results also suggest that skill mismatch should not hamper the ability of existing NPs to practice independently under full SOP.

5.2 ACS Analysis

We now present results describing how the labor market outcomes of healthcare workers in the ACS respond to the increase in demand for NPs documented in the BGT data. We first present effects on earnings and employment. We then show how NP SOP affects NP employment across the healthcare sector.

Table 7 presents the effects of adopting full NP SOP on earnings for NPs. As shown in column (1), the earnings of NPs are very similar in states that adopt full NP SOP (compared to NPs in states that never adopt SOP) in the year prior to the policy adoption, but earnings for NPs in states that adopt full SOP increase by about 6 percent in the year-of and one-year after adoption. Earnings for NPs remain about 5 percent higher two or more years after adoption. Figure 2 presents our estimates of the event study regression of full NP SOP

²³A notable exception is that the estimates suggest some decreased frequency of job postings mentioning mental health skills. That said, we do not place a lot of weight on this result given the multiple hypotheses that we are testing (Savin 1984).

adoption on earnings. The event study estimates confirm that the adoption of full NP SOP has an immediate, persistent, and positive impact on NP earnings. Indeed, the stability of the earnings effect over time—evident even four or more years after SOP adoption—implies that the labor supply response of NPs may be quite limited, at least in the initial few years following the removal NP SOP restrictions.

Table 7 and Figure 2 also present the estimated effects of full NP SOP adoption on earnings for MDs, RNs, LPNs, and PAs. While the estimates of Equation 1 in Table 7 suggest a potential short-term impact on MD earnings,²⁴ these effects are not evident in the full event study estimates in Figure 2. We also find no evidence that the earnings of RNs, LPNS, or PAs are affected by the policy change. Thus, only limited evidence suggests that the adoption of full NP SOP is spilling over and affecting the earnings of other healthcare occupations. This contrasts with Kleiner et al. (2016), who find that the earnings of physicians decline when NPs are granted full independent practice authority when examining earlier SOP policy changes.

Table 8 presents the impact of expanded NP SOP on equilibrium employment for NPs and other healthcare workers in the ACS. Panel A presents the effect on the natural logarithm of overall full-time employment (where occupational employment has been summed to the state-year level) and Panel B presents estimates using the ratio of total employment as the outcome, e.g., total RN employment divided by total NP employment. Thus, if the increase in demand we observe in BGT data is leading to an increase in NP employment, then we would expect positive coefficients in column (1) of Panel A and negative coefficients in all of Panel B. As shown in Table 8, we find no evidence that adoption of full NP SOP is increasing equilibrium employment for NPs or affecting overall employment at any of the healthcare occupations we examine within the first four years post-deregulation.²⁵ Moreover, when we examine the impact of full SOP adoption on relative employment in Panel B, the estimates imply no change in NP employment relative to other occupations. This result is further supported by the event study estimates in Figure 3.

²⁴The change in earnings for physicians in the short-run relative to the leading effect is -0.06 (se=0.03). In the long-run, the change in coefficients falls to -0.03 (se=0.02). Thus, there is some evidence that the adoption of NP SOP lowers physician earnings, at least in the short-run.

²⁵If anything, the estimates in column (1) of Panel A imply that NP employment may be declining. The long-run effect minus the one-year before effect is -0.21 (se=0.13). That said, the estimates are quite noisy.

Even if the adoption of full NP SOP is not increasing overall NP employment, these policies could lead to a reallocation of NPs across different types of healthcare employers in a way that increases access to primary care. As we describe above, once NPs are allowed to practice independently, we expect that this policy change should increase self-employment among NPs and generally increase NP employment at areas where physician employment is less common and thus, physician oversight had been more costly.

Table 9 presents our estimates of the impact of full NP SOP adoption on NP self-employment and place of service in the ACS. Looking at column (1), we find that there is no measurable difference between NP self-employment in adopting and non-adopting states in the year prior to adoption, but self-employment increases by 1.4 (se=0.8) percentage points in the year-of and one-year after adoption and remains 1.8 (se=0.6) percentage points higher two or more years after adoption. This rise in self-employment is unique to NPs, with no other healthcare occupations experiencing any changes (see Appendix Table A4). Moreover, the effect is quite persistent and grows slightly over time. As we show in the event study estimates in Figure 4, NPs are 2.7 (se=0.9) percentage points more likely to be self-employed four or more years after full SOP adoption. Additionally, the magnitudes of these effects are quite large, with the long-run effect in Table 9 representing a 60 percent increase above the average rate of three percent.

The adoption of full NP SOP also appears to affect NP place of service with NPs reallocating their employment away from hospitals and towards outpatient care centers, which include clinics and urgent care centers. Ignoring the leading coefficient, the estimates imply that two or more years after full SOP adoption, NP employment at hospitals decreases by 5.6 (se=4.1) percentage points and increases at outpatient care centers by 3.5 (se=1.5) percentage points.²⁶ If we account for the leading effect, this employment realignment is magnified and suggests that NPs may also be reallocating into physician offices.²⁷ These changes in place of employment indicate that the need for physician oversight (before full

²⁶Because all NPs are employed at one of the four places of employment, the coefficients in any period sum to zero.

²⁷The long-run coefficient minus the leading coefficient is -12.5 (se=6.4) for hospitals, 5.7 (se=2.4) for outpatient care centers, and 7.3 (se=3.7) for physician offices.

SOP is adopted) was a binding constraint for a lot of NPs making decisions about how to practice and employers contemplating hiring NPs.

The movement of NPs away from hospitals and towards self-employment and employment at outpatient care centers could positively impact the geographic allocation of primary care providers and even increase the number of primary care providers (and thus, access to primary care) even if total NP employment remains fixed. For example, when we look at the place of service for self-employed NPs, the most commonly observed location is “Office of Other Health Practitioner.” Thus, much of the movement of NPs into self-employment may reflect the opening of new primary care practices. Additionally, it is not unreasonable to think that NPs employed at outpatient care centers and physician offices may be more likely to be engaged in providing primary care than NPs employed in hospitals.²⁸ This again points to the idea that the reemployment pattern among NPs that we uncover is consistent with full NP SOP increasing the number of primary care providers, even if it has been unsuccessful at increasing the aggregate number of NPs in the short-run.

5.3 Robustness

We perform numerous robustness tests of our BGT and ACS analysis to test the sensitivity of our results to minor perturbations to our empirical specification. These estimates are presented in Table 10 (BGT analysis) and Table 11 (ACS analysis). Generally speaking, our results are quite robust to these alternative specifications.

Our main empirical specifications excluded states that allowed NPs to practice independently (i.e., full NP SOP states) over the entire sample period. The exclusion of these “always adopters” from the control group addresses potential biases associated with variation in treatment timing in the two-way fixed effects difference-in-differences empirical approach (Goodman-Bacon 2021; Callaway and Sant’Anna 2021). We examine the sensitivity of our results to these exclusions by presenting estimates that use all states. We also investigate whether the differential timing of SOP law changes is distorting our estimates

²⁸One potential concern with this interpretation is that many outpatient care centers and physician offices are associated with hospitals. Many NPs in the ACS that report working in a hospital may be employed in these hospital affiliated physician offices and outpatient care centers, as opposed to working inpatient or emergency care units.

and inferences. Fortunately, a majority of states that adopted full NP SOP over the period 2010-2019 did so during a relatively compact time horizon from the middle of 2014 to middle of 2016, which allows us to exclude states with shorter pre- (post-) periods in our analytic data and thereby present estimates that limit our treatment sample to the seven states that adopted full NP SOP over this more limited time frame. As we show in columns 2-3 of Table 10 and columns 3-4 of Table 11, neither the BGT nor the ACS results are sensitive to these further restrictions placed on the analytic samples.

We also estimate additional specifications that test the sensitivity of our results to variation in ACA adoption, changes in the skill grouping variables, and small changes to the ACS empirical specification. We find that excluding states that did not adopt Medicaid expansion (under the ACA) does not materially affect our results (see column 4 on Table 10 and column 5 of Table 11); that small changes in our skill grouping variables have no material effects on our results;²⁹ and that small changes to our ACS empirical specification—such as including top-coded and winsorized earnings or excluding sample weights—also do not substantially change our estimates (see column 2 and 6 of Table 11).

6 Conclusion

Our paper fits into a broad literature that seeks to understand the impact of occupational licensing and its effect on labor and product markets. Occupational licenses could help provide some quality control in an industry, but they may unnecessarily restrict labor supply increasing consumer prices and limiting output. Evaluating this tradeoff in the healthcare market is especially valuable given the importance of providing high-quality service to consumers but also long-standing concerns around limitations in healthcare access and rising healthcare costs.

In this paper, we study the labor market effects of states expanding the scope of practice for nurse practitioners allowing them to practice without physician oversight. We posit that

²⁹In results not shown, we have tried several reconfigurations of our skills groupings to test the sensitivity of our results to alternative skill groupings. These include: combining healthcare support and office support skills, breaking our “na” from other skills, and creating an “education skills” grouping from the other skills. None of these changes had a material impact on our skills analysis estimates in Table 6.

this change in the set of tasks that an already licensed healthcare provider is legally allowed to perform is most likely to affect labor demand in the short run. We then set out to assess empirically whether the adoption of full SOP indeed affects labor demand and how this change in labor demand affects equilibrium outcomes in the healthcare labor market. This analysis allows us to analyze whether expanded SOP has the potential to increase access to primary care and lower healthcare costs. It also offers insights into the broader labor and product market effects of occupational licenses.

Using Burning Glass Technologies data reflecting the near universe of job postings, we find that full NP SOP adoption substantially increased labor demand for NPs in the form of a 31 percent increase in job postings, but did not affect the number of job postings for other primary care providers, including PCPs and RNs. Thus, healthcare providers do not appear to believe that physician oversight is necessary for NPs to provide quality care and the increased demand for NPs is not displacing employers' demand for other healthcare workers. At the same time, we also find that this increase in demand for NPs is not associated with any changes in the specific skills among NPs being sought after by employers. This implies that employers are not seeking different types of NPs but simply more NPs. These results suggest that full SOP adoption has the potential to increase access to primary care.

We then show how this increase in labor demand affects equilibrium labor market outcomes in the ACS. We find that the increase in labor demand from states adopting full NP SOP increases earnings for NPs but does not increase total NP employment—either directly or relative to other healthcare workers. This implies that the short-run labor supply for NPs is highly inelastic. Moreover, the short-term impacts of full SOP adoption may be more associated with cost reductions (as providers use more lower-cost NPs than PCPs) than increased access. That said, we do see that full NP SOP is changing the allocation of NPs across the healthcare industry—with NPs moving into self-employment, away from hospitals, and into outpatient care centers. This reallocation of NPs suggests that while full NP SOP is not increasing the overall number of NPs, it may be increasing the number of primary care providers as NPs in self-employment and at outpatient care centers may be more likely to provide primary care than NPs employed at hospitals.

Given the continued efforts to “bend the cost curve” in healthcare, expanding non-physician provider scope of practice laws is an appealing tool for both lowering cost of care and expanding access to care. In this study, we find evidence that NP SOP can help achieve both objectives. However, a large expansion in the number of primary care providers is being held back by the short-term inelastic labor supply of NPs. States that want to use expanded SOP to increase healthcare access should think about combining this policy, which substantially increases the demand for NPs, with other workforce promoting policies that help produce a larger supply of NPs such as expanding training programs within the state or offering loan repayment programs for NPs that agree to practice within the state for a specified period of time.

This study also makes important contributions to the broader literature on occupational licenses. First, we show that it is not simply the presence of an occupational license but the restrictions within the license also affect labor and product market outcomes. We also show that occupational licenses can impact the industrial organization within a market, reallocating workers across industries and geographic markets, encouraging self-employment, and possibly increasing overall competition. The increase in self-employment, in particular, reveals the negative effects of tighter regulations on the entrepreneurial activity of licensed professionals. In this way, NP support for full independence policies likely reflects an underlying desire to launch their own primary care business ventures, rather than solely seeking equal clinical standing among their PCP coworkers.

References

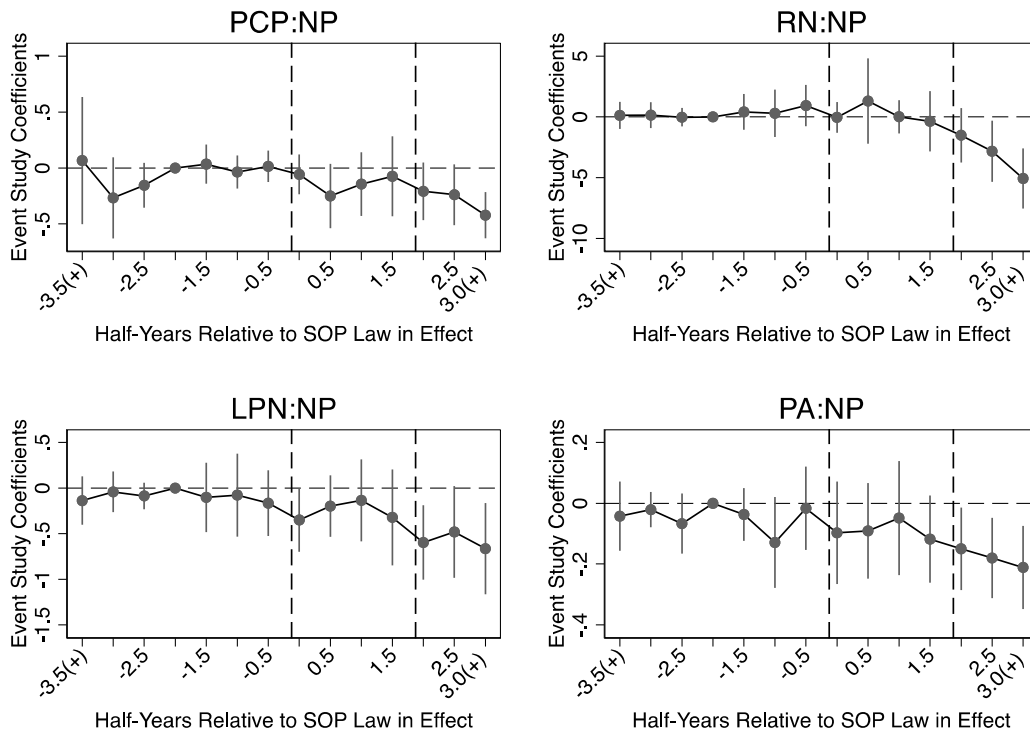
- Alexander, D. and M. Schnell**, “Just What the Nurse Practitioner Ordered: Independent Prescriptive Authority and Population Mental Health,” *Journal of Health Economics*, Jul 2019, *66*, 145–162.
- Auerbach, D. I., P. I. Buerhaus, and D. O. Staiger**, “Implications of the Rapid Growth of the Nurse Practitioner Workforce in the US: An Examination of Recent Changes in Demographic, Employment, and Earnings Characteristics of Nurse Practitioners and the Implications of Those Changes,” *Health Affairs*, 2020, *39* (2), 273–279.
- Barnes, H., M. R. Richards, M. D. McHugh, and G. Martsof**, “Rural and Non-rural Primary Care Physician Practices Increasingly Rely on Nurse Practitioners,” *Health Affairs*, 2018, *37* (6), 908–914.
- Callaway, B. and P. H. Sant’Anna**, “Difference-in-Differences with Multiple Time Periods,” *Journal of Econometrics*, Dec 2021, *225* (2), 200–230.
- Cramer, J. and A. B. Krueger**, “Disruptive Change in the Taxi Business: The Case of Uber,” *American Economic Review*, 2016, *106* (5), 177–82.
- Deming, D. and L. B. Kahn**, “Skill Requirements across Firms and Labor Markets: Evidence from Job Postings for Professionals,” *Journal of Labor Economics*, 2018, *36* (S1), S337–369.
- Dillender, M.**, “How Do Medicaid Expansions Affect the Demand for Health Care Workers? Evidence from Vacancy Postings,” *Journal of Human Resources*, 2022, *57*.
- Faberman, R. J. and B. Mazumder**, “Is There a Skills Mismatch in the Labor Market?,” *Chicago Fed Letter*, 2012, *300*.
- Goodman-Bacon, A.**, “Difference-in-Differences with Variation in Treatment Timing,” *Journal of Econometrics*, 2021.
- Hershbein, B. and L. B. Kahn**, “Do Recessions Accelerate Routine-Biased Technological Change? Evidence from Vacancy Postings,” *American Economic Review*, 2018, *108* (7), 1737–1772.
- IOM**, “The Future of Nursing: Leading Change, Advancing Health,” Technical Report, Institute of Medicine, Washington, DC: The National Academies Press 2010.
- Kleiner, M. M.**, “Occupational Licensing,” *The Journal of Economic Perspectives*, 2000, *14* (4), 189–202.
- , **A. Marier, K. W. Park, and C. Wing**, “Relaxing Occupational Licensing Requirements: Analyzing Wages and Prices for a Medical Service,” *The Journal of Law and Economics*, 2016, *59* (2), 261–291.

- **and A. B. Krueger**, “Analyzing the Extent and Influence of Occupational Licensing on the Labor Market,” *Journal of Labor Economics*, 2013, 31 (S1), 173–202.
- **and K. W. Park**, *Battles among Licensed Occupations: Analyzing Government Regulations on Labor Market Outcomes for Dentists and Hygienists* 2010.
- Lancaster, V., D. Mahoney-Nair, and N. J. Ratcliff**, “Technology Report Review of Burning Glass Job-Ad Data,” Technical report 2019.
- Lazear, E. P. and J. R. Spletzer**, “Hiring, Churn, and the Business Cycle,” *American Economic Review*, 2012, 102 (3), 575–79.
- Luo, Tianyuan, Cesar L Escalante, and Carmina E Taylor**, “Labor market outcomes of granting full professional independence to nurse practitioners,” *Journal of Regulatory Economics*, 2021, 60 (1), 22–54.
- Markowitz, S., E. K. Adams, M. J. Lewitt, and A. L. Dunlop**, “Competitive Effects of Scope of Practice Restrictions: Public Health or Public Harm?,” *Journal Health Economics*, Sep 2017, 55, 201–218.
- Markowitz, Sara and E Kathleen Adams**, “The Effects of State Scope of Practice Laws on the Labor Supply of Advanced Practice Registered Nurses,” *American Journal of Health Economics*, 2022, 8 (1).
- McMichael, B. J. and S. Markowitz**, “Towards a Uniform Classification of Nurse Practitioner Scope of Practice Laws,” Working Paper 28192, NBER 2021.
- National Academies of Sciences, Engineering and Medicine**, “The Future of Nursing 2020-2030: Charting a Path to Achieve Health Equity,” Technical Report, Washington, DC: The National Academies Press 2021.
- Nicholson, S. and C. Propper**, “Medical Workforce,” in B. V. Elsevier, ed., *Handbook of Health Economics Vol. 2*, 2011, pp. 874–925.
- Perry, J. J.**, “The Rise and Impact of Nurse Practitioners and Physician Assistants on Their Own and Cross-Occupation Incomes,” *Contemporary Economic Policy*, 2009, 27 (4), 491–511.
- Poghosyan, L., E. J. Timmons, C. M. Abraham, and G. R. Martsof**, “The Economic Impact of the Expansion of Nurse Practitioner Scope of Practice for Medicaid,” *Journal of Nursing Regulation*, 2019, 10 (1), 15–20.
- Savin, N. E.**, “Multiple hypothesis testing,” *Handbook of econometrics*, 1984, 2, 827–879.
- Smith, L. B.**, “The effect of nurse practitioner scope of practice laws on primary care delivery,” *Health Economics*, 2022.
- Timmons, E. J.**, “The Effects of Expanded Nurse Practitioner and Physician Assistant Scope of Practice on the Cost of Medicaid Patient Care,” *Health policy*, 2017, 121 (2), 189–196.

Traczynski, J. and V. Udalova, “Nurse Practitioner Independence, Health Care Utilization, and Health Outcomes,” *Journal of Health Economics*, Mar 2018, *58*, 90–109.

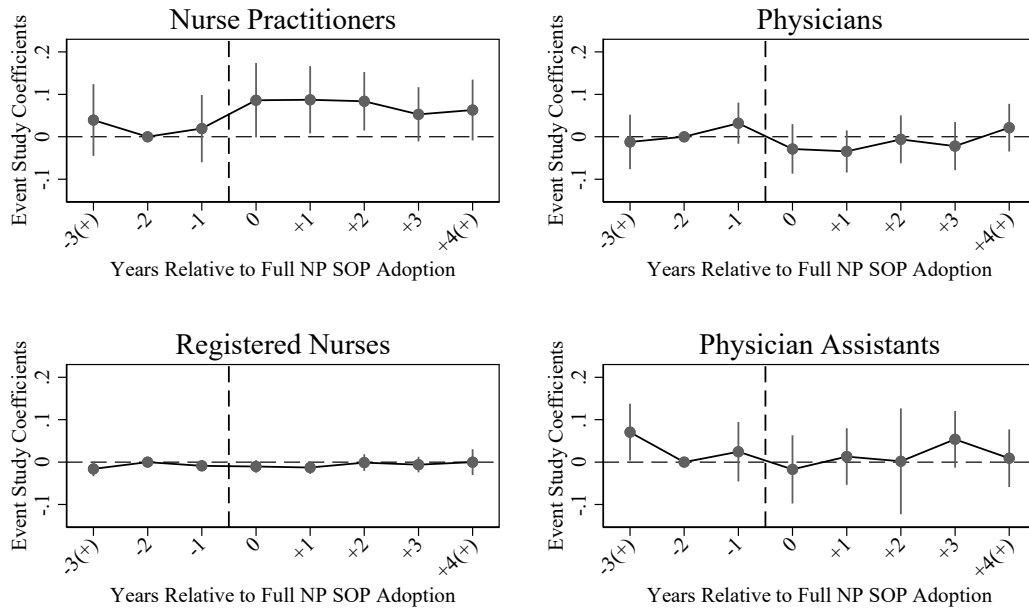
Wing, C. and A. Marier, “Effects of Occupational Regulations on the Cost of Dental Services: Evidence from Dental Insurance Claims,” *Journal of Health Economics*, 2014, *34*, 131–143.

Figure 1: Effect of Full NP SOP on Relative Job Postings



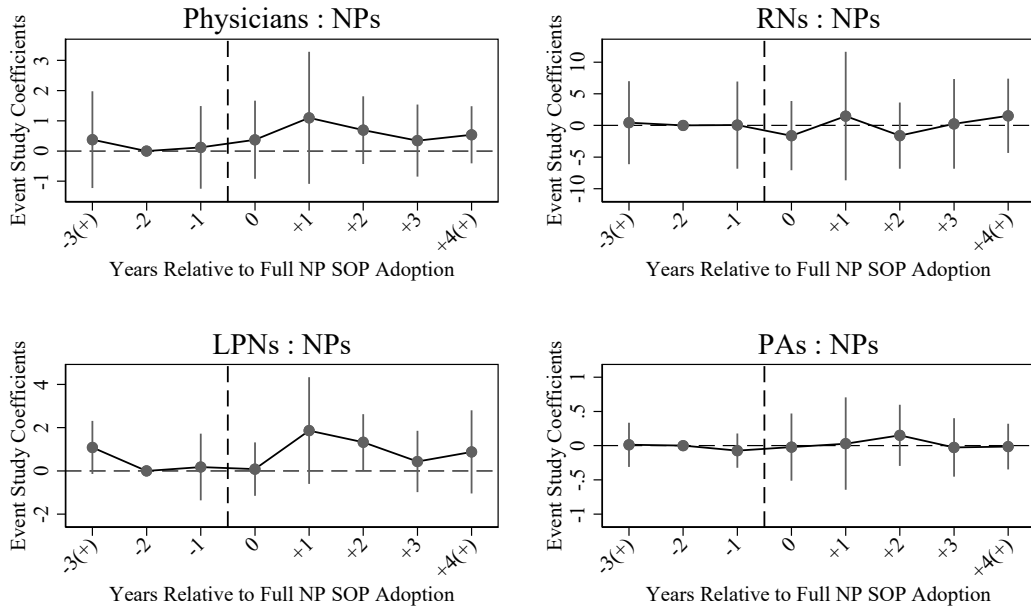
Notes: This figure plots the coefficients and 95 percent confidence intervals of the event study estimates showing the effect of Full NP SOP adoption on the relative number of NP job postings (at the state-quarter-year level) in the BGT data. All coefficients are relative to the effect two years prior to adoption. The first dashed vertical line is just prior to adoption, the second one is two years after adoption.

Figure 2: Effect of Full NP SOP Adoption on Natural Log of Earnings



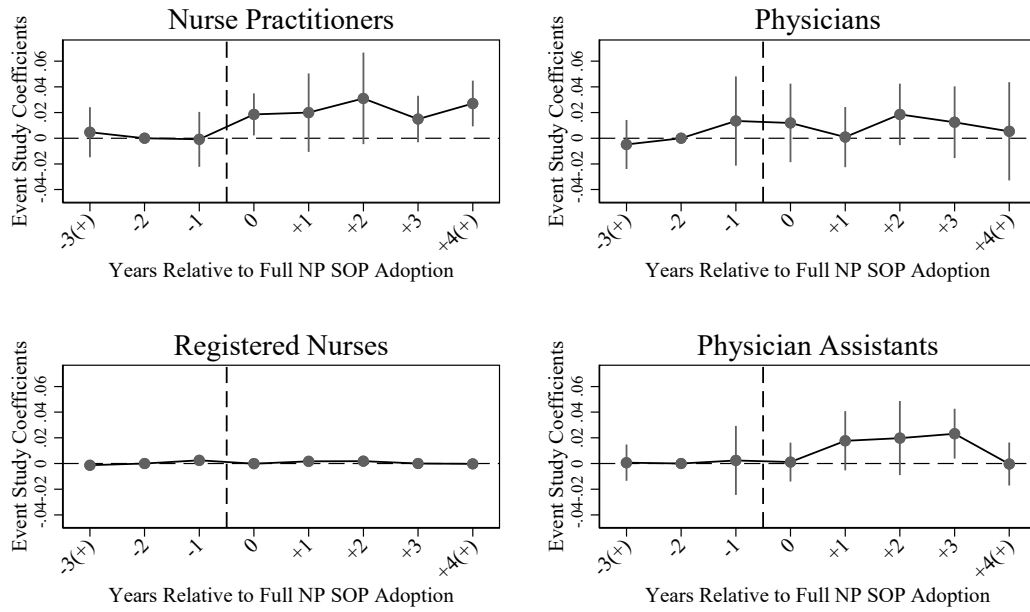
Notes: This figure plots the coefficients and 95 percent confidence intervals of the event study estimates showing the effect of Full NP SOP adoption on the natural log of earnings for different health care occupations in the ACS. All coefficients are relative to the effect two years prior to adoption.

Figure 3: Effect of Full NP SOP Adoption on Relative NP Employment



Notes: This figure plots the coefficients and 95 percent confidence intervals of the event study estimates showing the effect of Full NP SOP adoption on relative employment for different health care occupations in the ACS. All coefficients are relative to the effect two years prior to adoption.

Figure 4: Effect of Full NP SOP Adoption on Self Employment



Notes: This figure plots the coefficients and 95 percent confidence intervals of the event study estimates showing the effect of Full NP SOP adoption on self-employment for different health care occupations in the ACS. All coefficients are relative to the effect two years prior to adoption.

Table 1: Full Nurse Practitioner Scope of Practice Adoption, 2011-2019

State	Full NP SOP Effective Date
Connecticut	7/1/2014
Delaware	9/1/2015
Illinois	7/1/2019
Maryland	10/1/2015
Minnesota	1/1/2015
Nebraska	3/1/2015
Nevada	7/1/2013
New York	1/1/2015
South Dakota	7/1/2017
West Virginia	6/1/2016

Notes: SOP effective date information was compiled from state legislation documents, state nursing licensing information, media reports, and existing NP SOP literature. We cross-referenced this information with McMichael and Markowitz (2021).

Table 2: Summary Statistics for Burning Glass Technologies Healthcare Job Postings, 2011Q1-2019Q2

	Nurse Practitioners	Primary Care		Registered Nurses	Licensed	
		Physicians	Physicians		Nurses	Physician Assistants
Average Quarterly Job Postings	23,545	23,177	214,330	34,140	10,153	
Growth in Job Postings, 2011-2018	97.6%	49.9%	150.5%	111.1%	16.9%	
Avg Number of Skills per Posting	6.5	4.1	6.8	7.1	5.8	
Avg Number of "Skill Groupings" per Posting	3.1	2.1	3.3	3.5	2.8	
% of Postings for Specific Skill Groupings						
General Care Skills	62.0	74.0	58.1	64.5	53.1	
Specialized Care Skills	40.9	35.4	38.1	27.5	46.4	
Mental Health Skills	18.9	3.3	7.7	6.9	5.9	
Emergency Care Skills	28.0	11.3	43.2	42.4	35.3	
Healthcare Support Skills	47.2	21.2	58.8	69.4	35.6	
Office Support Skills	32.8	18.2	31.6	37.5	28.7	
Leadership Skills	8.9	3.6	12.4	10.0	7.2	
Other Skills	75.5	47.0	83.3	90.2	67.6	
N	800,545	788,010	7,287,228	1,160,759	345,197	

Notes: Not all BGT job postings include skills, but these omissions are rare (typically 1% or less of postings for a given provider type). "Skill Groupings" are our combined skill measurements, grouping the individual BGT skills into more aggregated combinations of skills. The specific BGT skills included in each "skill grouping" are presented in Appendix Table A1. "Other Skills" include unspecified skills, designated "na" by BGT. Indeed, unspecified skills make up a majority of "Other skills," including 56 percent for nurse practitioners.

Table 3: Summary Statistics from American Community Survey, Sample of Healthcare Workers Aged 25-60, 2010-2019

	Nurse Practitioners		Physicians		Registered Nurses		Licensed Practical Nurses		Physician Assistants	
	Practitioners	Physicians	Registered Nurses	Licensed Practical Nurses	Physician Assistants					
Age	42.7	42.8	42.6	42.5	38.5					
Female	0.91	0.40	0.89	0.89	0.70					
Immigrant	0.11	0.30	0.16	0.15	0.13					
Hispanic	0.05	0.07	0.07	0.11	0.09					
Asian American	0.06	0.24	0.10	0.05	0.09					
Black	0.09	0.07	0.13	0.28	0.08					
Other Non-White	0.01	0.02	0.02	0.04	0.03					
College Degree	0.98	1.00	0.60	0.05	0.84					
Full-Time Employment	0.85	0.87	0.80	0.75	0.82					
Self Employed	0.030	0.180	0.008	0.016	0.028					
Topcoded Earnings	0.01	0.29	0.00	0.00	0.01					
Earnings (\$1000s)										
All Employed	88.1	197.5	58.6	34.6	85.3					
Full-Time Employed	96.9	218.8	67.0	41.9	97.6					
Full-Time and Non-topcoded	94.6	124.1	65.8	41.0	91.6					
Full-time, Non-topcoded, and Winsorized	94.0	120.5	64.7	39.7	89.6					
Industry										
Hospitals	0.40	0.48	0.64	0.26	0.44					
Physicians Offices	0.26	0.34	0.04	0.08	0.31					
Outpatient Care Centers	0.16	0.06	0.05	0.07	0.10					
Other Industry	0.19	0.13	0.27	0.60	0.15					
N	12,182	68,755	244,231	63,050	9,298					

Notes: Nurse Practitioners include nurse midwives because the ACS combined the two occupations into a single occupation. According to the 2019 Occupation Employment Statistics (OES), Nurse Practitioners made up almost 97 percent of this combination nationally. Full time employed is defined as working at least 40 weeks over the past year, averaging at least 30 hours per week, and reporting positive earnings. The ACS topcodes the highest two percent of earnings in each state in each year. The winsorized sample excludes the observations with the highest and lowest two percent of earnings within each occupation grouping.

Table 4: Effects of Full NP SOP on Job Postings, BGT Data, 2011Q1 - 2019Q2

	Nurse Practitioners	Primary Care Physicians	Registered Nurses	Licensed Practical Nurses	Physician Assistants
	(1)	(2)	(3)	(4)	(5)
1 Year Pre	-0.10 (0.10)	-0.06 (0.11)	-0.07 (0.04)	-0.13 (0.07)	-0.20 (0.11)
SOP Short-Run	0.01 (0.11)	-0.03 (0.14)	-0.02 (0.08)	-0.12 (0.10)	-0.10 (0.16)
SOP Long-Run	0.27 (0.12)	-0.07 (0.17)	-0.07 (0.05)	-0.08 (0.09)	-0.04 (0.13)
State FE	Yes	Yes	Yes	Yes	Yes
Yr-Qtr FE	Yes	Yes	Yes	Yes	Yes
N	1,156	1,156	1,156	1,156	1,156

Notes: Outcome is the natural log of the total number of job postings for a given occupation in each state-quarter-year. SOP Short-Run is defined as the quarters associated with the year of adoption and one year after adoption. SOP Long-Run is defined as the quarters associated with two or more years after adoption. Always treated SOP states are excluded from the analyses. Standard errors are clustered at the state level.

Table 5: Effects of Full NP SOP on Relative Job Postings, BGT Data, 2011Q1-2019Q2

	Total Occupation Job Postings: NP Job Postings			
	Primary Care Physicians	Registered Nurses	Licensed Practical Nurses	Physician Assistants
	(1)	(2)	(3)	(4)
1 Year Pre	0.02 (0.14)	0.50 (0.77)	-0.03 (0.14)	-0.04 (0.05)
SOP Short-Run	-0.10 (0.19)	0.11 (1.05)	-0.16 (0.14)	-0.05 (0.06)
SOP Long-Run	-0.29 (0.15)	-3.79 (1.15)	-0.52 (0.18)	-0.15 (0.05)
State FE	Yes	Yes	Yes	Yes
Yr-Qtr FE	Yes	Yes	Yes	Yes
N	1,156	1,156	1,156	1,156
Sample Mean	1.1	9.8	1.8	0.4

Notes: The outcome is the ratio of the number of job postings for different healthcare occupations to the number of nurse practitioner postings in each state-quarter-year. SOP Short-Run is defined as the quarters associated with the year of adoption and one year after adoption. SOP Long-Run is defined as the quarters associated with two or more years after adoption. Always treated SOP states are excluded from the analyses. Standard errors are clustered at the state level.

Table 6: Effects of Full NP SOP on Skills in BGT Job Postings for Nurse Practitioners, BGT Data, 2011Q1 - 2019Q2

	Number of BGT Skills	Number of Skill Groupings	Skill Groupings									
			General Care Skills	Specialized Care Skills	Emergency Care Skills	Mental Health Skills	Healthcare Support Skills	Office Support Skills	Leadership Skills	Other Skills		
1 Year Pre	(1) 0.47 (0.42)	(2) 0.08 (0.12)	(3) 0.01 (0.02)	(4) -0.03 (0.02)	(5) 0.01 (0.02)	(6) 0.03 (0.03)	(7) 0.05 (0.03)	(8) 0.02 (0.02)	(9) -0.01 (0.01)	(10) -0.00 (0.02)		
SOP Short-Run	0.18 (0.37)	-0.03 (0.11)	-0.02 (0.02)	-0.00 (0.02)	-0.02 (0.01)	0.02 (0.02)	-0.00 (0.03)	0.00 (0.03)	0.01 (0.01)	-0.01 (0.02)		
SOP Long-Run	-0.26 (0.45)	-0.09 (0.14)	-0.02 (0.03)	0.00 (0.02)	-0.04 (0.01)	0.02 (0.03)	-0.01 (0.03)	-0.02 (0.03)	-0.00 (0.01)	-0.00 (0.02)		
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Yr-Qtr FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Observations	1,156	1,156	1,156	1,156	1,156	1,156	1,156	1,156	1,156	1,156		
Sample Mean	6.8	3.2	0.62	0.40	0.18	0.29	0.49	0.34	0.09	0.78		

Notes: The outcome is either the average number of skills per job posting (columns 1 and 2) or the probability that a job posting includes a skill associated with a specific skill grouping (columns 3-10) – both computed at the state-quarter-year level. SOP Short-Run is defined as the quarters associated with the year of adoption and one year after adoption. SOP Long-Run is defined as the quarters associated with two or more years after adoption. Always treated SOP states are excluded from the analyses. Sample means differ slightly from the means in Table 2 because these means are based on a straight average of state-quarter-year averages and the means use only the analytic sample. Standard errors are clustered at the state level.

Table 7: Effects of Full NP SOP on Earnings, ACS Data, 2010-2019

	Nurse Practitioners	Physicians	Registered Nurses	Licensed Practical Nurses	Physician Assistants
	(1)	(2)	(3)	(4)	(5)
1 Year Pre	0.00 (0.03)	0.04 (0.02)	0.01 (0.01)	-0.01 (0.02)	-0.03 (0.04)
SOP Short-Run	0.06 (0.02)	-0.02 (0.02)	0.00 (0.01)	0.01 (0.01)	-0.06 (0.03)
SOP Long-Run	0.05 (0.02)	0.01 (0.01)	0.01 (0.01)	-0.03 (0.02)	-0.04 (0.03)
State FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	9,591	32,530	184,587	44,724	7,049

Notes: The outcome is the natural log of individual earnings and each column presents results from a separate regression on full-time aged 25-60 workers in a specific occupation. SOP Short-Run is defined as the year of adoption or one year after adoption. SOP Long-Run is defined as two-years or more after adoption. Always treated SOP states are excluded from the analyses. Standard errors are clustered at the state level.

Table 8: Effects of Full NP SOP on Employment, ACS Data, 2010-2019

	Nurse Practitioners	Physicians	Registered Nurses	Licensed Practical Nurses	Physician Assistants
	(1)	(2)	(3)	(4)	(5)
<i>Panel A: Natural Log of Total Employment</i>					
1 Year Pre	0.16 (0.11)	0.14 (0.07)	0.03 (0.02)	0.00 (0.07)	-0.03 (0.09)
SOP Short-Run	0.02 (0.13)	0.10 (0.09)	-0.02 (0.03)	0.07 (0.07)	0.08 (0.14)
SOP Long-Run	-0.05 (0.09)	0.03 (0.05)	-0.03 (0.03)	0.10 (0.06)	0.10 (0.11)
N	338	340	340	340	337
<i>Panel B: Relative Employment</i>					
1 Year Pre		-0.16 (0.81)	-0.21 (4.00)	-0.65 (0.74)	-0.08 (0.12)
SOP Short-Run		0.43 (0.60)	-0.51 (2.34)	0.13 (0.86)	-0.01 (0.20)
SOP Long-Run		0.26 (0.49)	-0.45 (2.04)	0.13 (0.71)	0.04 (0.11)
N		333	328	330	326
Sample Mean		6.06	21.06	2.71	0.77

Notes: The outcome in Panel A is the natural log of total occupational employment at the state-year level. The outcome in Panel B is the ratios of total employment for each healthcare occupation relative to the total NP employment. All employment totals are limited to workers aged 25-60 employed full-time. All specifications include state and year fixed effects. SOP Short-Run is defined as the year of adoption or one year after adoption. SOP Long-Run is defined as two-years or more after adoption. Always treated SOP states are excluded from both analyses and relative employment ratios more than two standard deviations from the mean (within each occupation) are also excluded from the ratio analysis. Standard errors are clustered at the state level.

Table 9: Effects of Full NP SOP on NP Place of Service, ACS Data, 2010-2019

	Employer Type Among Non-Self Employed				
	Self- Employment	Hospitals	Physicians Offices	Outpatient Care Centers	Other
	(1)	(2)	(3)	(4)	(5)
1 Year Pre	-0.003 (0.015)	0.071 (0.089)	-0.064 (0.065)	-0.022 (0.034)	0.015 (0.035)
SOP Short-Run	0.014 (0.008)	0.015 (0.054)	-0.034 (0.032)	-0.011 (0.024)	0.030 (0.024)
SOP Long-Run	0.018 (0.006)	-0.056 (0.041)	0.007 (0.044)	0.035 (0.015)	0.013 (0.028)
State FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Sample Mean	0.03	0.40	0.26	0.16	0.19
Observations	12,182	11,790	11,790	11,790	11,790

Notes: The outcome is an indicator for being self-employed (column 1) or for being employed at a different employer type (column 2-5). The sample includes all NPs aged 25-60, where columns 2-5 exclude self-employed NPs. SOP Short-Run is defined as the year of adoption or one year after adoption. SOP Long-Run is defined as two-years or more after adoption. Always treated SOP states are excluded from the analyses. Standard errors are clustered at the state level.

Table 10: Robustness Estimates for NPs in BGT Analysis

	Preferred Specification	All States	Common Adoption Period	Exclude No ACA Exp. States
	(1)	(2)	(3)	(4)
<i>Panel A: Effect on Natural Log of NP Job Postings</i>				
1 Year Pre	-0.104 (0.10)	-0.105 (0.10)	-0.009 (0.13)	-0.122 (0.11)
SOP Short-Run	0.01 (0.11)	-0.033 (0.01)	0.10 (0.09)	-0.034 (0.12)
SOP Long-Run	0.27 (0.12)	0.20 (0.12)	0.30 (0.15)	0.21 (0.13)
N	1,156	1,734	1,054	816
<i>Panel B: Effect on Relative Number of Job Postings (RNs : NPs)</i>				
1 Year Pre	0.49 (0.77)	0.46 (0.74)	-0.60 (0.71)	0.56 (0.82)
SOP Short-Run	0.11 (1.05)	0.25 (1.01)	-1.13 (0.67)	0.44 (1.18)
SOP Long-Run	-3.79 (1.15)	-3.34 (1.13)	-3.96 (1.28)	-3.20 (1.28)
N	1,156	1,734	1,054	816

Notes: See notes for Tables 4-5. Column (2) presents estimates that use always treated states as control states. Column (3) presents estimates when we limit our treatment sample to Full NP SOP adopting states over the two-year period (7/1/14 - 6/1/16) as the treated states. Column (4) presents estimates when we exclude states that did not expand Medicaid from the control sample. SOP Short-Run is defined as the year of adoption or one year after adoption. SOP Long-Run is defined as two-years or more after adoption. Standard errors are clustered at the state level.

Table 11: Robustness Estimates for NPs in ACS Data

	(1)	(2)	(3)	(4)	(5)	(6)
	Preferred Specification	No Earnings Restrictions	All States	Common Adoption Period	Exclude No ACA Exp. States	No Sample Weights
Panel A: Effect on Natural Log of Earnings for NPs working Full-Time						
1 Year Pre	0.00 (0.03)	0.01 (0.03)	-0.01 (0.03)	-0.01 (0.04)	-0.01 (0.03)	0.02 (0.01)
SOP Short-Run	0.06 (0.02)	0.05 (0.02)	0.06 (0.02)	0.05 (0.02)	0.06 (0.02)	0.04 (0.01)
SOP Long-Run	0.05 (0.02)	0.08 (0.03)	0.04 (0.02)	0.04 (0.02)	0.04 (0.02)	0.04 (0.02)
N	9,591	10,071	10,901	9,147	6,126	9,591
Panel B: Effect on Self-Employment						
1 Year Pre	-0.003 (0.015)		-0.004 (0.015)	0.012 (0.013)	-0.005 (0.012)	-0.002 (0.014)
SOP Short-Run	0.014 (0.008)		0.016 (0.008)	0.021 (0.008)	0.013 (0.010)	0.011 (0.009)
SOP Long-Run	0.018 (0.006)		0.021 (0.006)	0.017 (0.005)	0.018 (0.007)	0.016 (0.009)
N	12,182		13,916	11,616	7,772	12,182
Panel C: Effect on Relative Employment (RNs : NPs)						
1 Year Pre	-0.21 (4.00)		0.72 (4.02)	-0.84 (4.20)	-1.76 (3.37)	-0.65 (3.88)
SOP Short-Run	-0.51 (2.34)		-0.44 (2.26)	-1.27 (2.49)	0.10 (3.05)	-0.33 (2.33)
SOP Long-Run	-0.45 (2.04)		-0.62 (2.09)	-0.79 (2.33)	0.74 (1.72)	-0.73 (1.91)
N	328		483	228	301	328

Notes: See notes for Tables 7-9. Column (2) presents estimates when we include topcoded and winsorized earnings levels. Column (3) presents estimates that use always treated states as control states. Column (4) presents estimates when we limit our treatment sample to Full NP SOP adopting states over the two-year period (7/1/14 - 6/1/16) as the treated states. Column (5) presents estimates when we exclude states that did not expand Medicaid from the control sample. Column (6) presents results when we do not use the sample weights as weights in our estimates. SOP Short-Run is defined as the year of adoption or one year after adoption. SOP Long-Run is defined as two-years or more after adoption. Standard errors are clustered at the state level.

APPENDIX

Figure A1: Event Study for Full NP SOP on Natural Log Total NP Job Postings

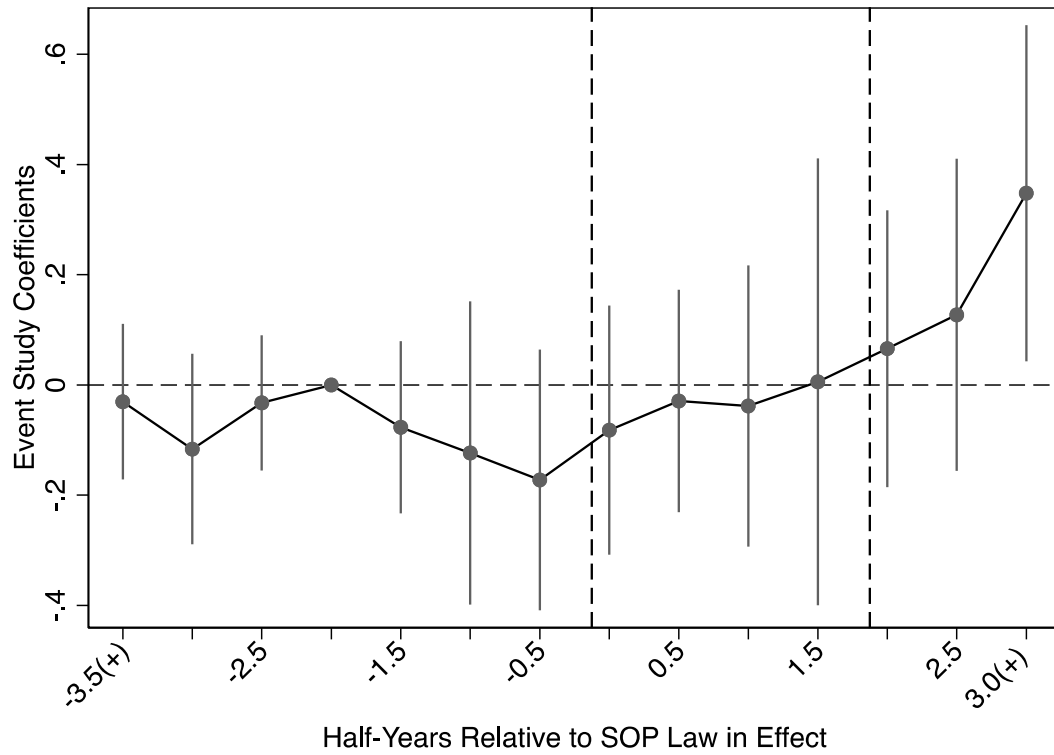


Table A1: BGT Skills Included in our Skill Groupings

General Care Skills	Healthcare Support (continued)	Office & Business Support (continued)	Leadership (continued)
Advanced Patient Care	Basic Living Activities Support	General Marketing	Program Management
Basic Patient Care	Blood Collection	General Networking	
General Medical Tests and Procedures	Exercise Training	General Sales	Other Skills
General Medicine	First Aid	General Sales Practices	Art and Illustration
Geriatrics	Healthcare Procedure and Regulation	General Shipping and Receiving	Biologics Industry Knowledge
Healthcare Procedure and Regulation	Medical Procedure and Regulation	Graphic and Visual Design Software	Biology
Injury Treatment	Medical Support	Health Information Management and Security	Broadcasting Industry Knowledge
Pediatrics	Mobility Assistance	Housekeeping	Chemical Analysis
Routine Examination Tests and Procedures	Nutrition and Diet	Human Resource Management and Planning	Chemistry
	Occupational Health and Safety	Labor Compliance	Child Care
Specialized Care Skills	Patient Education and Support	Management Information System (MIS)	Child Development
Allergies	Patient Physical Measurements	Market Analysis	Civil and Architectural Engineering
Anesthesiology	Physical Abilities	Marketing Management	Clinical Informatics
Cardiology	Physical Therapy	Marketing Strategy	Clinical Research
Cellular Biology	Public Health and Disease Prevention	Medical Billing and Coding	Construction Management
Dental Care	Rehab Therapy	Medical Documentation and Abstraction	Data Analysis
Dermatology	Rehabilitation	Medical Records	Drug Development
Ear, Nose, and Throat	Social Work	Microsoft Development Tools	Education Administration
Endocrinology		Microsoft Office and Productivity Tools	Environmental Work
Eye Care	Office & Business Support Skills	Office Machines	Equipment Repair and Maintenance
Gastroenterology	Administrative Support	Operations Management	Food and Beverage Service
Genetics	Advanced Customer Service	Order Management	Foreign language skills
Infectious Diseases	Auditing	Patient Reception	Hazardous Waste Management
Nephrology	Basic Customer Service	PHP Web	Instructional and Curriculum Design
Neurology	Billing and Invoicing	Process Improvement	Laboratory Research
Neuroscience	Brand Management	Procurement	Law Enforcement and Criminal Justice
Nuclear Medicine	Budget Management	Product Development	Lean Manufacturing
Obstetrics and Gynecology (OB/GYN)	Business Communications	Project Management	Litigation
Oncology	Business Process and Analysis	Public Relations	Mathematics
Orthopedics	Business Solutions	Quality Assurance and Control	Medical Research
Pathology	Claims Processing	Recruitment	Molecular Biology
Pharmacy	Clinical Data Management	Regulation and Law Compliance	Music
Pulmonology	Compensation and Benefits	Sales Management	na
Radiology	Computer and Information Technology Industry Knowledge	Scheduling	Peer Review
Speech Language Pathology	Contract Management	Social Media	Physics
Surgery	Customer Relationship Management (CRM)	Software Development Principles	Research Methodology
Urology	Cybersecurity	Specialized Sales	Retail Industry Knowledge
	Data Management	System Design and Implementation	Robotics
Emergency Care Skills	Data Techniques	Web Development	Simulation
Emergency and Intensive Care	Database Administration		Social Services Industry Knowledge
Emergency Services	Dictation	Leadership Skills	Surveillance
	Employee Relations	Business Development	Talent Management
Mental Healthcare Skills	Enterprise Resource Planning (ERP)	Business Management	Teaching
Mental and Behavioral Health Specialties	Financial Advisement	Business Strategy	Technical Support
Mental Health Diseases and Disorders	Financial Management	Employee Training	Telecommunications
Mental Health Therapies	Financial Reporting	Leadership and Management	Training Programs
	Financial Risk Management	Office Management	Writing
Healthcare Support Skills	General Accounting	People Management	
Alternative Therapy	General Administrative and Clerical Tasks	Performance Management	

Notes: This figure excludes any BGT skill (called "skill clusters" in the BGT data) comprising less than 0.01 percent of all skills mentioned in the BGT postings, in terms of frequency. This (includes three "Specialized Care" skills together comprising 0.018 percent of skills mentioned), three "Healthcare Support" skills (together comprising 0.004 percent of all skills mentioned), (133 "Office and Business Support" skills together comprising 0.382 of all skills mentioned), and 246 "Other" skills (together comprising 0.301 percent of all skills mentioned). Thus, this table lists more than 99 percent of all skill mentioned in the BGT data, in terms of frequency of being mentioned. BGT Skills within skill groupings are organized alphabetically.

**Table A2: Full NP SOP on NP Job Postings
Effects by HPSA Designation**

	Full HPSA Counties	Full Other Counties
	(1)	(2)
1 Year Pre	-0.11 (0.10)	-0.21 (0.19)
SOP Short-Run	0.05 (0.12)	-0.12 (0.17)
SOP Long-Run	0.31 (0.14)	0.30 (0.17)
State FE	Yes	Yes
Yr-Qtr FE	Yes	Yes
N	1,089	1,156

Notes: See notes from Table 4.

Table A3: Effects of Full NP SOP on Skill in BGT Job Postings for Primary Care Physicians
BGT Data, 2011Q1 - 2019Q2

	Number of BGT Skills	Number of Skill Groupings	Skill Groupings							
			General Care Skills	Specialized Care Skills	Emergency Care Skills	Mental Health Skills	Healthcare Support Skills	Office Support Skills	Leadership Skills	Other Skills
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1 Year Pre	0.19 (0.18)	-0.06 (0.06)	-0.00 (0.02)	-0.02 (0.01)	-0.01 (0.01)	-0.00 (0.01)	-0.01 (0.02)	-0.01 (0.02)	-0.01 (0.01)	-0.01 (0.02)
SOP Short-Run	-0.07 (0.14)	-0.09 (0.06)	-0.02 (0.01)	0.00 (0.02)	-0.00 (0.01)	-0.01 (0.01)	-0.02 (0.02)	-0.01 (0.01)	-0.01 (0.00)	-0.03 (0.03)
SOP Long-Run	0.01 (0.17)	-0.02 (0.08)	-0.00 (0.01)	-0.02 (0.01)	-0.01 (0.01)	-0.01 (0.02)	-0.02 (0.03)	-0.00 (0.02)	0.01 (0.01)	0.02 (0.04)
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yr-Qtr FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample Mean	4.2	2.2	0.73	0.36	0.03	0.12	0.22	0.18	0.04	0.48
N	1,156	1,156	1,156	1,156	1,156	1,156	1,156	1,156	1,156	1,156

Notes: The outcome is an either the average number of skills per job posting (columns 1 and 2) or the probability that a job posting includes a skill associated with a specific skill grouping (columns 3-10) – both computed at the state-quarter-year level. SOP Short-Run is defined as the quarters associated with the year of adoption and one year after adoption. SOP Long-Run is defined as the quarters associated with two or more years after adoption. Always treated SOP states are excluded from the analyses. Sample means differ slightly from the means in Table 2 because these means are based on a straight average of state-quarter-year averages and the means use only the analytic sample. Standard errors are clustered at the state level.

**Table A4: Effects of Full NP SOP on Self-Employment
ACS Data, 2010 - 2019**

	Physicians	Nurse Practitioners	Licensed Practical Nurses	Physician Assistants
	(1)	(2)	(3)	(4)
1 Year Pre	0.019 (0.016)	0.003 (0.002)	0.002 (0.005)	0.004 (0.011)
SOP Short-Run	0.014 (0.009)	0.002 (0.001)	-0.003 (0.003)	0.008 (0.006)
SOP Long-Run	0.018 (0.013)	0.001 (0.001)	-0.004 (0.005)	0.013 (0.007)
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Sample Mean	0.18	0.008	0.016	0.028
N	68,755	244,231	63,050	9,298

Notes: The outcome is an indicator for being self-employed. SOP Short-Run is defined as the year of adoption or one year after adoption. SOP Long-Run is defined as two-years or more after adoption. Always treated SOP states are excluded from the analyses. Standard errors are clustered at the state level.