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Marcus Dillender
The University of Illinois at Chicago

Andrew Friedson
University of Colorado, Denver

Cong Gian
Indiana University

Kosali Simon
Indiana University

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Marcus Dillender*
School of Public Health,
University of Illinois at Chicago

Andrew Friedson
Department of Economics,
University of Colorado Denver

Cong Gian
O'Neill School of Public Affairs,
Indiana University

Kosali Simon
O'Neill School of Public Affairs,
Indiana University

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ABSTRACT

The Patient Protection and Affordable Care Act (ACA) increased demand for healthcare across the U.S., but it is unclear if or how the supply side has responded to meet this demand. In this paper, we take advantage of plausibly exogenous geographical heterogeneity in the ACA in order to examine the response of the healthcare education sector to increased demand for healthcare services. We look across educational fields, types of degrees, and types of institutions; we pay particular attention to settings where our conceptual model predicts heightened responses. We find no statistically significant evidence of increases in graduates and can rule out fairly modest effects. This implies that healthcare production may have adjusted to increased demand from insurance expansion in other ways rather than primarily through new graduates from local healthcare educational markets.

JEL Classification Codes: I13, I23, J21

Key Words: healthcare workforce, demand for schooling, educational pipeline, Affordable Care Act, Medicaid expansion

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1. Introduction

Concern regarding the adequacy of the U.S. healthcare workforce has guided public policy for several decades (McHugh et al. 2008; Bärnighausen and Bloom 2011; Donelan et al. 2010). Policy interventions (e.g., visa waivers, federal loan programs) have attempted to influence demand and supply for healthcare workers along both geographic and specialty lines (Richards, Chou, and Sasso 2009). Additionally, the recent rise in opioid overdose mortality has heightened concerns about the adequacy of the existing workforce for treating addiction disorders, leading to large infusions of government funds to increase workforce education and training (Beck, Manderscheid, and Buerhaus 2018). Sustained recruitment policy efforts suggest a lack of adequate response in the educational market to demand for workers in the healthcare sector.

Evidence from studies of local economic conditions suggests that the educational sector on the whole appears very responsive to local economic conditions for workers in general (Blom, Cadena, and Keys 2015; Hershbein 2012; Kahn 2010; Johnson 2013) as well as to expectations about future returns to specific degrees (Baker et al. 2018; Long, Goldhaber, and Huntington-Klein 2015; Wiswall and Zafar 2015). However, these studies also provide evidence suggesting that students are often not fully aware of labor market conditions when choosing general educational avenues. Furthermore, the political sustainability of the Patient Protection and Affordable Care Act (ACA) has been in question from its inception, with over 50 congressional attempts at repeal by early 2014 (O'Keefe 2014), which may have affected long-term decision making regarding career choices. Thus, it is not clear that healthcare education would respond to the increased demand for healthcare arising from insurance enrollment gains following policies such as the ACA. Understanding the education sector response is important for economists insofar as it provides evidence on structural economic adjustment behavior to downstream demand shocks, particularly when such shocks occur through upstream public policy actions.

In this study, we examine whether increases in demand for healthcare resulting from the ACA led to subsequent responses in the education market (i.e., training additional workers to meet that demand) in the short run. The 2014 provisions of the ACA insured about 20 million low-to-middle-income non-elderly adults (Garrett and Gangopadhyaya 2016). Going at least as far back as the RAND Health Insurance Experiment (Manning et al. 1987), there is a considerable body

of evidence demonstrating that expanded health insurance coverage and increased health insurance generosity increase utilization of healthcare by lowering the amount that the consumer pays for care. Indeed, the 2014 components of the ACA expanded both insurance enrollment and utilization of care considerably (Courtemanche et al. 2017; Courtemanche et al. 2019; Frean, Gruber, and Sommers 2017; Kaestner et al. 2017; Simon, Soni, and Cawley 2017; Shartzer, Long, and Anderson 2015; Sommers, Blendon, and Orav 2016; Sommers et al. 2015; Wherry and Miller 2016; Miller and Wherry 2017). However, it is unclear how, if at all, the supply side of the healthcare market adjusted to the influx of the newly insured under the ACA.

Shortages of healthcare workers were a major concern even before the ACA was fully implemented (Sargen, Hooker, and Cooper 2011; Frogner et al. 2015; Ku et al. 2009; Bodenheimer and Pham 2010; Juraschek et al. 2012; Dall et al. 2017; Staiger, Auerbach, and Buerhaus 2012; Kaiser Family Foundation 2009). If the healthcare sector did not have excess capacity prior to the ACA, then to avoid congestion problems, other adjustments within the healthcare market would be necessary to meet the new demand for care upon full implementation of the ACA. For example, the market could increase utilization of labor inputs (increasing hours, hiring more workers, or adjusting the mix of workers to take greater advantage of gains from specialization) or could employ new technologies that allow for greater worker productivity (for example, telehealth; Chen, Mehrotra, and Auerbach 2014). However, to some extent the market did not fully adjust, or did not adjust as quickly as necessary: congestion problems have already been observed in wait times for Medicaid appointments (Miller and Wherry 2017) and in the ambulance sector (Courtemanche et al. 2019).

Dillender (2018) documents that the healthcare sector did increase the demand for healthcare labor as measured by additional job postings. However, it is unknown if this demand for new workers was met, and if so, if it was met by existing reserve workers, by workers from other countries or sectors, or by newly trained workers. Similarly, it is not clear if students or schools have reacted to the increased demand, or if they even perceived the increased demand to likely last in the long term, given the ACA's political uncertainty.[1] Our study complements this work

[1] It is also possible that schools in non-expansion states expected to have their state expand in the near future and initiated steps to expand their programs.

by exploring the extent to which the educational pipeline for health professionals responded to additional demand in the healthcare labor market. Specifically, we examine whether the number of healthcare degrees completed, which is the joint product of demand and supply in the education market, increased in states that expanded Medicaid under the ACA relative to states that did not expand Medicaid. To do this, we utilize graduation counts in health professional training programs that were mandatorily reported via the Integrated Postsecondary Education Data System (IPEDS). We find no evidence of educational pipeline increases and are able to rule out fairly small magnitudes, even in the case of subsectors that might be particularly responsive (such as one-year degrees). Our results thus imply that pipeline increases for healthcare degrees do not represent one of the major ways in which the supply side is adjusting.

2. Background and Literature Review

During the implementation of the ACA, many stakeholders pointed to the need for increased education and training of healthcare workers and argued that the ACA would be a boon for the healthcare industry (Institute of Medicine 2014; White 2018); this suggests potential for the ACA to lead to an increase in healthcare education enrollment. However, it remains unclear whether the ACA's Medicaid expansions, which account for much of the increase in health insurance coverage, indeed influenced education decisions, particularly given the tendency of Medicaid to reimburse providers at lower rates than other forms of insurance (Zuckerman, Williams, and Stockley 2009; Mabry et al. 2016).

While the ACA did not include major changes to funding for medical education, it did redistribute the allocation of resident slots for physicians so that hospitals in states with lower resident-to-population ratios have more slots as of 2011. As many non-Medicaid-expansion states had low resident-to-population ratios prior to the ACA (Mullan, Chen, and Steinmetz 2013), this redistribution likely brought more resident slots to states that did not expand Medicaid. This redistribution could have reduced the need for additional physicians in states that gained resident slots. However, since the market for physicians tends to be national, we would not expect changes to local conditions to have large effects on physician training. Other changes to medical education from the ACA are small. For example, the ACA funded nurse practitioner programs as part of a demonstration project limited to five hospitals and their associated care

networks (Barnes et al. 2018; Clark-Shirley et al. 2018). Other recent reforms, such as the Massachusetts Health Insurance Reform of 2006, expanded state-level loan forgiveness programs, which incentivized interstate migration of healthcare labor (Massachusetts Department of Public Health 2008; Friedson and Marier 2017).[2]

While prices in private markets can freely adjust through market forces to address shortages, Medicaid and Medicare payments are set by the government, potentially causing imbalances between demand and supply sides of relevant markets (such as labor shortages) to persist. Given concerns about shortages of healthcare workers, which in many cases pre-date the ACA (Sargen, Hooker, and Cooper 2011; Frogner et al. 2015; Ku et al. 2009; Bodenheimer and Pham 2010; Juraschek et al. 2012; Dall et al. 2017; Staiger, Auerbach, and Buerhaus 2012; and Kaiser Family Foundation 2009), coupled with the fact that demand from public health insurance is expected to continue to grow as more states adopt Medicaid expansions and more of the U.S. population becomes age-eligible for Medicare, how the education pipeline for healthcare workers has responded to increased demand for healthcare has important implications for the health of the entire sector.

The ACA Medicaid Expansions

Medicaid is a federal-state partnership program that provides health insurance to people with low incomes and to those with qualifying disabilities. Though the federal government sets baselines for which populations qualify and for what services must be covered by the plan, each state is allowed some leeway in increasing generosity while using federal matching funds, and greater leeway in expansions that involve state-only funds. While Medicaid has traditionally provided coverage to low-income families with children, the ACA initially required that states expand Medicaid coverage to all non-elderly adults with incomes below 138 percent of the Federal Poverty Level (FPL) in 2014 or lose all federal Medicaid funding.[3] However, in the 2012 case of

[2] Staiger, Auerbach, and Buerhaus (2011) also found that healthcare employment grew faster in Massachusetts relative to control states following the Massachusetts health insurance reform.

[3] Under the Medicaid expansion, the federal government provided a proportion of the additional funds needed for the program expansion that was far larger that its usual contribution. Prior to the ACA expansion, usual federal contributions covered between 50 and 73.05 percent of a state's Medicaid program, whereas under the expansion, the newly insured would receive 100 percent federal funding for the first year, falling eventually to 90 percent federal funding for 2020 and onward. See Rudowitz (2014) for further details.

National Federation of Independent Business v. Sebelius, the U.S. Supreme Court ruled that taking away all other Medicaid funding for noncompliance was unconstitutional, meaning that states could opt out of the Medicaid expansion without punishment. As of the end of 2017, 33 states and the District of Columbia had adopted the ACA's Medicaid expansion.

Previous research has documented the effect of the ACA's Medicaid expansions on health insurance coverage. These studies have found that the expansion increased the number of insured Americans and their use of healthcare services (Courtemanche et al. 2017; Courtemanche et al. 2019; Frean, Gruber, and Sommers, 2017; Kaestner et al. 2017; Simon, Soni, and Cawley 2017; Shartzer, Long, and Anderson 2015; Sommers, Blendon, and Orav 2016; Sommers et al. 2015; Wherry and Miller 2016). As with other Medicaid expansions, the research that considers crowd-out arising from the ACA's Medicaid expansions finds that the ACA's Medicaid expansion crowded out some private coverage. For example, Kaestner et al. (2017) find that about 25 percent of people who received Medicaid coverage from the ACA's Medicaid expansion would have had private coverage if not for the Medicaid expansion. Given that private coverage tends to reimburse at higher rates than Medicaid does, this crowd-out has implications for the potential educational response to the ACA's Medicaid expansion at the margin. To the extent that there was crowding out of private coverage that reimburses providers at high rates, the Medicaid expansion may have led to a smaller increase in the educational pipeline for new healthcare workers. However, it should be noted that the ACA temporarily increased Medicaid reimbursement rates to equal Medicare reimbursement rates for primary care services for 2013 and 2014, so Medicaid's reimbursement rates were not as far below private reimbursement rates during these years.

The increases in health insurance coverage from the ACA would be expected to increase the demand for healthcare. Ahead of the ACA's full implementation, Abraham (2014) produced a variety of estimates of the likely impact of the ACA's coverage expansions on the demand for healthcare using data from the Medical Expenditure Panel Survey (MEPS) and estimates of the effect of health insurance coverage from the prior literature. Abraham's MEPS analysis, which assumes that the newly insured would respond to having health insurance in the same way as the typical publicly insured patient, suggests that the ACA would be expected to increase inpatient

stays, emergency department visits, office-based visits, and prescription drugs by 3 to 6 percent. The implied effects from estimates in the literature suggest a wider range of possible effects of the ACA for inpatient stays, emergency department visits, and prescription drugs, while the implied effect on office-based visits is a 6 to 10 percent increase. Estimates of the effect of the ACA's Medicaid expansion vary widely across studies and settings, but the evidence points to sizable increases in the use of healthcare from the expansions, particularly for elective services like primary care, mental healthcare, and preventive care. Mazurenko et al. (2018) provide a review of early research on the effects of the ACA's Medicaid expansion.

The increase in the use of healthcare services due to the ACA, coupled with concerns about shortages of healthcare workers, leads to the possibility of increased wait times and decreased access to care. Early research examining spillovers has found mixed results. While Benitez, Perez, and Tipirneni (2018) and Carey, Miller, and Wherry (2018) do not find evidence that the Medicaid expansion increased wait times or had negative spillovers on the previously insured, Courtemanche et al. (2019) find evidence that counties that experienced larger increases in health insurance coverage from the ACA also experienced increased wait times for ambulances, and Miller and Wherry (2017) find that Medicaid enrollees faced longer wait times to get appointments in states that expanded their Medicaid programs.

Evidence on the impact of the ACA on local labor market outcomes has been limited. Dillender (2018) finds that healthcare employers have posted more advertisements for healthcare workers in response to the ACA's Medicaid expansions. This finding is consistent with earlier findings that dental providers respond to Medicaid dental expansions by hiring more hygienists (Buchmueller, Miller, and Vujicic 2016). However, while Dillender's (2018) study suggests an attempted employer hiring response to increased Medicaid coverage, it is unclear whether the positions were filled, and if so where the workers came from, especially since the increase in attempted hiring largely applied to lower-skilled, less mobile professions and because unemployment for healthcare sector workers was already low prior to the ACA. A change in the education pipeline is one possible source of additional healthcare workers, but little research has explored the impact of Medicaid expansions on this pipeline.

3. Conceptual Framework

In general, educational decisions respond to local economic conditions (Blom, Cadena, and Keys 2015; Hershbein 2012; Kahn 2010; Johnson 2013) as well as to expectations about the future returns of specific degrees (Baker et al. 2018; Long, Goldhaber, and Huntington-Klein 2015; Wiswall and Zafar 2015). However, responsiveness depends on how well such signals are transmitted to potential students (Hastings, Neilson, and Zimmerman 2015). This holds true in the healthcare sector as well, where educational decisions and specialty choices are driven by an individual's rate of return for a degree and specialty.[4] The main difference for the healthcare sector is that, because of strict licensure requirements in many parts of the healthcare workforce, the expected return of education often includes economic rents due to restricted entry (Kleiner et al. 2016).

We expect that the impact of the ACA on the educational pipeline will depend on how the ACA influenced an individual's perceived rate of return for medical education. As the ACA did not directly influence licensure requirements or other barriers to entry, any changes would stem from an individual's perception of future employment stability and earnings.[5] From the point of view of a potential student in healthcare, the effect of the ACA on these outcomes is somewhat ambiguous: individual earnings will be determined in part by the volume and payer mix of patients seen by an individual's employer. Thus, an increase in individuals with Medicaid health insurance could increase worker earnings; it could also decrease those earnings if the patient mix shifts toward patients with less generous insurance plans, such as Medicaid. Further, to the extent that potential students see the ACA as temporary, any effect of the policy on their decisions would be muted.[6]

It is also possible that the ACA has impacted the educational pipeline for the healthcare workforce by influencing the behavior of educational institutions; since graduation outcomes are

[4] See Nicholson and Propper (2012) for a review of the relevant literature.
[5] We assume that the ACA did not systematically change individuals' perception of other sources of utility from a medical career, such as job satisfaction.
[6] Potential students may be constrained by their ability to afford schooling or may run up against borrowing limits that constrain their ability to finance a degree. However, loan limits are higher for healthcare degrees than for other degrees at a similar level of education. See for example the limits on unsubsidized Stafford loans: https://www.edvisors.com/college-loans/federal/stafford/graduate/.

the joint product of individual- and organization-level choices, it is unclear how the educational sector's output would be affected. Schools would need to be convinced that the ACA creates additional demand for their educational services, that this increase is worth expanding their offerings (either by increasing cohort sizes or by offering new programs), and that the increase is sustainable (i.e., that the ACA will not be short-lived). But even if schools want to increase their healthcare offerings, it is not clear that they will be able to do so, as an inability to find faculty or clinical sites can often prevent schools from expanding healthcare education (Cleary et al. 2009). For example, it is possible that increases in utilization of care may force hospitals to reallocate labor resources toward meeting patient needs and away from traineeship offerings, making it difficult for schools to get students needed clinical experience. Additionally, institutions that depend heavily on public funding may be less flexible if public budgets are not adjusted to match desired growth of the institution.

The above conceptual framework helps make some predictions. If the ACA Medicaid expansion has indeed induced the healthcare educational pipeline to increase the volume of new healthcare workers, then we might expect certain types of degrees to be more responsive. Specifically, degrees that take less time to complete would represent a smaller time investment for students and a smaller resource investment for educational institutions, and as such may be the quickest to respond to any signals from the labor market when the changes to those signals have an uncertain future. These short programs also tend to be for careers with smaller barriers to entry upon graduation, such as fewer and less complicated licensing exams.

4. Data

Our institution-level data on degree completion come from the Integrated Postsecondary Education Data System (IPEDS), which is compiled from surveys conducted by the U.S. Department of Education's National Center for Education Statistics. Participation in the surveys is required for all colleges, universities, and technical and vocational institutions that participate in the federal student financial aid programs by an amendment to the Higher Education Act of 1965. In addition to containing information about each academic institution, IPEDS contains counts of the number of graduates receiving degrees for each of the school's programs, which are the main outcome of interest in this study. This program-level information includes the

Classification of Instructional Programs code (CIPCODE), the number of years the program takes to complete, and whether the program is online. For more information on IPEDS data, refer to the IPEDS Data Center (2018).[7]

As our focus is on the educational pipeline for healthcare workers, we limit our analytical sample to degrees in healthcare professions, which are those with a two-digit CIPCODE of 51. We exclude from this sample medical degrees (MD and DO degrees) and dental degrees (D.D.S. and D.M.D.), as the physician and dentist labor market tends to be national, and changes in the rules for residency slots as part of the ACA make it difficult to accurately identify the sole effect of the Medicaid expansion as the number of slots increased in "control" states. Additionally, as physicians take many years to complete their education and enter the workforce, any response to the Medicaid expansion would only be partially captured in the time horizon of our data. This leaves all other postsecondary degrees tied to healthcare professionals.[8,9] To ensure that our sample includes several years both before and after the ACA Medicaid expansions, we study the school years ending between 2010 and 2017, which gives us four years of post-ACA data, making the interpretation of our results a short-run effect. IPEDS data also include information on type of institution; dividing institutions according to type of control and degree levels offered, we arrive at nine institutional categories.[10]

Information on states' decisions about adopting the Medicaid expansions comes from the Kaiser Family Foundation (2019). Most states that adopted the Medicaid expansion did so in January 2014 as the ACA originally stipulated, though several states did so at later dates. For our baseline results, we focus on states that expanded Medicaid in 2014.[11] Additionally, several states had

[7] For examples of other studies that use IPEDS data, refer to Deming et al. (2016); Denning, Marx, and Turner (2019); and Gilpin, Saunders, and Stoddard (2015).
[8] This includes degrees that are required before career advancement for practicing professionals, such as a master's in science in nursing (which is usually obtained by a registered nurse before becoming a nurse practitioner). Detailed definitions of degrees contained within each CIPCODE, as well as descriptions of degree length and institutional definitions within IPEDS, can be found in Appendix B.
[9] Distributions of graduates by number of years of completion and healthcare profession for our sample are presented in Appendix Figures A1–A3.
[10] Control categories are public, private not-for-profit, and private for-profit. Level categories are 4-year and higher (4 year), 2-year but less than 4-year (2 year), and less than 2-year. For example: public 4-year is one of the institution types.
[11] This excludes NH, PA, IN, AK, MT, and LA.

expanded health insurance coverage to childless adults substantially prior to 2014 and so were not fully treated by the ACA's Medicaid expansion. To avoid including states that are only partially treated in the treatment group, we exclude these states as well.[12] Each state's status as an early, on-time, late, or non-expander is shown in Figure 1.

We combine information from several other sources to arrive at our final analysis samples at both the state and county levels. We obtain population and unemployment rates from the Census Population Estimate and the Bureau of Labor Statistics. County-level versions of these variables come from the Census Bureau's Small Area Income and Poverty Estimates (SAIPE). Other county-level characteristics come from the County Health Rankings file from the Robert Wood Johnson Foundation.

Table 1 reports means and standard deviations for the variables most pertinent to our analyses at both the state and county levels. The first row of Table 1 shows means and standard deviations for the number of graduates in the healthcare sector in general. The next seven rows show means and standard deviations for relevant subsets of graduates based on field of study, length of study, and institution type.[13] The next five rows show the descriptive statistics for variables used as controls.

5. Empirical Strategy

To examine the effect of the ACA Medicaid expansion on the educational pipeline for the healthcare workforce, we first estimate the following difference-in-differences model using ordinary least squares (OLS):

$$y_{st} = \alpha_0 + \alpha_1(Post_t \times Expansion_s) + \alpha_2 X_{st} + \tau_s + \theta_t + \varepsilon_{st} \quad (1),$$

where y_{st} is number of degrees granted in all or subsets of healthcare educational programs, for state *s* in year *t*. $Post_t \times Expansion_s$ is a binary variable that takes on the value 1 during the

[12] This excludes CA, CT, MN, NJ, and WA. Several existing papers also classify these states as partial expansion states (see Wherry and Miller 2016; Soni et al. 2017; Kaestner et al. 2017; McMorrow et al. 2017).
[13] Additional information on the distribution of degrees by type and length to completion can be found in Appendix Figures A1–A3.

time period in which a state has expanded its Medicaid program; it takes on the value 0 otherwise, making α_1 the difference-in-differences estimator for the effect of the Medicaid expansion. Under the assumptions that degrees granted in expansion and non-expansion states followed parallel trends prior to the ACA, and that no other circumstances changed systematically in one group at the same time as the ACA Medicaid expansion, $\widehat{\alpha_1}$, the difference-in-differences estimator, is an estimate of the causal effect of the ACA Medicaid expansion on the number of degrees granted in the short run. τ_s is a vector of state fixed effects, θ_t is a vector of year fixed effects, and ε_{st} is an idiosyncratic error term. X_{st} is a vector of time varying state-level control variables including the unemployment rate, median household income, and the poverty rate. Standard errors are clustered at the state level. We also estimate the same model where the unit of observation is the county-year rather than the state-year. In these models we drop all counties with a population under 10,000 in the 2010 census to avoid control variables calculated with unreasonably small sample sizes.[14] For county-level analyses, we also test for openings or closings of the only healthcare educational program in a county due to the Medicaid expansion by estimating equation (1) with a binary variable for whether a county has any graduates as an outcome. The standard errors for the county-level analyses are also clustered at the state level.

We first estimate equation (1) for all healthcare degrees in the IPEDS. We then look at degrees that take less than one year to complete. We expect that programs with shorter time to completion are able to respond to increases in demand for additional workers more rapidly.[15] Though all institutional forms may see increased demand for education, it may be that private institutions are the savviest at adjusting to market conditions; they also may use more aggressive recruitment strategies (such as advertisement). We thus estimate equation (1) for for-profit institutions. We then run the analysis for several subsets of the data. We analyze the four most commonly awarded healthcare degree categories as a group and individually: Registered, Clinical Nursing, Nursing Admin, and Research (CIPCODE 51.38); Allied Health and Medical

[14] We also conducted county-level "dose response" analyses similar to the analyses found in Courtemanche et al. (2019) but did not obtain additional insights from them. We do not present the results in the main body of the paper, as these analyses failed the test for parallel trends, but they can be found in Appendix C.

[15] We also conducted this analysis for degrees taking one year or less excluding nursing degrees, to remove the effect of nursing continuing education for career advancement, which does not represent "new" entrants into the workforce. Results are similar with this additional restriction and are available upon request.

Assisting Services (CIPCODE 51.08); Health and Medical Admin Services (CIPCODE 51.07); and Practical Nursing, Vocational Nursing, and Nursing Assistants (CIPCODE 51.39).

To assess whether pretreatment trends differ between expansion and non-expansion states, as well as to explore the time pattern of the treatment effect, we use a full event study regression model as follows:

$$y_{st} = \beta_0 + \sum_{t=2010}^{2017} \beta_t * 1[year = t] * Expansion_s + \alpha_2 X_{st} + \tau_s + \theta_t + \varepsilon_{st} \qquad (2)$$

The vector of coefficients $\widehat{\beta_t}$ in equation (2) for the pretreatment interactions allows us to form a test for the parallel trend assumption, whereas the coefficients of posttreatment interactions help us capture additional impact in the years following the reform as well as the overall treatment effect. We use 2013, the year before most states expanded Medicaid, as the omitted year (year zero in event time). We estimate equation (2) for all of the subsamples used for equation (1).

While we can directly test for differential pre-trends between expansion and non-expansion states, it may still be the case that certain non-expansion states would provide more satisfactory counterfactuals than others. To help reinforce the validity of our analysis, in addition to estimating standard difference-in-differences models, we also implement the synthetic control method described by Abadie, Diamond, and Hainmueller (2010), which produces a set of weights for all non-expansion states that minimize the difference between pre-intervention outcomes in expansion and non-expansion states. After selecting the weights for our synthetic control group, we then calculate the estimated effect of the Medicaid expansion as the difference in mean degree completions between the expansion states and the synthetic control group following the Medicaid expansion.

We assess the statistical significance of our synthetic control estimates using permutation tests. Specifically, we randomly select 1,000 sets of 22 treatment states and then replicate the synthetic control approach for each set of randomly chosen treatment states. We then calculate the share of estimates from the randomly selected treatment states that are larger than our original estimate,

which is the *p*-value from a one-sided test and reflects the likelihood that we would obtain similarly sized estimates from randomly chosen treatment states.[16]

6. Results

Graphical Evidence

Figure 2 plots trends in the number of graduates with healthcare degrees separately for expansion and non-expansion states; the vertical dashed line is 2013, the last year before the implementation of the ACA Medicaid expansions. For both expansion and non-expansion states, the number of graduates remains steady and roughly parallel both pre- and post-ACA. Thus, these figures show no obvious changes in the overall data before or after the ACA expansion, in states with vs. without the expansion.

The above graphical analysis is repeated in Figure 3, Panel A. Panels B, C, and D show trends in graduates separately for the four most common health professions in the IPEDS, for all healthcare degrees that take less than one year to complete, and for healthcare degrees from for-profit institutions, respectively. Again, there is no obvious change in trend for Medicaid expansion states at the same time as the ACA Medicaid expansion. For degrees from for-profit institutions, there is a slight uptick in the number of degrees awarded in the non-Medicaid expansion states starting in 2015. In Figure 4, we plot trends in the number of graduates for each of the four most common degrees individually. There is also no obvious change in trend for Medicaid expansion states during the ACA Medicaid expansion in these subgroups. This graphical analysis suggests that healthcare degree receipt trended similarly prior to the ACA for both expansion and non-expansion states and also suggests that there were no major trend breaks after the ACA.

Difference-in-Differences

Table 2 reports results from our estimation of equation (1). Column 1 reports $\widehat{\alpha_1}$ for equations with the state-year as the unit of observation, whereas columns 2 and 3 are for equations with the county-year as the unit of observation. Columns 1 and 2 use number of graduates as the outcome

[16] See Hu et al. (2018) for an example of a study that takes a similar approach to study the effects of the ACA's Medicaid expansion.

variable, and column 3 uses a binary variable taking on the value of 1 if a county has at least one graduate (which we interpret to mean that the county has at least one program) and the value of 0 otherwise.[17] Each Panel (A through D4) represents a different subset of degrees, corresponding to the subsets used in the above graphical analysis. Only the difference-in-differences estimators ($\widehat{\alpha_1}$) are reported.[18]

We do not find an effect of Medicaid expansion on the number of graduates at either the state or county level that is significant at conventional levels; we are able to rule out year-over-year changes in statewide graduation as small as 1,715 graduates (5.6 percent of baseline) with 90 percent confidence in our main specification.[19] In our alternate specification that sets the dependent variable to be the log of the number of graduates plus one (Appendix Table A1), we can rule out increases as large as 2.8 percent of baseline, with 90 percent confidence. For comparison, Long, Goldhaber, and Huntington-Klein (2015) also use the IPEDs and find that increasing wages in a general field by 10 percent predicts an increase in graduations in majors associated with that field by up to 2.21 percent, thus the magnitude of effects we can rule out resulting from the ACA are similar to those associated with small but not miniscule incentive changes from other contexts. As states have an average of roughly 240,000 healthcare workers as of 2016,[20] the 90 percent confidence interval of our estimates can rule out a short-run increase in the annual rate of growth of the number of healthcare workers through degree attainment of more than 0.7 percent (1,715/240,000) for states on average.

This pattern of results, which indicates insignificant coefficients that can rule out fairly small effects, is consistent for all subsamples: in eight estimations of the effect of the Medicaid expansion at the state level and in eight estimations of the effect of the Medicaid expansion at the county level, we consistently find results that are not statistically significant at conventional levels with narrow confidence intervals. The sole exception is Panel D3, the effect of the

[17] Full event time analyses and stratification based on type of program for this outcome can be found in Appendix D.
[18] Full regression results are available upon request.
[19] We arrive at this number by taking the coefficient (0.06) and standard error (0.99) reported in row 1, column 1 of panel A in Table 2, which leads to an upper bound CI of 0.06 + 0.99*1.645 = 1.715 (in thousands). The baseline number of graduates in 2013 is 30,910 (Table A2, first column, reports baseline mean), thus the 1,715 represents 5.6 percent.
[20] The national healthcare workforce is 12.4 million (BLS 2016), thus we obtain 240,000 as the average over 50 states and Washington, DC.

Medicaid expansion on the number of degrees in Health and Medical Administrative services, which shows a decrease in the number of graduates significant at the 10 percent level; although marginally significant, this is in the opposite direction suggested by theory.

County-level estimates are also largely indicative of no effect of expansion on the educational market. We do estimate a small but unexpected negative effect (a 1 percent decrease) of the Medicaid expansion on the likelihood of a county having at least one graduate for all healthcare sector degrees. This result is statistically significant at the 5 percent level and appears to be driven largely by degrees in the most common fields; we estimate a 2 percent reduction from Medicaid expansion on the likelihood of a county having at least one graduate in the top 4 professions. This estimate is statistically significant at the 1 percent level. There is a similar, statistically significant estimate for degrees in Health and Medical Administrative services; there are negative (but insignificant) point estimates for all other types of degrees except for those taking less than one year to complete. These decreases in the likelihood of counties having graduates without corresponding changes in the overall number of graduates are consistent with a consolidation of larger programs into fewer counties.

Event Study

We plot event time results and 95 percent confidence intervals around the estimates in Figures 5 and 6 for state-level analyses; we provide full regression results in Appendix Tables A1 and A2.[21] Recall that 2013 is the omitted year in the event time analysis and as such is not reported on the figures. None of the analyses have strongly noticeable pre-ACA trends, and the figures that are perhaps slightly suggestive of a pre-ACA trend (Figure 5, Panel C, and Figure 6, Panel A) do not have any point estimates in the pre-ACA period that are statistically significant at conventional levels. Out of 48 total pre-ACA point estimates, only one is statistically significant at the 10 percent level, well within the expected rate for that confidence level.

Post-ACA estimates are either flat or suggestive of a decrease in the number of degrees awarded in Medicaid expansion states relative to non-expansion states, particularly for the healthcare sector as a whole, the top four professions, for-profit institutions, and for health and medical

[21] Event time figures for county-level analyses are qualitatively similar and available upon request.

administrative services; the point estimates are only consistently significant at conventional levels for the last of these subsamples.

Synthetic Control

Figures 7 and 8 plot synthetic control analyses in event time; the relevant dependent variable means (to show the appropriateness of the match of the synthetic control) as well as tests for significance of the estimates can be found in Appendix Tables A4 and A5. Broadly, the synthetic control estimation reinforces the story emerging from the difference-in-differences and event time analyses: there is either no effect of the ACA Medicaid expansion on the number of graduates or a small (and in the synthetic control analyses statistically insignificant at conventional levels) decrease in the number of graduates.

7. Extensions

We next extend our analysis in two ways. Our first extension is to examine an additional data source on volume of new labor inputs passing through the healthcare educational pipeline. Specifically, we examine test passing counts for the U.S.'s national examination for nursing certification: the National Council Licensure Examination (NCLEX) for both registered nurses (the NCLEX-RN) and practical nurses (the NCLEX-PN). All nurses who practice in the U.S. are required to pass these exams before they can obtain their licenses, and neither NCLEX exam has a limit to the number of people who may take the exam at any given time. The robustness of our insights from the IPEDS analysis can be strengthened through a comparison of results with this alternate measure of state-level healthcare labor inflows. Our second extension is to examine data on state-level spending on higher education from the Annual Survey of State and Local Government Finances. These financial data allow us to examine one possible mechanism for the null findings above: public funding for higher education may not have changed in response to the ACA, making it difficult for educational programs that rely on this source of funding to grow.

NCLEX

To study the impact of the ACA on the volume of people taking the NCLEX, we draw data from the 2010–2017 NCLEX Examination Statistics, which are put out annually by the National

Council of State Boards of Nursing.[22] These annual reports contain information on the number of individuals passing each exam in each state, which serves as a measure of the volume of nurses entering the labor force (the exam passing numbers include individuals who graduated from programs in previous years but did not take or pass the exam in those years). Only individuals who have completed accredited nursing programs can register to take the NCLEX. Figure 9 reports the number of individuals passing the exam in Medicaid expanding and non-expanding states over the same time period as the above analysis using the IPEDS. The general pattern is similar to that seen in the IPEDS graduation data: expansion and non-expansion states follow similar trends, and expansion states do not display increases in volume of exam passers in a noticeable manner at the time of the ACA Medicaid expansions.

We next conduct difference-in-differences and event study analyses (estimation of equations 1 and 2) using the state-level NCLEX pass counts. These results are reported in Table 3 and Figure 10. We find a small but insignificant positive effect of the Medicaid expansion on the number of people passing the NCLEX-PN, and a negative and significant effect of the Medicaid expansion on the number of people passing the NCLEX-RN, which appears to be an artifact of a preexisting negative trend. Neither of these results contradicts our earlier findings of a null effect of the Medicaid expansion on the number of graduates in U.S. healthcare degrees.

The NCLEX Examination Statistics also provide information on the number of international graduates passing the two NCLEX exams each year. The data do not report information on which state these graduates intend to go to, or if they intend to move to the U.S. at all (as passing the NCLEX gives an individual the ability but not the obligation to practice nursing in the U.S.). However, the time series of international exam pass volume, which is reported in Figure 11, does provide some suggestive evidence as to the international component of flows into U.S. nursing labor supply. When the ACA came into effect in 2014, there was an immediate (but temporary) uptick in the number of international passers for the NCLEX-PN. After two years, this increase subsided but was replaced with a larger increase in international passers for the NCLEX-RN. This evidence is merely suggestive and not well identified in an econometric sense, but it does suggest the possibility that one reason for a muted response in the number of domestic healthcare

[22] All annual NCLEX reports can be found at https://www.ncsbn.org/1236.htm.

graduates is that some of the labor demand was being met by in-migration from the international healthcare workforce or from new international NCLEX passers. The literature would benefit from future research that is able to study the geography of where foreign healthcare professional in-migrants chose to locate.

State and Local Education Spending

Using the U.S. Census Bureau's Annual Survey of State and Local Government Finances between 2010 and 2016 (the most recent year of available data), we collect for each state the total spent on higher education, and the per capita amount spent on higher education. Figure 12 reports these values in a time series. We then use these variables as outcomes for the difference-in-differences analysis from equation (1) and the event time analysis in equation (2).

Results of these analyses are presented in Table 4 and Figure 13. We again do not find any effect of the ACA Medicaid expansion that is statistically significant at conventional levels. Also, the estimate of the impact of the Medicaid expansion on total expenditures is negative and larger than its standard error, providing some weak evidence that states that expanded Medicaid may have seen decreases in spending on higher education. Together, this analysis provides some weak evidence that lack of additional government funding to education (or even a possible decrease) may have helped constrain growth in the healthcare educational pipeline, serving as one possible mechanism for our above results on the number of healthcare profession graduates.

8. Discussion and Conclusion

In this paper, we examine whether the healthcare education market responds in the short run to the increase in the demand for healthcare labor, which was spurred by the ACA insurance expansion and its demonstrated increase in access to care. Our conceptual framework suggests that longer-duration programs may be slower to increase enrollment and graduation and that local demand conditions may matter less among degrees for occupations with national job markets. However, we hypothesize that short-duration degrees with local labor markets should respond to local changes in healthcare demand arising from the ACA's health insurance expansion.

We test this hypothesis using data from the 2010 to 2017 IPEDS. Our most robust models that pass the parallel trends tests consistently find either no effect of the ACA Medicaid expansion on the healthcare workforce educational pipeline or small decreases in graduation numbers. These results are unchanged across a range of identification strategies and have fairly tight confidence intervals that allow us to rule out reasonably small levels of growth in the number of graduates.

This pattern of results is somewhat surprising, given the increases in insurance coverage and utilization of care (Courtemanche et al. 2017; Courtemanche et al. 2019; Frean, Gruber, and Sommers 2017; Kaestner et al. 2017; Simon, Soni, and Cawley 2017; Shartzer, Long, and Anderson 2015; Sommers, Blendon, and Orav 2016; Sommers et al. 2015; Wherry and Miller 2016), as well as the increases in hiring activity in health fields (Dillender 2018). A response in the educational sector would seem likely, given this setting.

There are a few possibilities as to why the educational sector may not have responded. Dillender's (2018) finding of increased attempted hiring in health fields due to the ACA Medicaid expansion does not necessarily translate into additional successful hiring or into a signal of greater potential earnings to students. There is some evidence (Glied and Ma 2015) that hospitals were unsuccessful in hiring attempts, which suggests that unless wages increase by a large amount it will be difficult to attract more students into the pipeline. In this case, providers may have been able to stretch capacity by working additional hours, decreasing the length of patient visits, or taking advantage of technological improvements such as telemedicine or health information systems (Buntin et al. 2011; Agha 2014; Chen, Mehrotra, and Auerbach 2014).

The other finding in Dillender (2018) was "downskilling" or shifting hiring advertising activity toward workers with lower levels of human capital and fewer associated skills. A second possibility is that hiring was successful, but in positions that do not require healthcare degrees. This would be the case for employees such as medical scribes, who do not have specialized training but have been shown to improve the efficiency of existing labor inputs and have become increasingly popular (Gidwani et al. 2017; Mishra, Kiang, and Grant 2018; Friedson 2018).

Since we have access to graduation but not enrollment data, we cannot tell whether enrollment numbers have risen without affecting graduation rates; it may be that a signal has indeed reached the healthcare educational pipeline, but that those drawn in by new expansions are less qualified than those who already would have pursued the field. Another possibility is that institutions may not be able to expand programs sufficiently, perhaps due to a lack of faculty or insufficient clinical sites. Lastly, it is possible that actors in the educational market did not see the ACA as a permanent change and as such did not make changes in their investment decisions, or at least did not do so during the time period studied.

More research is needed to fully understand how the healthcare workforce has adjusted to the new post-ACA levels of utilization. A lack of increased training is not necessarily indicative of a future shortfall of capacity, but given recent evidence of longer appointment wait times (Miller and Wherry 2017), it is becoming increasingly important for economists to understand how these markets are performing.

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Tables and Figures

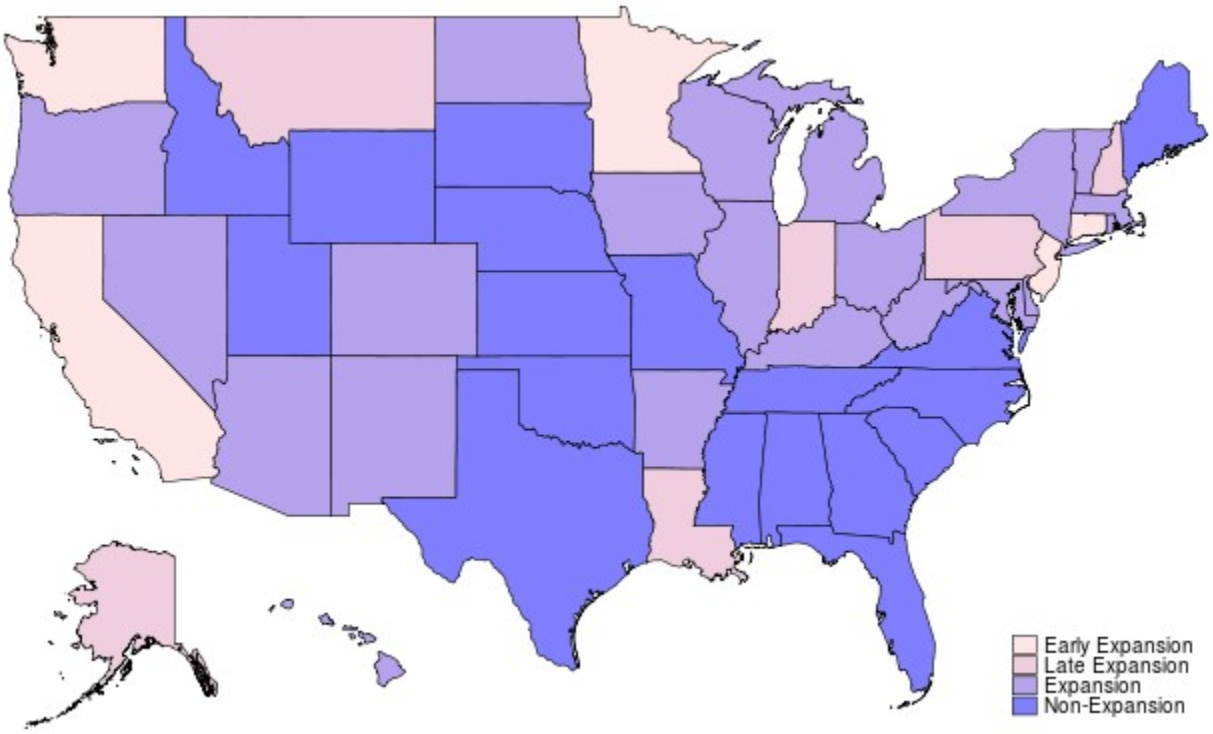
Table 1 Summary Statistics

	State level		County level	
	Mean	Standard deviation	Mean	Standard deviation
	(1)	(2)	(3)	(4)
Number of graduates (thousands)				
In health care sector (CIPCODE 51)	30.96	23.18	2.63	4.56
In top 4 professions	20.96	14.73	1.73	3.42
In less than one year	6.17	5.63	0.51	0.99
At for-profit institution	6.04	6.31	0.49	1.05
Registered, clinical nursing, nursing admin, and research (CIPCODE 51.38)	8.23	5.42	0.64	1.37
Allied health and medical assisting services (CIPCODE 51.08)	5.49	4.99	0.49	0.84
Health and medical admin services (CIPCODE 51.07)	3.93	3.57	0.42	1.37
Practical nursing, vocational nursing, and nursing assistants (CIPCODE 51.39)	3.31	2.51	0.18	0.30
Unemployment rate (%)	6.30	2.21	7.10	2.81
Median household income ($)	52,925	8,916	46,437	12,480
Poverty rate (%)	14.96	3.06	17.13	6.26
Population (thousands)	11,349	11,475	108	263
Population in 2010 (thousands)	11,040	11,475	105	251
#Obs.	320		15,744	

NOTE: Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with population count of fewer than 10,000. *Health care sector* refers to graduates in CIPCODE 51. *Top 4 professions* refers to graduates in CIPCODEs 51.38, 51.39, 51.07, 51.08. *Less than one year* refers to graduates with award level equal to 1. *For-profit institution* refers to graduates in institutions with sector codes 3, 6, and 9. Number of graduates is weighted by state population in 2010 in (1) and (2) and county population in 2010 in (3) and (4). See Appendix B for detailed coding definitions.

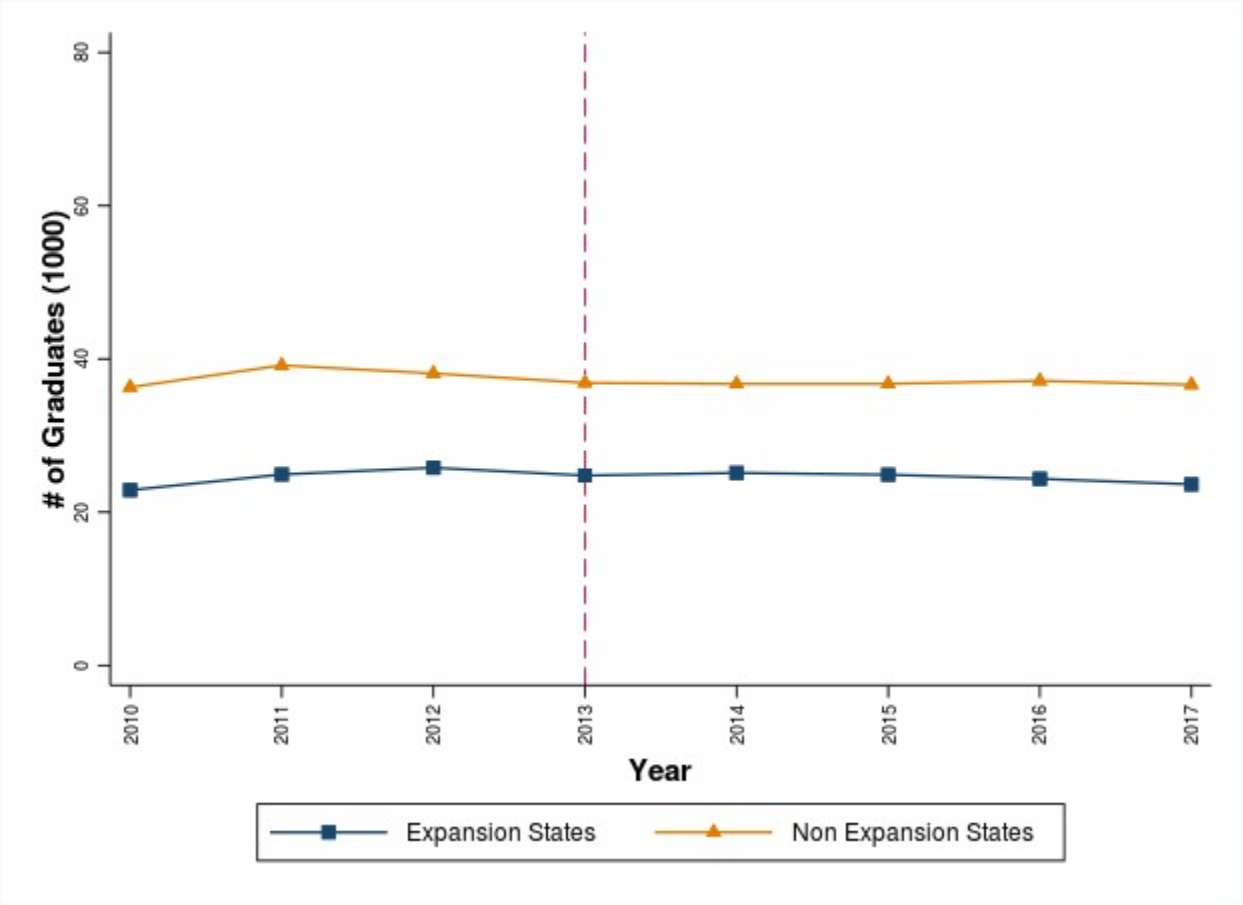
SOURCE: Integrated Postsecondary Education Data System (IPEDS) 2010–17. Health uninsurance rate is from Small Area Health Insurance Estimates (SAHIE, 2013). Unemployment rate is from Bureau of Labor Statistics (BLS). Median household income and poverty rate are from Small Area Income and Poverty Estimates (SAIPE) at the county level. Population count is from Census Bureau.

Figure 1 ACA Medicaid Expansions



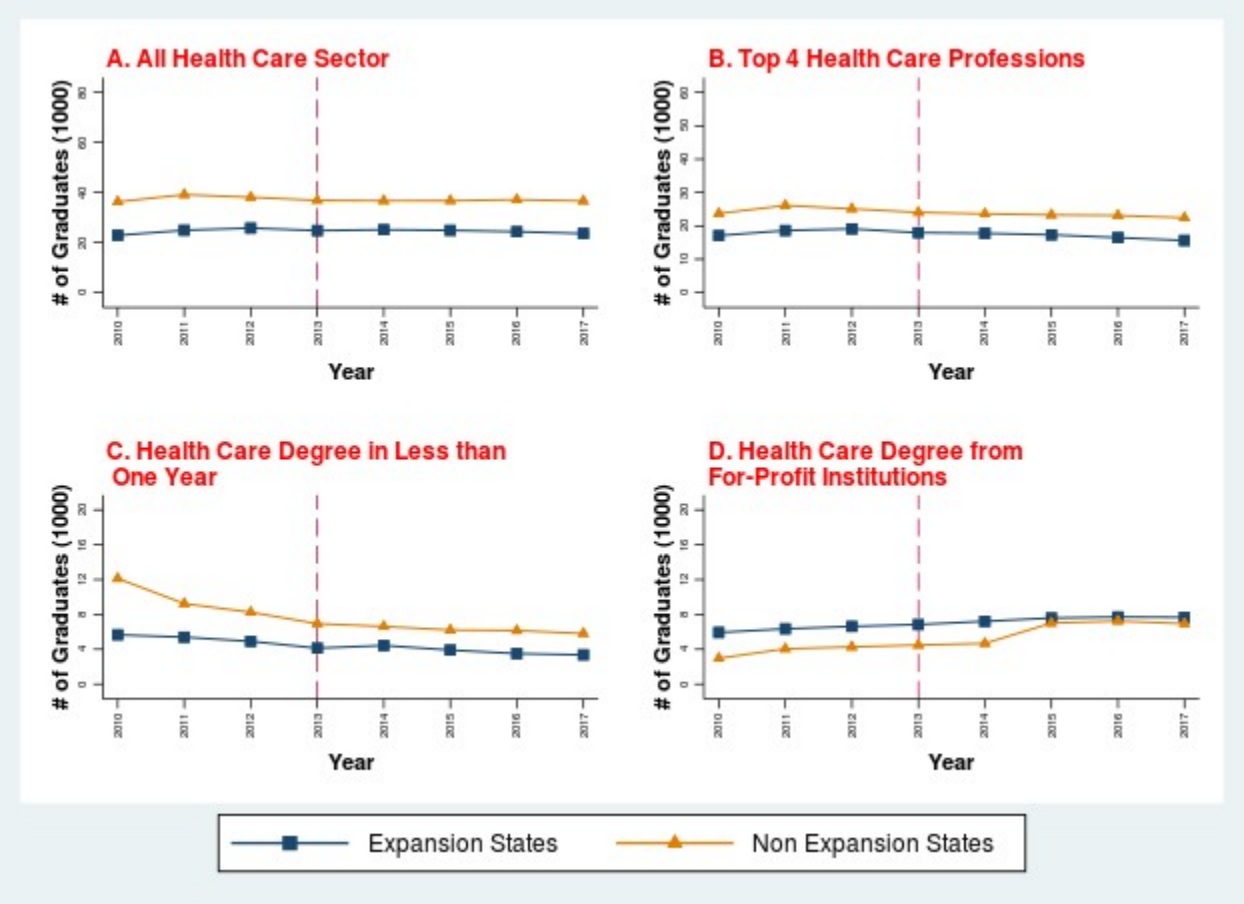
NOTE: Analysis sample includes expansion and non-expansion states. Expansion states (22) are AR, AZ, CO, DC, DE, HI, IA, IL, KY, MA, MD, MI, ND, NM, NV, NY, OH, OR, RI, VT, WI, WV. Non-expansion states (18) are AL, FL, GA, ID, KS, ME, MO, MS, NC, NE, OK, SC, SD, TN, TX, UT, VA, WY. Analysis sample excludes early and late expansion states. Early expansion states (5) are CA, CT, MN, NJ, WA. Late expansion states (6) are AK, IN, LA, MT, NH, PA.
SOURCE: Kaiser Family Foundation (2019).

Figure 2 Number of Graduates (Thousands) in the Health Care Sector



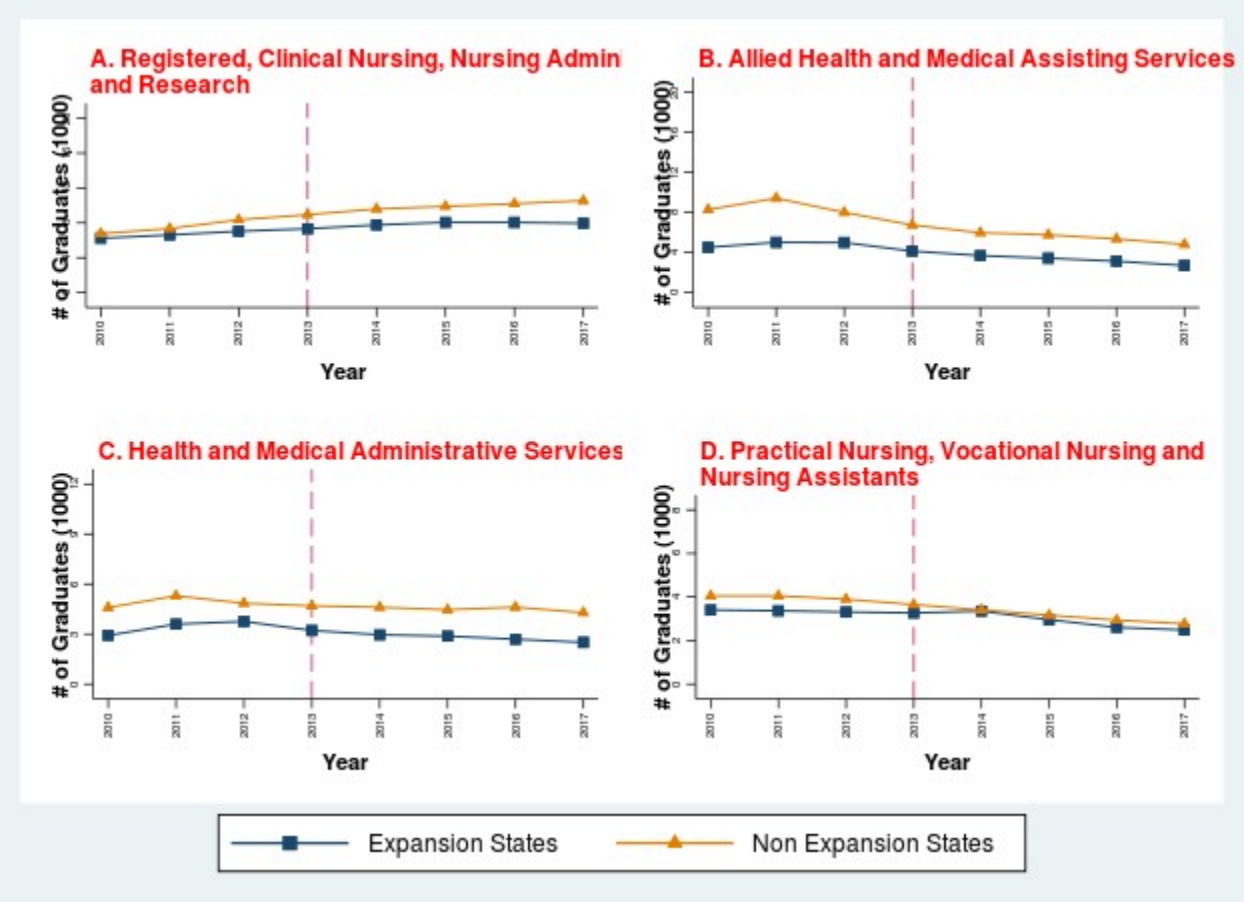
NOTE: Graph shows # of graduates at the state level (for the average state) among expansion vs. non-expansion states. Sample excludes early expansion states (CA, CT, MN, NJ, WA) and late expansion states (AK, IN, LA, MT, NH, PA). Graduates from counties with population count of fewer than 10,000 are not included in these data. Number of graduates is weighted by population count in 2010.
SOURCE: IPEDS 2010–17. Population count from Census Bureau.

Figure 3 Number of Graduates (Thousands), State Level, by Expansion Status



NOTE: Graph shows # of graduates at the state level (average state) in expansion vs. non-expansion states. Figure A includes graduates in health care sector (CIPCODE 51). Figure B includes graduates in CIPCODEs 51.38, 51.39, 51.07, 51.08. Figure C includes graduates with award level equal to 1. Figure D includes graduates in institutions with sector codes 3, 6, and 9. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states. Graduates from counties with a population count of fewer than 10,000 are not included in these data. Number of graduates is weighted by state population count in 2010. See Appendix B for detailed coding definitions.
SOURCE: IPEDS 2010–17. Population count from Census Bureau.

Figure 4 Number of Graduates (Thousands) in Selected Health Care Professions at the State Level by Expansion Status



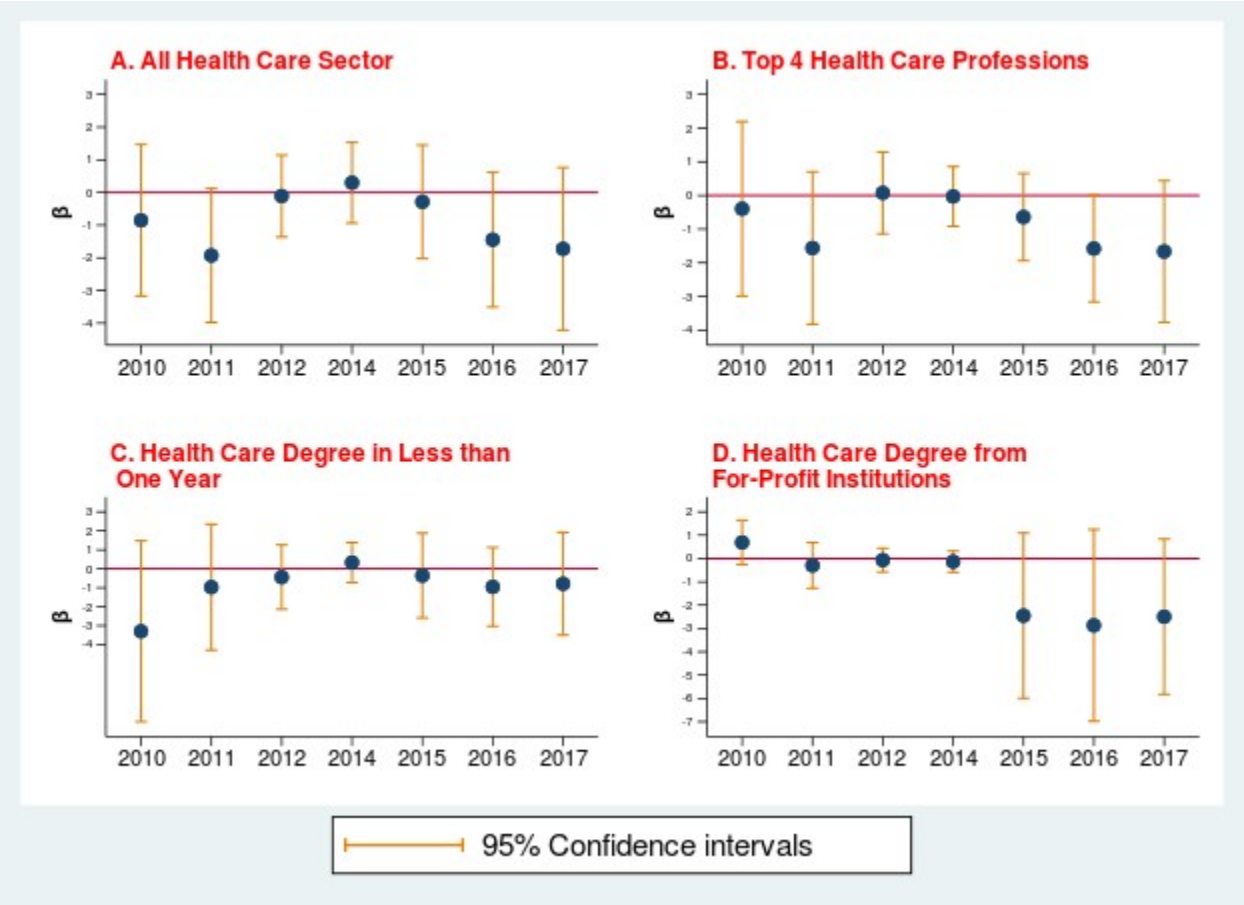
NOTE: Graph shows # of graduates at the state level (average state) in expansion vs. non-expansion states. Figure A includes graduates in CIPCODE 51.38. Figure B includes graduates in CIPCODE 51.08. Figure C includes graduates in CIPCODE 51.07. Figure D includes graduates in CIPCODE 51.39. Top 4 professions account for 65% of total health care workforce. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states. Graduates from counties with population count of fewer than 10,000 are not included in these data. Number of graduates is weighted by state population count in 2010. See Appendix B for detailed coding definitions.
SOURCE: IPEDS 2010–17. Population count from Census Bureau.

Table 2 Difference-in-Differences Regression Results

Dependent variable	State level	County level	
	Number of graduates (1000s)	**Number of graduates (1000s)**	**Having a program**
	(1)	(2)	(3)
	Panel A. All Healthcare Sector		
Post X Medicaid expansion	0.06	0.02	-0.01**
	(0.99)	(0.12)	(0.00)
	Panel B. Health Care Graduates in Less than One Year		
Post X Medicaid expansion	0.71	0.10	0.01
	(0.82)	(0.10)	(0.01)
	Panel C. Health Care Graduates at For-Profit Institutions		
Post X Medicaid expansion	-1.89	-0.12	-0.02
	(1.20)	(0.09)	(0.02)
	Panel D. Health Care Graduates in Top 4 Professions		
Post X Medicaid expansion	-0.40	-0.06	-0.02***
	(0.73)	(0.12)	(0.00)
	Panel D1. Registered, Clinical Nursing, and Nursing Administration		
Post X Medicaid expansion	-0.74	0.01	-0.01
	(0.66)	(0.12)	(0.01)
	Panel D2. Allied Health and Medical Assisting Services		
Post X Medicaid expansion	0.83	0.02	-0.01
	(0.84)	(0.09)	(0.01)
	Panel D3. Health and Medical Administrative Services		
Post X Medicaid expansion	-0.79*	-0.12	-0.01*
	(0.45)	(0.11)	(0.01)
	Panel D4. Practical Nursing, Vocational Nursing, and Nursing Assistants		
Post X Medicaid expansion	0.29	0.03	-0.01
	(0.46)	(0.04)	(0.02)
Economic conditions	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
State fixed effects	Yes	No	No
County fixed effects	No	Yes	Yes
# Obs.	320	15,744	15,744

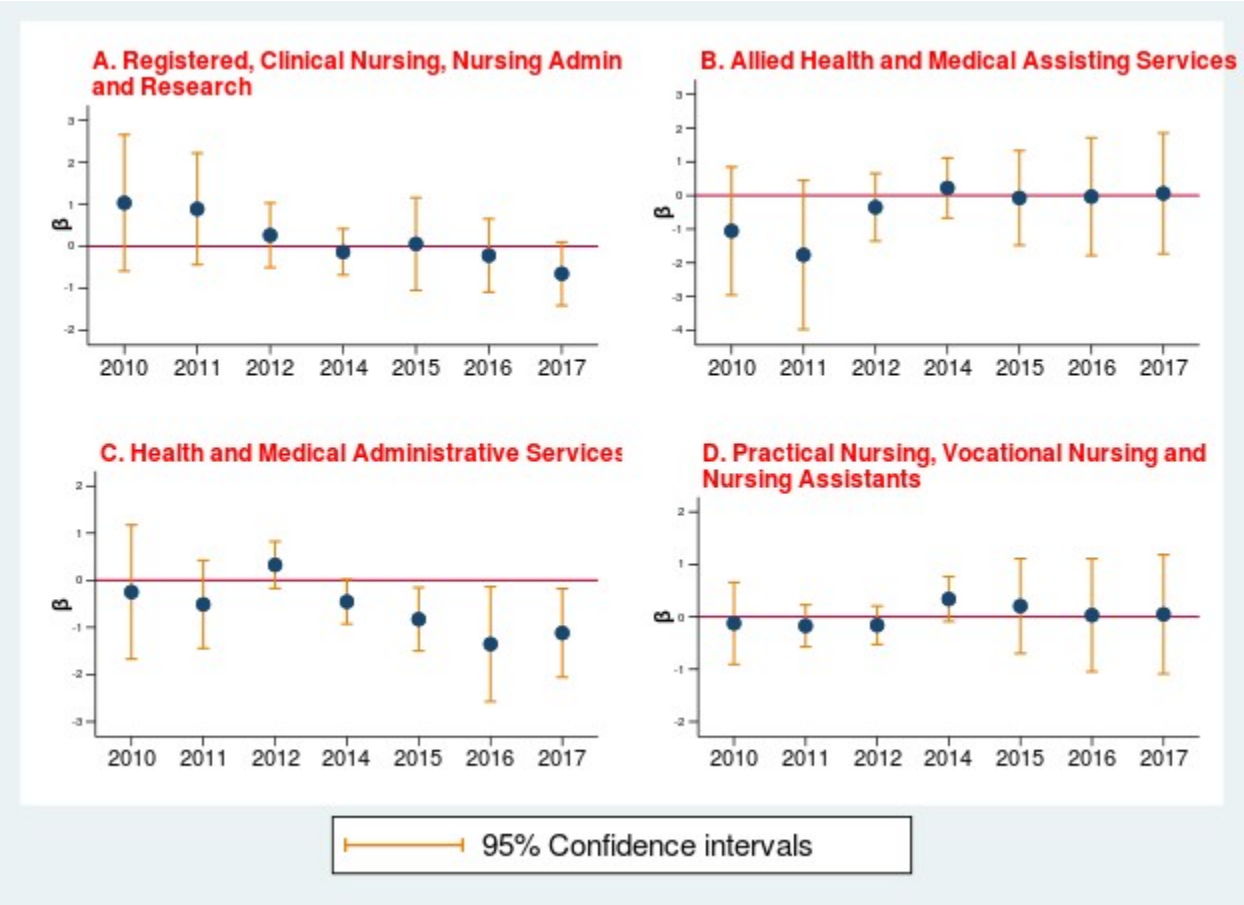
NOTE: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. The table displays the indicated coefficients from OLS regressions. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states. Panel A includes graduates in the health care sector (CIPCODE 51). Panel B includes graduates with award level equal to 1. Panel C includes graduates in institutions with sector codes 3, 6, and 9. Panel D includes graduates in CIPCODEs 51.38, 51.07, 51.08, 51.39. Panel D1 includes graduates in CIPCODE 51.38. Panel D2 includes graduates in CIPCODE 51.07. Panel D3 includes graduates in CIPCODE 51.08. Panel D4 includes graduates in CIPCODE 51.39. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate at the state level in (1) and county level in (2) and (3). All regressions are weighted by 2010 population counts at the state level in (1) and county level in (2) and (3). See Appendix B for detailed coding definitions. Standard errors, heteroscedasticity-robust and clustered by state, are in parentheses.
SOURCE: IPEDS 2010–17. Unemployment rate from BLS; median household income and poverty rate, SAIPE.

Figure 5 Plot of Coefficients from State-Level Event Study Regressions



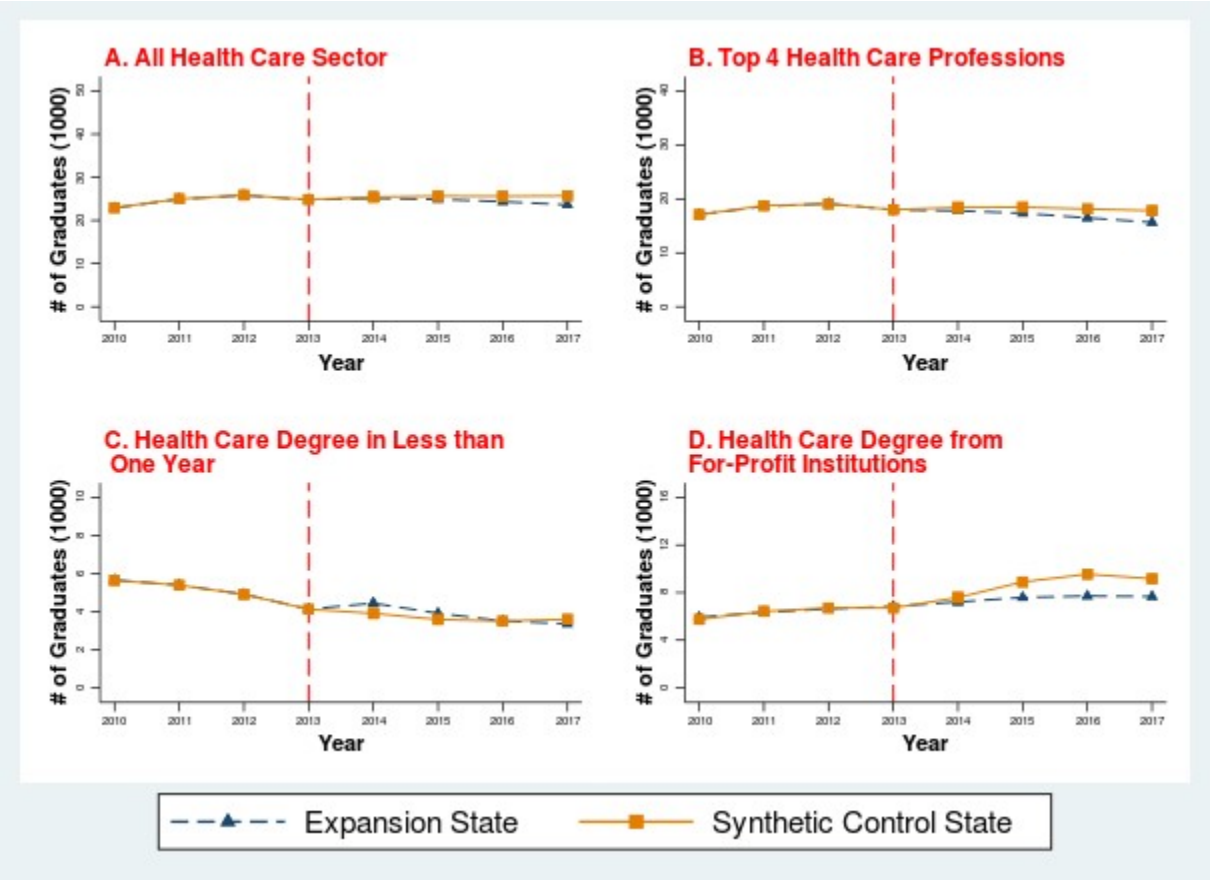
NOTE: Graph shows coefficients and confidence intervals from state-level event study regression. Figure A includes graduates in entire health care sector. Figure B includes graduates in CIPCODEs 51.38, 51.39, 51.07, 51.08. Figure C includes graduates with award level equal to 1. Figure D includes graduates in institutions with sector codes 3, 6, and 9. Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with population count of fewer than 10,000. All regression estimates are weighted by state population in 2010. All regressions control for state fixed effects, year fixed effects, median household income, poverty rate, and unemployment rate at the state level. Baseline (omitted) year is 2013. Confidence intervals are constructed from state-clustered, heteroscedasticity-robust standard errors.
SOURCE: IPEDS 2010–17. Population count from Census Bureau; median household income, BLS; poverty rate and unemployment rate, SAIPE.

Figure 6 Plot of Coefficients from State-Level Event Study Regression in Selected Health Care Professions



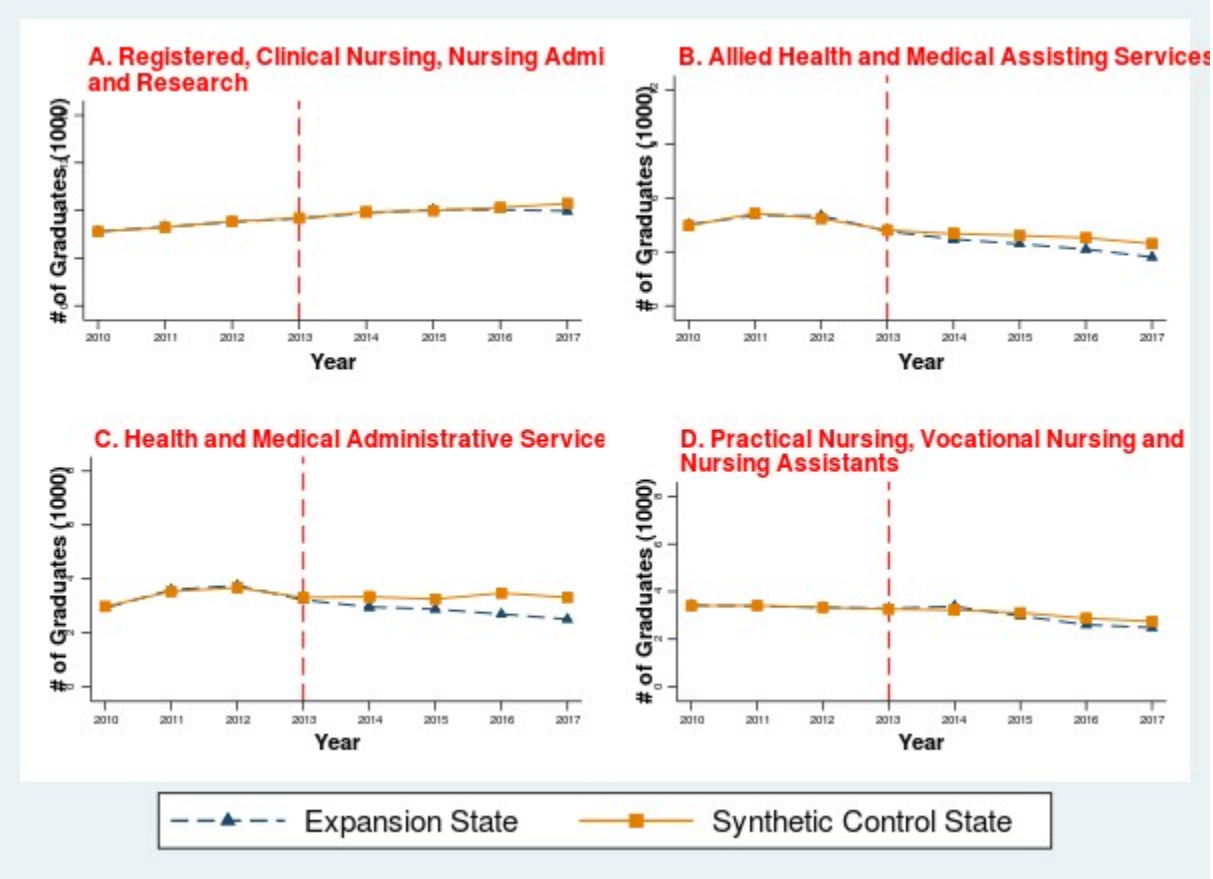
NOTE: Graph shows # of graduates at the state level in expansion vs. non-expansion states. Figure A includes graduates in CIPCODE 51.38. Figure B includes graduates in CIPCODE 51.08. Figure C includes graduates in CIPCODE 51.07. Figure D includes graduates in CIPCODE 51.39. Top 4 professions account for 65% of total health care workforce. Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with population count of fewer than 10,000. All regression estimates are weighted by state population in 2010. All regressions control for state fixed effects, year fixed effects, median household income, poverty rate, and unemployment rate at the state level. Baseline (omitted) year is 2013. Confidence intervals are constructed from state-clustered, heteroscedasticity-robust standard errors.
SOURCE: IPEDS 2010–17. Population count from Census Bureau.

Figure 7 Synthetic Control: Number of Graduates in Top 4 Professions, Less than One Year, at For-Profit Institutions



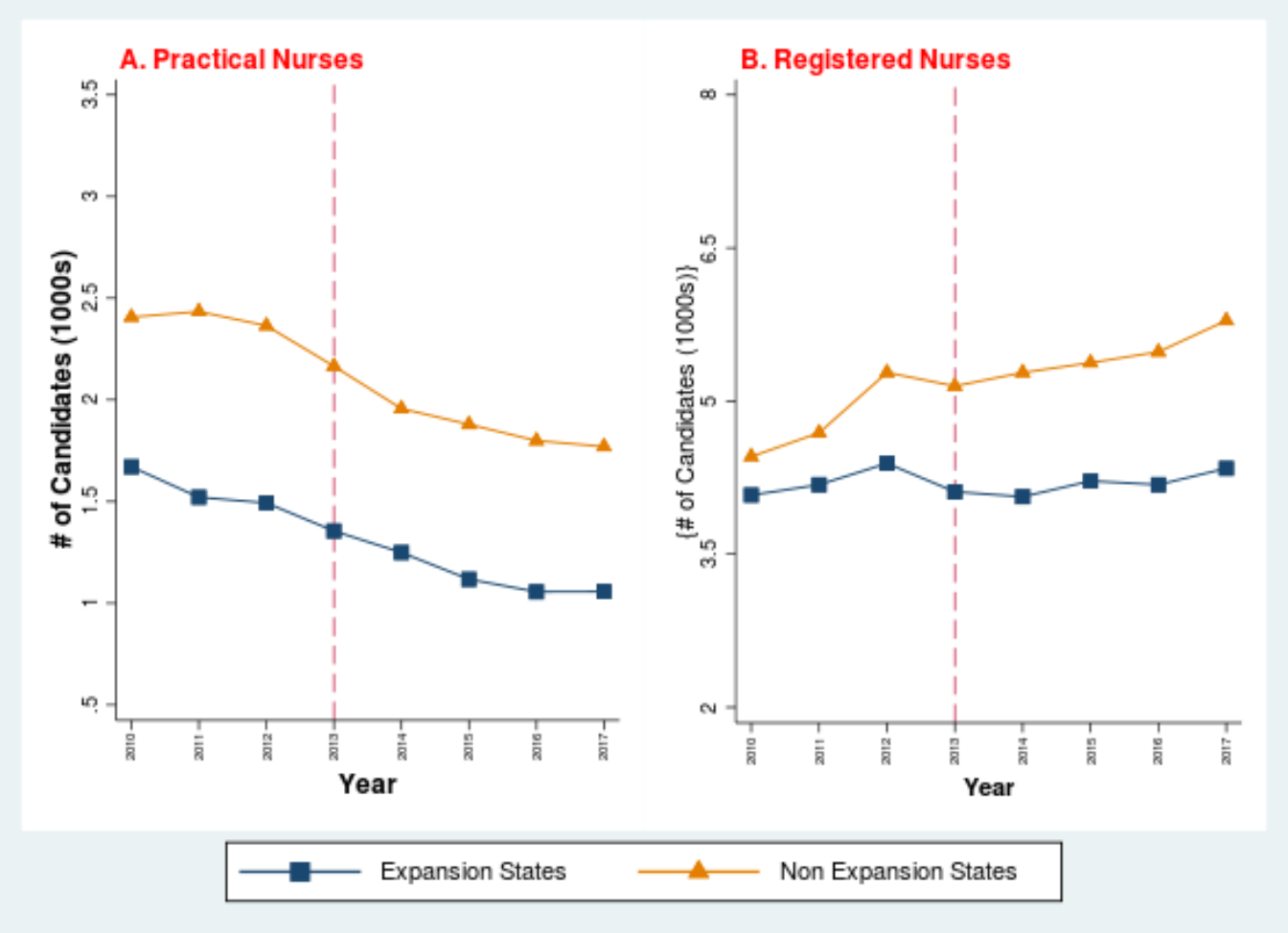
NOTE: Graph shows # of graduates from state-level synthetic control regression. Figure A includes graduates in entire health care sector. Figure B includes graduates in CIPCODEs 51.38, 51.39, 51.07, 51.08. Figure C includes graduates with award level equal to 1. Figure D includes graduates in institutions with sector codes 3, 6, and 9. Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with population count of fewer than 10,000. Pre-trend weights are constructed based on # of graduates in each of the pre-2014 periods.
SOURCE: IPEDS 2010–17.

Figure 8 Synthetic Control: Number of Graduates in Selected Health Care Professions



NOTE: Graph shows # of graduates from state-level synthetic control regression. Figure A includes graduates in CIPCODE 51.38. Figure B includes graduates in CIPCODE 51.08. Figure C includes graduates in CIPCODE 51.07. Figure D includes graduates in CIPCODE 51.39. Top 4 professions account for 65% of total health care workforce. Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with population count of fewer than 10,000. Pre-trend weights are constructed based on # of graduates in each of the pre-2014 periods.
SOURCE: IPEDS 2010–17.

Figure 9 Number of Candidates Passing the NCLEX



NOTE: Figure displays the # of candidates by expansion and non-expansion states. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states.

SOURCE: National Council Licensure Examination for Practical Nurses and Registered Nurses 2010–17.

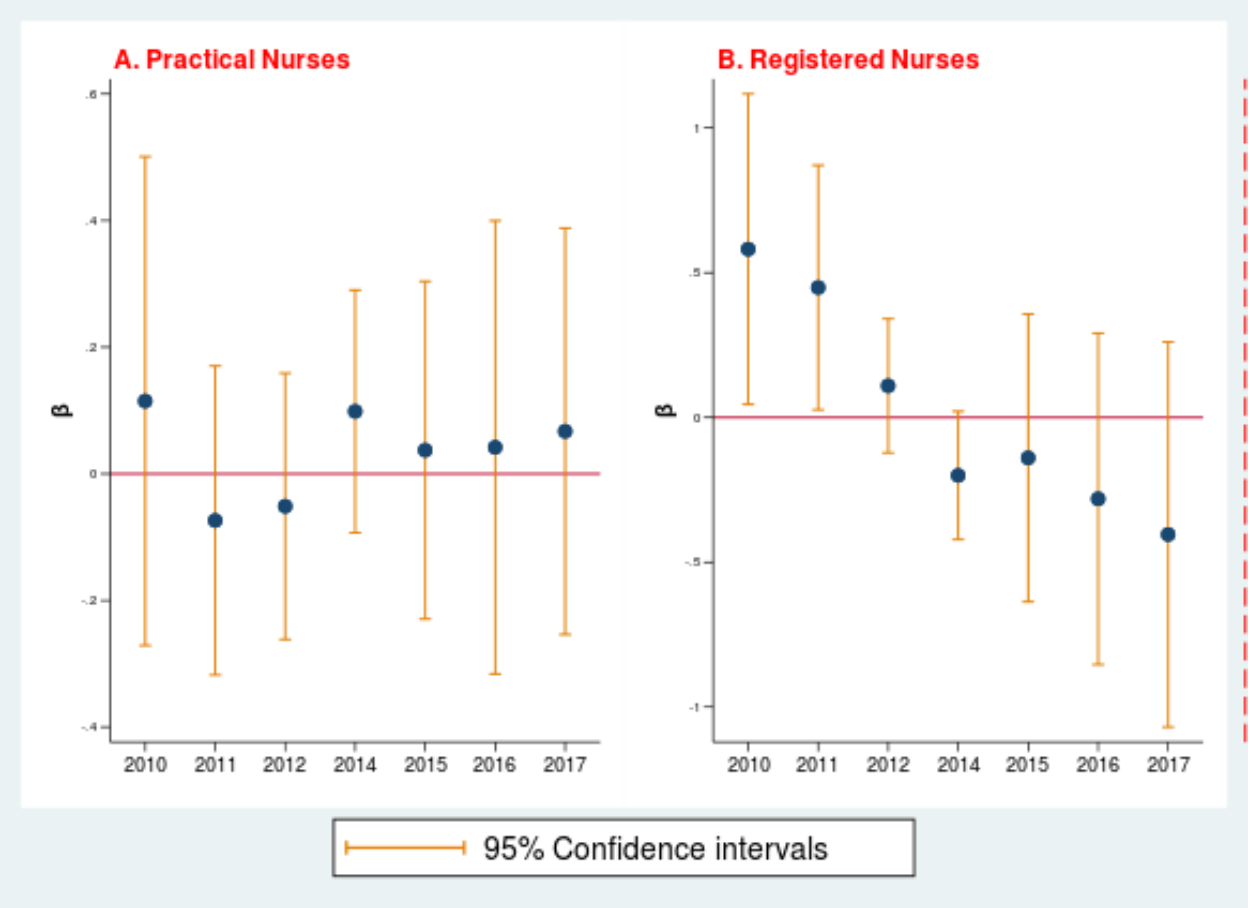
Table 3 Difference-in-Differences Regression Results: Number of Candidates Passing NCLEX Exams

Dependent variable: Number of candidates passing NCLEX exams	Practical nurses	Registered nurses
	(1)	(2)
Medicaid expansion X post	0.072	-0.516*
	(0.202)	(0.275)
Economic conditions	Yes	Yes
State fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Baseline mean (1000s)	1.765	4.635
# Obs.	320	320

NOTE: * $p < 0.10$. The table displays the indicated coefficients from OLS regressions. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate at state level. All regressions are weighted by 2010 population counts at state level. Standard errors, heteroscedasticity-robust and clustered by state, are in parentheses.

SOURCE: National Council Licensure Examination for Practical Nurses and Registered Nurses 2010–17. Unemployment rate from BLS; median household income and poverty rate, SAIPE.

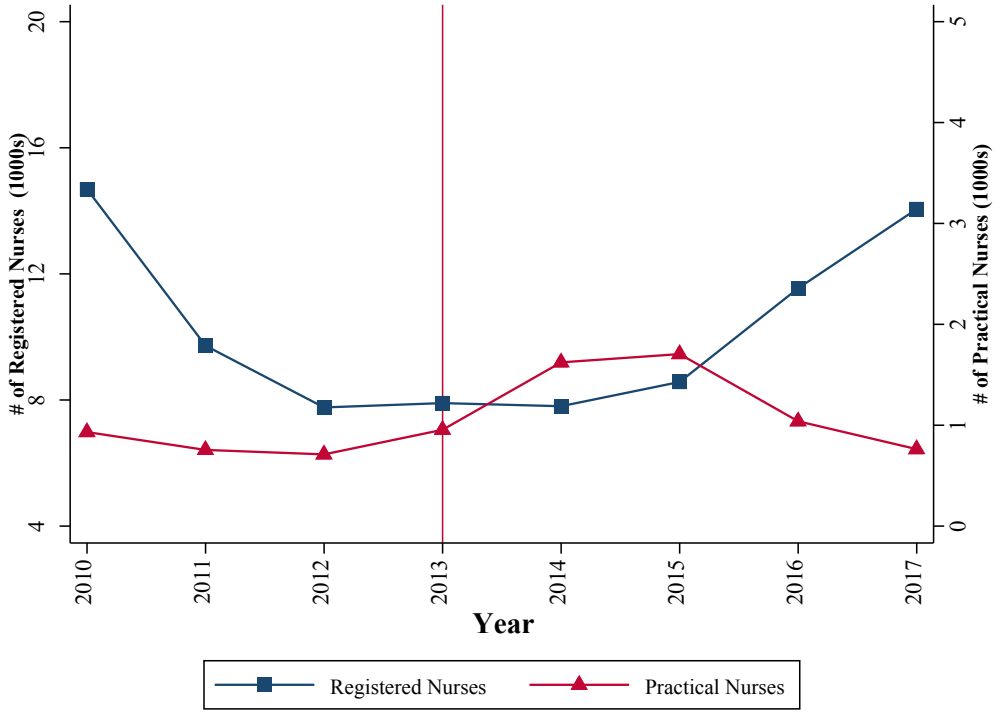
Figure 10 Event Study Regression Results: Number of Candidates Passing NCLEX Exams



NOTE**:** The figure plots coefficients from event study regressions. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states. All regression control for state fixed effects, year fixed effects, and economic conditions at state-year level, including unemployment rate, median household income and poverty rate at state level. All regressions are weighted by 2010 population counts at state level. Standard errors, heteroscedasticity-robust and clustered by state, are in parentheses.

SOURCE: National Council Licensure Examination for Practical Nurses and Registered Nurses 2010–17. Unemployment rate from BLS; median household income and poverty rate, SAIPE.

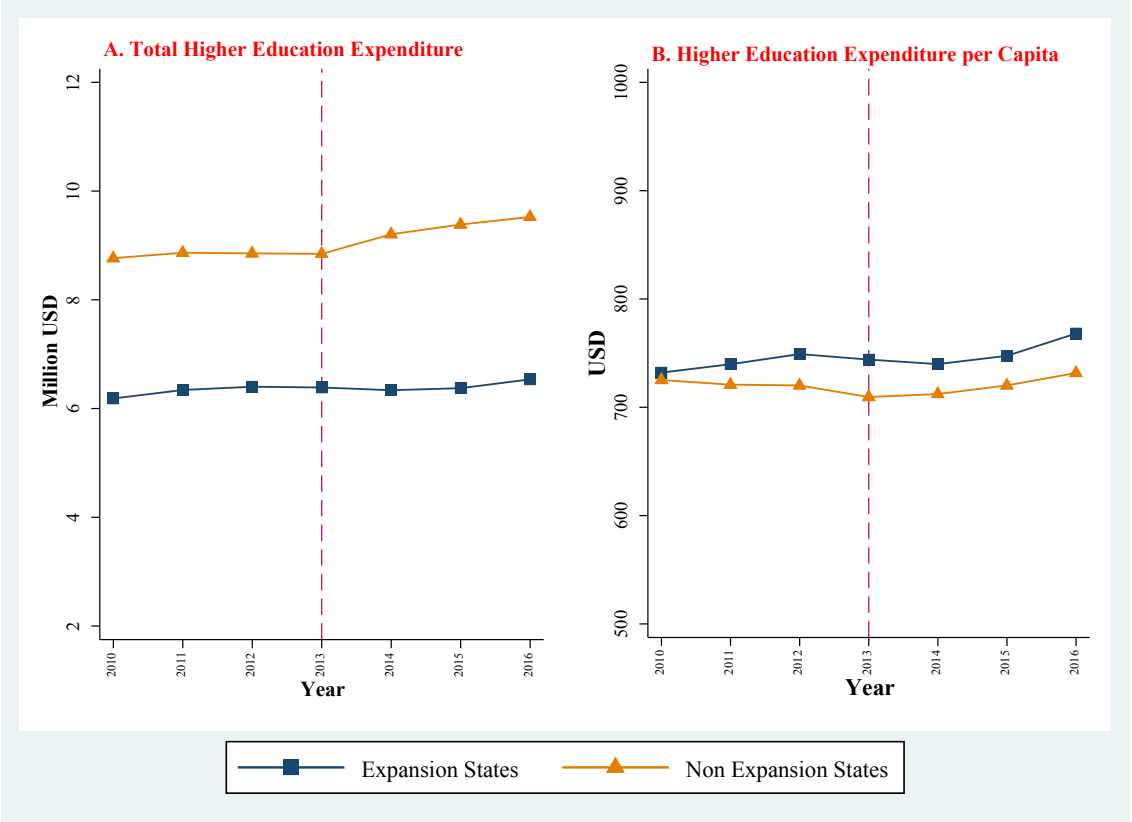
Figure 11 Number of International Candidates Passing the NCLEX Exams



NOTE: Figure displays the # of internationally educated candidates passing the NCLEX-RN and NCLEX-PN.

SOURCE: National Council Licensure Examination for Practical Nurses and Registered Nurses 2010–17.

Figure 12 Higher Education Expenditures



NOTE: Figure displays the higher education expenditure by expansion and non-expansion states. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states.

SOURCE: Annual Survey of State and Local Government Finances 2010–2016.

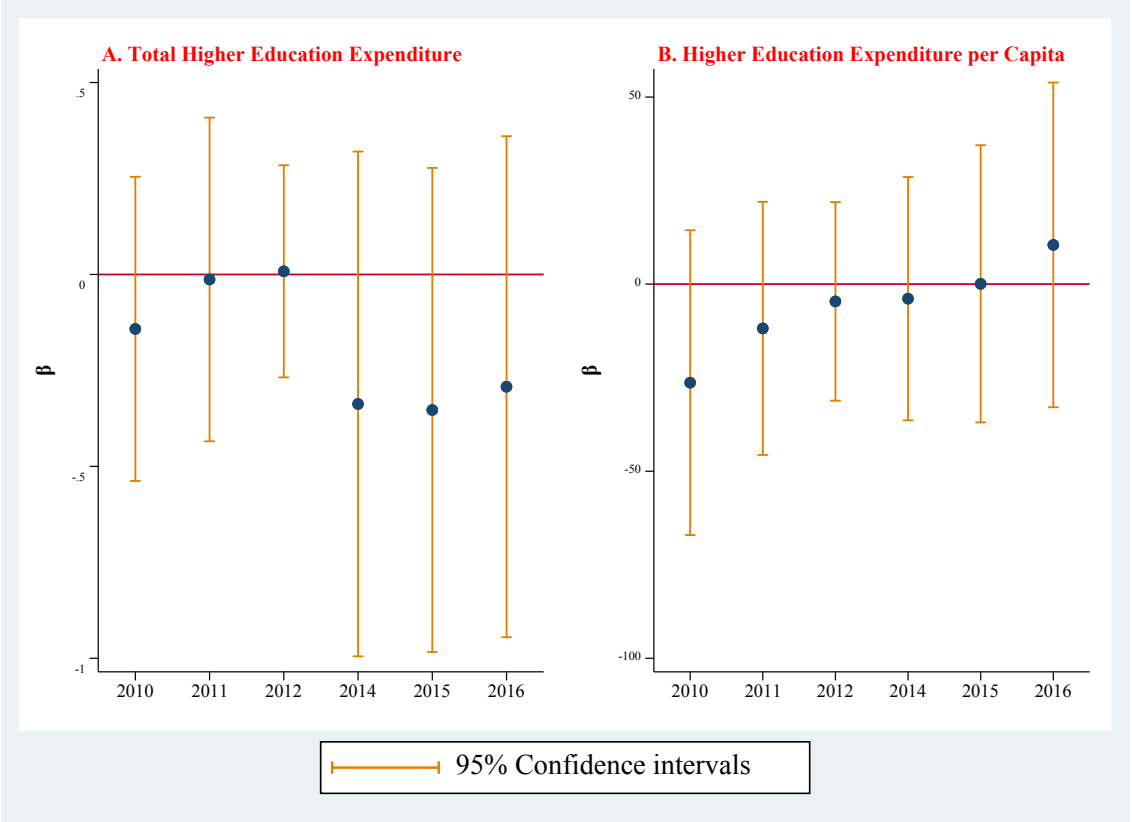
Table 4 Difference-in-Differences Regression Results: State and Local Higher Education Expenditures

	Total higher education expenditure (million USD)	Total expenditure per capita (USD)
	(1)	(2)
Medicaid expansion X post	-0.302 (0.282)	10.721 (14.274)
Economic conditions	Yes	Yes
State fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Baseline mean (1000s)	7.634	726.518
# Obs.	273	273

NOTE: The table displays the indicated coefficients from OLS regressions. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate at state level. All regressions are weighted by 2010 population counts at state level. Standard errors, heteroscedasticity-robust and clustered by state, are in parentheses.

SOURCE: Annual Survey of State and Local Government Finances 2010–2016. Unemployment rate from BLS; median household income and poverty rate, SAIPE.

Figure 13 Event Study Regression Results: State and Local Higher Education Expenditures

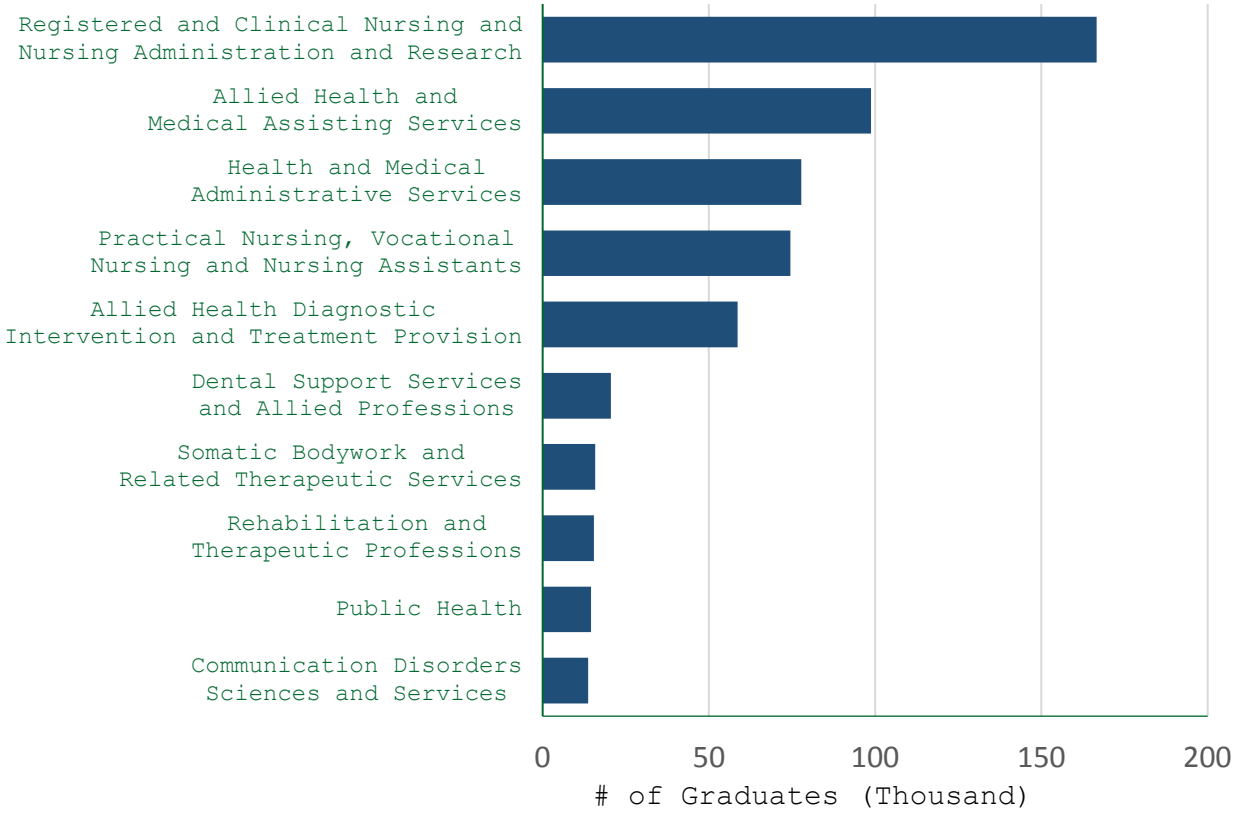


NOTE: The figure plots coefficients from event study regressions. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states. All regressions control for state fixed effects, year fixed effects, and economic conditions at state-year level, including unemployment rate, median household income, and poverty rate.
SOURCE: Annual Survey of State and Local Government Finances 2010–2016. Unemployment rate from BLS.

Appendix

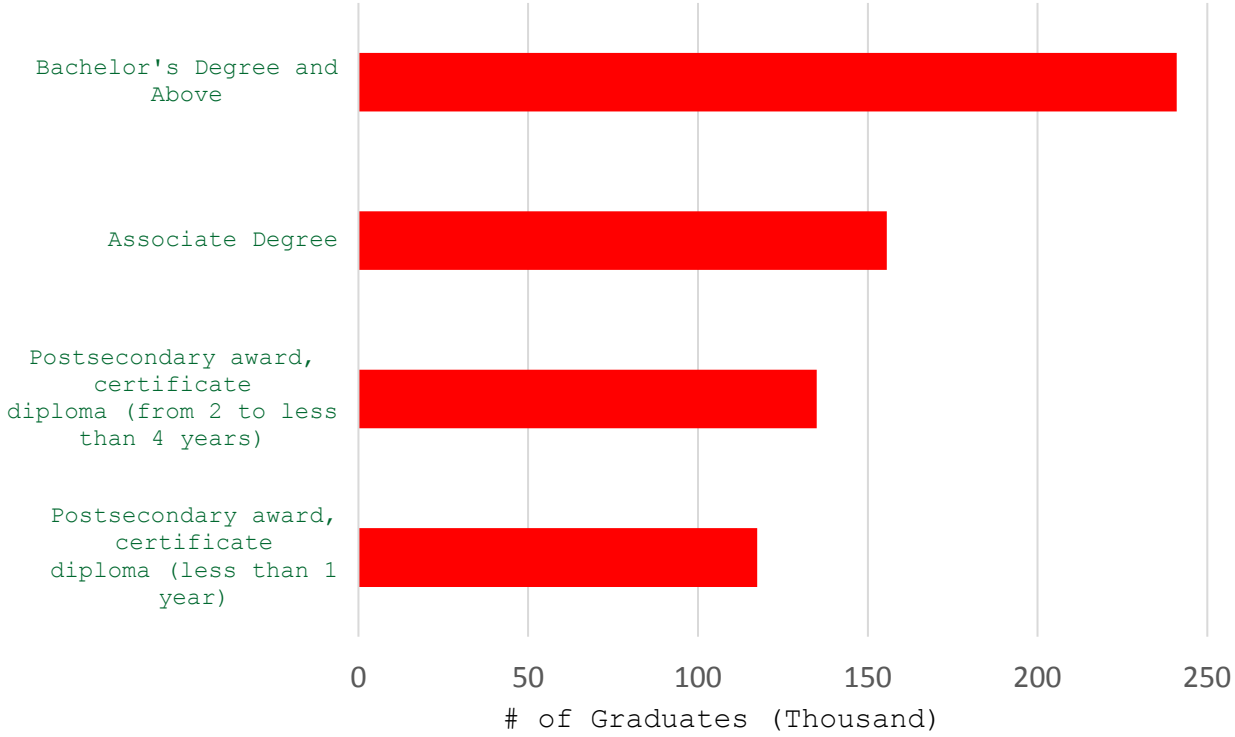
Appendix A. Supplementary Tables and Figures

Figure A1 Distribution of Graduates in Top 10 Health Care Professions/Occupations in 2013



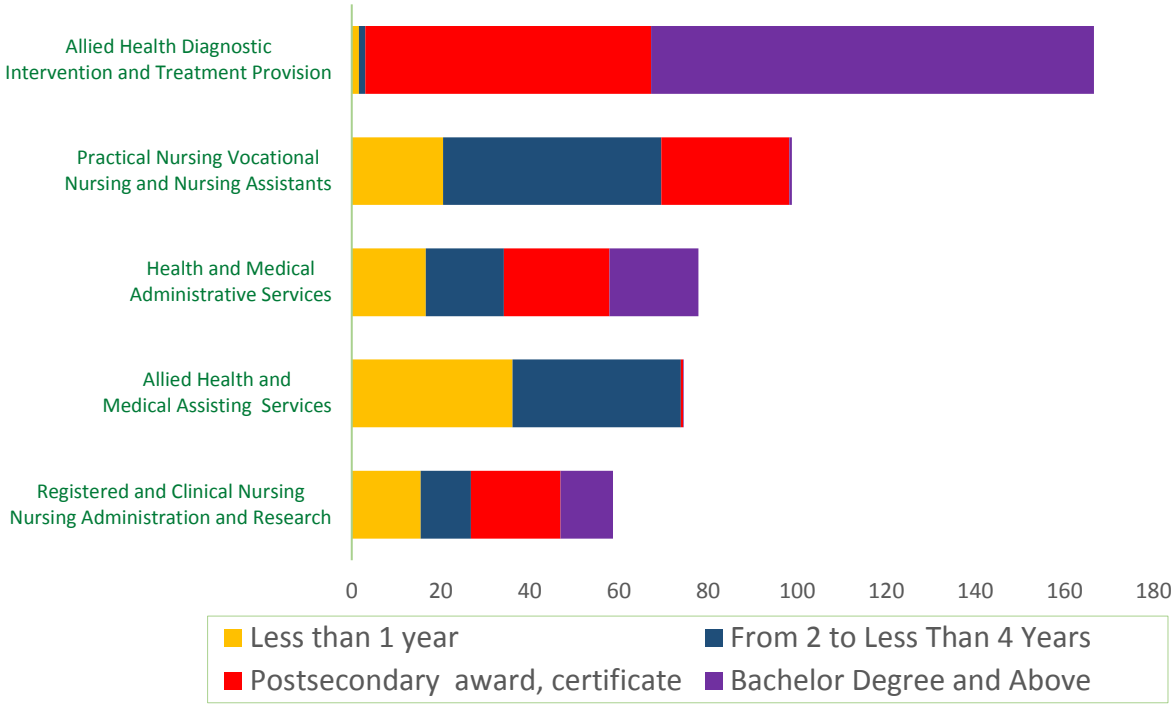
NOTE: The figure displays the number of graduates in top ten health care professions (CIPCODEs 51.38, 51.07, 51.08, 51.39, 51.09, 51.06, 51.35, 51.23, 51.22, 51.02) in 2013. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states. Top 10 health care professions account for 85% of total graduates in health care.
SOURCE: IPEDS 2013.

Figure A2 Distribution of Graduates by Type of Degree in 2013



NOTE: The figure displays the number of graduates in health care by type of degree in 2013. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states.
SOURCE: IPEDS 2013.

Figure A3 Distribution of Graduates by Type of Degree in Top Five Health Care Professions in 2013



NOTE: The figure displays the number of graduates in top five health care professions by type of degree in 2013. Sample excludes early s (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states.
SOURCE: IPEDS 2013.

Table A1 Difference-in-Differences Regression Results: Log of (# Number of Graduates +1) as Dependent Variable

	State level	County level
Dependent variable	Log of (number of graduates +1)	Log of (number of graduates +1)
	(1)	(2)
	Panel A. All Healthcare Sector	
Post X Medicaid expansion	-0.021	0.002
	(0.029)	(0.019)
	Panel B. Health Care Graduates in Less than One Year	
Post X Medicaid expansion	-0.002	0.028
	(0.093)	(0.034)
	Panel C. Health Care Graduates in For-Profit Institution	
Post X Medicaid expansion	-0.210***	-0.033
	(0.068)	(0.022)
	Panel D. Health Care Graduates in Top 4 Professions	
Post X Medicaid expansion	-0.039	-0.009
	(0.036)	(0.021)
	Panel D1. Registered, Clinical Nursing, and Nursing Administration	
Post X Medicaid expansion	-0.050	-0.016
	(0.039)	(0.019)
	Panel D2. Allied Health and Medical Assisting Services	
Post X Medicaid expansion	0.001	-0.002
	(0.066)	(0.027)
	Panel D3. Health and Medical Administrative Services	
Post X Medicaid expansion	-0.090	-0.006
	(0.063)	(0.018)
	Panel D4. Practical Nursing, Vocational Nursing, and Nursing Assistants	
Post X Medicaid expansion	0.048	0.018
	(0.065)	(0.022)
Economic conditions	Yes	Yes
Year fixed effects	Yes	Yes
State fixed effects	Yes	No
County fixed effects	No	Yes
# Obs.	320	15744

NOTE: *** $p < 0.01$. The table displays the indicated coefficients from OLS regressions. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states. Panel A includes graduates in the health care sector (CIPCODE 51). Panel B includes graduates

with award level equal to 1. Panel C includes graduates in institutions with sector codes 3, 6, and 9. Panel D includes graduates in CIPCODEs 51.38, 51.07, 51.08, 51.39. Panel D1 includes graduates in CIPCODE 51.38. Panel D2 includes graduates in CIPCODE 51.07. Panel D3 includes graduates in CIPCODE 51.08. Panel D4 includes graduates in CIPCODE 51.39. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate at the state level in (1) and county level in (2). All regressions are weighted by 2010 population counts at the state level in (1) and county level in (2). See Appendix B for detailed coding definitions. Standard errors, heteroscedasticity-robust and clustered by state, are in parentheses. SOURCE: IPEDS 2010–17. Unemployment rate from BLS; median household income and poverty rate, SAIPE.

Table A2 Full Event Study Regression for Graduates

	State level				County level			
Dependent variable: Number of graduates	All health care	Top 4 professions	Less than one year	For-profit institution	All health care	Top 4 professions	Less than one year	For-profit institution
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2010*Medicaid expansion	-0.85	-0.40	-3.30	0.69	-0.34	-0.26	-0.12	0.07
	(1.15)	(1.28)	(2.35)	(0.47)	(0.26)	(0.26)	(0.23)	(0.06)
2011*Medicaid expansion	-1.93*	-1.56	-0.97	-0.29	-0.19	-0.16	0.08	-0.02
	(1.01)	(1.12)	(1.64)	(0.48)	(0.13)	(0.14)	(0.17)	(0.05)
2012*Medicaid expansion	-0.11	0.08	-0.44	-0.07	0.13	0.12	0.03	0.01
	(0.62)	(0.60)	(0.84)	(0.25)	(0.15)	(0.14)	(0.07)	(0.02)
2014*Medicaid expansion	0.30	-0.03	0.33	-0.13	0.01	-0.04	0.11**	0.01
	(0.61)	(0.44)	(0.52)	(0.22)	(0.08)	(0.08)	(0.05)	(0.01)
2015*Medicaid expansion	-0.29	-0.64	-0.36	-2.45	-0.01	-0.06	0.09	-0.13
	(0.86)	(0.64)	(1.10)	(1.75)	(0.08)	(0.09)	(0.05)	(0.09)
2016*Medicaid expansion	-1.45	-1.58*	-0.95	-2.87	-0.13	-0.18	0.07	-0.16
	(1.02)	(0.78)	(1.02)	(2.03)	(0.12)	(0.14)	(0.06)	(0.11)
2017*Medicaid expansion	-1.73	-1.66	-0.79	-2.50	-0.21	-0.25	0.11	-0.15
	(1.23)	(1.04)	(1.34)	(1.64)	(0.19)	(0.19)	(0.10)	(0.10)
Economic conditions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	No	No	No	No
County fixed effects	No	No	No	No	Yes	Yes	Yes	Yes
Baseline mean	30.91	21.23	5.65	5.58	2.61	1.74	0.43	0.46
Joint significant F test	2.40	2.18	1.72	0.98	1.89	1.91	1.55	1.17
P-value	0.08	0.11	0.18	0.41	0.15	0.14	0.22	0.33
# Obs.	320	320	320	320	15,744	15,744	15,744	15,744

NOTE: * $p < 0.10$; ** $p < 0.05$. The table displays the indicated coefficients from OLS regressions. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states. Columns (1) and (5) include graduates in the health care sector (CIPCODE 51); (2) and (6) include graduates in CIPCODEs 51.38, 51.07, 51.08, 51.39; (3) and (7) include graduates with award levels equal to 1; (4) and (8) include graduates in institutions with sector codes 3, 6, and 9. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate at the state level in (1)–(4) and the county level in (5)–(8). Baseline year is 2013. Joint significance F test for coefficients of pre-2014 interactions jointly equal 0. All regressions are weighted by 2010 county population. Standard errors, heteroscedasticity-robust and clustered by state, are in parentheses.
SOURCE: IPEDS 2010–17. Unemployment rate from BLS; median household income and poverty rate, SAIPE.

Table A3 Full Event Study Regression for Graduates in Selected Health Care Professions

	State level				County level			
Dependent variable: Number of graduates	Registered, clinical nursing, nursing admin, and research	Allied health and medical assisting services	Health and medical admin services	Practical nursing, vocational nursing, and nursing assistants	Registered, clinical nursing, nursing admin, and research	Allied health and medical assisting services	Health and medical admin services	Practical nursing, vocational nursing, and nursing assistants
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2010*Medicaid expansion	1.03	-1.05	-0.25	-0.12	-0.02	-0.06	-0.18	-0.01
	(0.80)	(0.94)	(0.70)	(0.39)	(0.11)	(0.09)	(0.16)	(0.02)
2011*Medicaid expansion	0.89	-1.77	-0.51	-0.17	-0.00	-0.08	-0.05	-0.02
	(0.66)	(1.09)	(0.46)	(0.20)	(0.08)	(0.11)	(0.05)	(0.02)
2012*Medicaid expansion	0.26	-0.35	0.33	-0.16	-0.01	0.03	0.11	-0.01
	(0.38)	(0.50)	(0.25)	(0.18)	(0.04)	(0.07)	(0.08)	(0.01)
2014*Medicaid expansion	-0.14	0.22	-0.45*	0.34	0.01	0.00	-0.08	0.03
	(0.27)	(0.44)	(0.23)	(0.21)	(0.03)	(0.04)	(0.06)	(0.02)
2015*Medicaid expansion	0.06	-0.07	-0.83**	0.21	0.04	-0.01	-0.13	0.03
	(0.54)	(0.69)	(0.33)	(0.45)	(0.07)	(0.04)	(0.12)	(0.03)
2016*Medicaid expansion	-0.22	-0.03	-1.35**	0.03	0.01	-0.01	-0.19	0.01
	(0.43)	(0.86)	(0.60)	(0.53)	(0.09)	(0.05)	(0.16)	(0.04)
2017*Medicaid expansion	-0.66*	0.06	-1.12**	0.05	-0.05	-0.01	-0.20	0.01
	(0.37)	(0.89)	(0.46)	(0.56)	(0.10)	(0.06)	(0.18)	(0.04)
Economic conditions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	No	No	No	No
County fixed effects	No	No	No	No	Yes	Yes	Yes	Yes
Baseline mean	8.23	5.58	4.04	3.48	0.61	0.49	0.44	0.20
Joint significant F test	1.75	4.35	1.93	0.78	0.37	4.84	1.36	0.88
P-value	0.17	0.01	0.14	0.51	0.77	0.01	0.27	0.46
# Obs.	320	320	320	320	15,744	15,744	15,744	15,744

NOTE: * $p < 0.10$; ** $p < 0.05$. The table displays the indicated coefficients from OLS regressions. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states. Columns (1) and (5) include graduates in CIPCODE 51.38; (2) and (6) include graduates in CIPCODE 51.08; (3) and (7) include graduates in CIPCODE 51.07; (4) and (8) include graduates in CIPCODE 51.39. Top 4 professions account for 65% of total health care workforce. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate at the state level in (1)–(4) and county level in (5)–(8). Base year is 2013. Joint significance F test of pre-2014 interactions jointly equal 0. All regressions are weighted by 2010 county population. Standard errors, heteroscedasticity-robust and clustered by state, are in parentheses.
SOURCE: IPEDS 2010–17. Unemployment rate from BLS; median household income and poverty rate, SAIPE.

Table A4 Mean of Controls in Pre-2014 Periods in Treatment Group vs. Synthetic Control Group, Synthetic Control Estimates, and *P*-Values

	All health care		Top 4 professions		Less than one year		At for-profit institution	
	Treatment group	Synthetic control group	Treatment group	Synthetic control group	Treatment group	Synthetic control group	Treatment group	Synthetic control group
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Number of graduates								
2010	22.88	22.95	17.09	17.07	5.66	5.64	5.93	5.75
2011	24.93	25.01	18.61	18.75	5.40	5.39	6.35	6.43
2012	25.80	25.88	19.11	19.05	4.91	4.91	6.63	6.71
2013	24.79	24.86	17.97	18.00	4.13	4.13	6.84	6.71
Synthetic control estimates	-1.09		-1.39		0.16		-1.25	
P-value (from one-sided test)	0.53		0.53		0.51		0.83	
# of Selections of treatment group	1,000		1,000		1,000		1,000	

NOTE: Table shows means of control variables, estimates, and *p*-values from synthetic control regressions. Columns (1) and (2) include graduates in entire health care sector; (3) and (4) include graduates in CIPCODEs 51.38, 51.39, 51.07, 51.08; (5) and (6) include graduates with award level equal to 1; (7) and (8) include graduates in institutions with sector codes 3, 6, and 9. Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with population count of fewer than 10,000. Pre-trend weights are constructed based on # of graduates in each of pre-2014 periods. *P*-values are obtained from comparing true estimates and distribution of estimates from 1,000 random selections of treatment group.
SOURCE: IPEDS 2010–17. Unemployment rate from BLS; median household income and poverty rate at the county level, SAIPE; population count, Census Bureau.

Table A5 Mean of Controls in Pre-2014 Periods in Treatment group vs. Synthetic Control Group, Synthetic Control Estimates, and *P*-Values in Selected Professions

	Registered, clinical nursing, nursing admin, and research		Allied health and medical assisting services		Health and medical admin services		Practical nursing, vocational nursing, and nursing assistants	
	Treatment group	Synthetic control group	Treatment group	Synthetic control group	Treatment group	Synthetic control group	Treatment group	Synthetic control group
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Number of graduates (1000s)								
2010	6.24	6.21	4.52	4.45	2.93	2.98	3.43	3.41
2011	6.62	6.58	5.02	5.14	3.60	3.54	3.39	3.41
2012	7.04	7.08	5.00	4.85	3.76	3.68	3.33	3.34
2013	7.33	7.35	4.15	4.20	3.22	3.31	3.29	3.27
Synthetic control estimates	-0.21		-0.54		-0.59		-0.13	
P-value	0.86		0.79		0.79		0.74	
# of Selections of treatment group	1,000		1,000		1,000		1,000	

NOTE: Table shows means of control variables, estimates, and *p*-values from synthetic control regressions. Columns (1) and (2) include graduates in CIPCODE 51.38; (3) and (4) include graduates in CIPCODE 51.08; (5) and (6) include graduates in CIPCODE 51.07; (7) and (8) include graduates in CIPCODE 51.39. Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with population count of fewer than 10,000. Pre-trend weights are constructed based on # of graduates in each of pre-2014 periods. *P*-values are obtained from comparing true estimates and distribution of estimate from 1,000 random selections of treatment group.
SOURCE: IPEDS 2010–17. Unemployment rate from BLS; median household income and poverty rate at county level, SAIPE; population count, Census Bureau.

Appendix B. IPEDS Variables and Explanations

1. IPEDS Definitions of Degrees

- Postsecondary award, certificate, or diploma of (less than 1 academic year)
    - Less than 900 contact or clock hours
    - Less than 30 semester or trimester credit hours, or
    - Less than 45 quarter credit hours

- Postsecondary award, certificate, or diploma of (at least 1 but less than 2 academic years)
    - At least 900, but less than 1,800 contact or clock hours, or
    - At least 30, but less than 60 semester or trimester hours
    - At least 45, but less than 90 quarter hours

- Associates degree

- Postsecondary award, certificate, or diploma of (at least 2 but less than 4 academic years)
    - 1,800 or more contact or clock hours, or
    - 60 or more semester or trimester credit hours, or
    - 90 or more quarter credit hours

- Bachelors degree

- Postbaccalaureate certificate

- Masters degree

- Post-masters certificate

2. CIPCODEs in IPEDS

51.38 Registered Nursing, Nursing Administration, Nursing Research, and Clinical Nursing
- 51.3801 Registered Nursing/Registered Nurse
- 51.3802 Nursing Administration
- 51.3803 Adult Health Nurse/Nursing
- 51.3805 Family Practice Nurse/Nursing
- 51.3806 Maternal/Child Health and Neonatal Nurse/Nursing
- 51.3808 Nursing Science
- 51.3809 Pediatric Nurse/Nursing
- 51.3810 Psychiatric/Mental Health Nurse/Nursing
- 51.3811 Public Health/Community Nurse/Nursing
- 51.3812 Perioperative/Operating Room and Surgical Nurse/Nursing
- 51.3813 Clinical Nurse Specialist
- 51.3814 Critical Care Nursing
- 51.3815 Occupational and Environmental Health Nursing
- 51.3816 Emergency Room/Trauma Nursing

51.3818 Nursing Practice
51.3819 Palliative Care Nursing
51.3820 Clinical Nurse Leader
51.3821 Geriatric Nurse/Nursing
51.3822 Womens Health Nurse/Nursing
51.3899 Registered Nursing, Nursing Administration, Nursing Research, and Clinical Nursing, Other

51.39 Practical Nursing, Vocational Nursing, and Nursing Assistants
51.3901 Licensed Practical/Vocational Nurse Training
51.3902 Nursing Assistant/Aide and Patient Care Assistant/Aide
51.3999 Practical Nursing, Vocational Nursing, and Nursing Assistants, Other

51.07 Health and Medical Administrative Services
51.0701 Health/Health Care Administration/Management
51.0702 Hospital and Health Care Facilities Administration/Management
51.0703 Health Unit Coordinator/Ward Clerk
51.0704 Health Unit Manager/Ward Supervisor
51.0705 Medical Office Management/Administration
51.0706 Health Information/Medical Records Administration/Administrator
51.0707 Health Information/Medical Records Technology/Technician
51.0708 Medical Transcription/Transcriptionist
51.0709 Medical Office Computer Specialist/Assistant
51.0710 Medical Office Assistant/Specialist
51.0711 Medical/Health Management and Clinical Assistant/Specialist
51.0712 Medical Reception/Receptionist
51.0713 Medical Insurance Coding Specialist/Coder
51.0714 Medical Insurance Specialist/Medical Biller
51.0715 Health/Medical Claims Examiner
51.0716 Medical Administrative/Executive Assistant and Medical Secretary
51.0717 Medical Staff Services Technology/Technician
51.0718 Long Term Care Administration/Management
51.0719 Clinical Research Coordinator
51.0799 Health and Medical Administrative Services, Other

51.08 Allied Health and Medical Assisting Services
51.0801 Medical/Clinical Assistant
51.0802 Clinical/Medical Laboratory Assistant
51.0803 Occupational Therapist Assistant
51.0805 Pharmacy Technician/Assistant
51.0806 Physical Therapy Technician/Assistant
51.0808 Veterinary/Animal Health Technology/Technician and Veterinary Assistant
51.0809 Anesthesiologist Assistant

51.0810 Emergency Care Attendant (EMT Ambulance)
51.0811 Pathology/Pathologist Assistant
51.0812 Respiratory Therapy Technician/Assistant
51.0813 Chiropractic Assistant/Technician
51.0814 Radiologist Assistant
51.0815 Lactation Consultant
51.0816 Speech-Language Pathology Assistant
51.0899 Allied Health and Medical Assisting Services, Other

3. IPEDs Definition of Sector Code

1 Public, 4-year or above
2 Private not-for-profit, 4-year or above
3 Private for-profit, 4-year or above
4 Public, 2-year
5 Private not-for-profit, 2-year
6 Private for-profit, 2-year
7 Public, less than 2-year
8 Private not-for-profit, less than 2-year
9 Private for-profit, less than 2-year

Appendix C. Analyses with Dose Response Model

We attempt to disentangle the ACA Medicaid expansion's county-level impact from its broader effects, such as the health insurance mandate and the health insurance marketplaces using a dose response model. To operationalize this model, we utilize estimates of the rate of insurance coverage in each county from the Census's Small Area Health Insurance Estimates. Following the general estimation strategy of Courtemanche et al. (2017), and specifically the county-level version of this strategy used by Courtemanche et al. (2019), we use OLS to estimate the following equation:

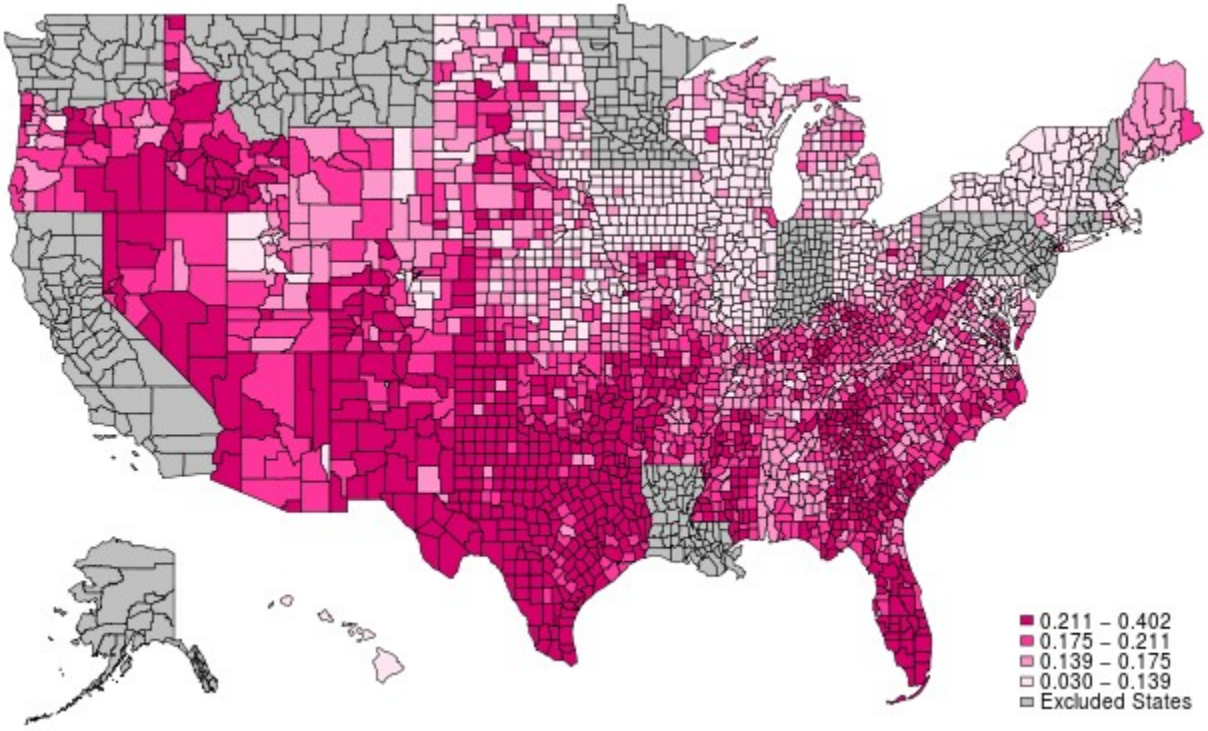
$$y_{cst} = \alpha_0 + \alpha_1(Post_t \times Uninsurance2013_c) + \alpha_2(Post_t \times Uninsurance2013_c \times Expansion_s) + \alpha_3 X_{cst} + \tau_c + \theta_{st} + \varepsilon_{cst} \quad \text{(C.1)}$$

$Uninsurance2013_c$ is a county's rate of uninsurance in 2013; θ_{st} is a vector of state-by-year fixed effects. Figure C1 shows within-state variation in the 2013 rate of insurance enrollment that is used for identification in this model. $\widehat{\alpha_1}/100$ is the effect of the ACA per one percentage point change in the pre-ACA rate of uninsurance. We thus scale the effect by the median pre-ACA rate of uninsurance to obtain $(\overline{Uninsurance2013_c})\widehat{\alpha_1}$, the effect of the ACA (but not the Medicaid expansion) in a county with the median rate of pre-ACA insurance coverage.

Similarly, $\widehat{\alpha_2}/100$ is an estimate of the additional effect of the Medicaid expansion in a county from a one percentage point change in the pre-ACA rate of uninsurance, and $(\overline{Uninsurance2013_c})\widehat{\alpha_2}$ is the additional effect of the Medicaid expansion in a county with the median rate of pre-ACA insurance coverage. This makes $(\overline{Uninsurance2013_c})(\widehat{\alpha_1} + \widehat{\alpha_2})$ the complete effect of the ACA in the median county within a Medicaid expansion state. These estimates can be interpreted as causal under assumptions analogous to the difference-in-differences assumptions: the outcome in counties with differing levels of pre-ACA health insurance enrollment must follow parallel trends pre-ACA, and there should be no systematic changes in circumstances in counties with differing levels of pre-ACA health insurance

enrollment, at the same time as the ACA was implemented.

Figure C1 County-Level Health Uninsurance Rate in 2013



NOTE: Graph shows health uninsurance rate in 2013 at the county level. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states.
SOURCE: SAHIE 2013.

Tables C1 and C2 report results for the dose response models. The results from these models are starkly different from the estimates from the difference-in-differences and synthetic control models, but they are unlikely causal estimates due to a lack of parallel trends. Six of the eight subsamples suggest negative and statistically significant effects of the ACA on graduation, coupled with smaller positive estimates of the additional effect of the Medicaid expansion. These results appear to be the result of a violation of the no pre-reform trends assumption underlying the model. Tables C3 and C4 report full event time estimates for these dose response models, and for the six subsamples with the strong estimates of the effect of the ACA; all six have large and consistently statistically significant point estimates for the pre-ACA time period. The remaining two subsamples that pass the test of the parallel trends assumption—degrees at for-profit institutions (Table C3, column 4) and degrees for Registered, Clinical Nursing, Nursing Admin, and Research (Table C4, column 1)—estimate small and statistically insignificant effects of both the Medicaid expansion and the ACA in general. While the dose response strategy was a priori a

promising one for investigating local educational market responses to ACA-induced demand increases, the violation of the parallel trends assumption does not permit us to draw any useful conclusions from this exercise.

Table C1 Triple-Difference Regression Results and Implied Effects for Number of Graduates

	All health care	Top 4 professions	Less than one year	At for-profit institution
	(1)	(2)	(3)	(4)
Panel A1. Regression Coefficients: Dependent Variable: # of Graduates (1,000s)				
Post X uninsured 2013	-9.44**	-7.73**	-5.21***	-1.47
	(4.28)	(2.98)	(1.14)	(1.89)
Post X uninsured 2013 X Medicaid expansion	3.48	2.77	0.98	0.92
	(4.46)	(3.12)	(2.51)	(2.12)
Panel A2. Implied Effects at Mean Pretreatment Uninsured Rate				
ACA w/o Medicaid expansion	-1.58**	-1.30**	-0.88***	-0.22
	(0.72)	(0.50)	(0.19)	(0.29)
Medicaid expansion	0.58	0.46	0.17	0.14
	(0.75)	(0.52)	(0.43)	(0.32)
Full ACA (with Medicaid expansion)	-1.00**	-0.83***	-0.72*	-0.08
	(0.41)	(0.29)	(0.38)	(0.12)
Economic conditions	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes
State-year fixed effects	Yes	Yes	Yes	Yes
Pre-period mean of dependent variable	2.61	1.74	0.43	0.46
# Obs.	15,744	15,744	15,744	15,744

NOTE: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. Each cell reports coefficients of indicated variables. Column (1) includes graduates in CIPCODE 51; (2) includes graduates in CIPCODEs 51.38, 51.39, 51.07, 51.08; (3) includes graduates with award level equal to 1; (4) includes graduates in institutions with sector codes 3, 6, and 9. Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with populations of fewer than 10,000. All regressions are weighted by population count in 2010. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate at the county level. Heteroskedasticity-robust, state-clustered standard errors in parentheses. SOURCE: IPEDS 2010–17. Health uninsurance rate from SAHIE 2013; population count, Census Bureau; unemployment rate, BLS; median household income and poverty rate, SAIPE.

Table C2 Triple-Difference Regression Results and Implied Effects for Number of Graduates in Selected Professions

	Registered, clinical nursing, nursing admin, and research	Allied health and medical assisting services	Health and medical admin services	Practical nursing, vocational nursing, and nursing assistants
	(1)	(2)	(3)	(4)
Panel A1. Regression Coefficients: Dependent Variable: # of Graduates (1,000s)				
Post X uninsured 2013	1.94	-4.46***	-3.61*	-1.60**
	(1.22)	(1.13)	(1.97)	(0.76)
Post X uninsured 2013 X Medicaid expansion	-1.88	1.97	2.10	0.58
	(1.22)	(1.39)	(1.89)	(1.17)
Panel A2. Implied Effects at Mean Pretreatment Uninsured Rate				
ACA w/o Medicaid expansion	0.32	-0.74***	-0.59*	-0.27**
	(0.20)	(0.19)	(0.32)	(0.13)
Medicaid expansion	-0.31	0.33	0.35	0.10
	(0.20)	(0.23)	(0.31)	(0.20)
Full ACA (with Medicaid expansion)	0.01	-0.41**	-0.25**	-0.18
	(0.08)	(0.16)	(0.11)	(0.16)
Economic conditions	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes
State-year fixed effects	Yes	Yes	Yes	Yes
Pre-period mean of dependent variable	0.61	0.49	0.44	0.20
# Obs.	15,744	15,744	15,744	15,744

NOTE: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. Each cell reports coefficients of indicated variables. Column (1) includes graduates in CIPCODE 51.38; (2) includes graduates in CIPCODE 51.08; (3) includes graduates in CIPCODE 51.07; (4) includes graduates in CIPCODE 51.39. Top 4 professions account for 65% of total health care workforce. Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with populations of fewer than 10,000. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate at the county level. All regressions are weighted by population count at the county level in 2010. Heteroskedasticity-robust, state-clustered standard errors in parentheses.
SOURCE: IPEDS 2010–17. Health uninsurance rate from SAHIE 2013; population count, Census Bureau; unemployment rate, BLS; median household income and poverty rate, SAIPE.

Table C3 Full Event Study Regression of Dose Response Model for Graduates in Health Care, Top 4 Professions, in Less than One Year, and at For-Profit Institutions

	All health care	Top 4 professions	Less than one year	For-profit institution
	(1)	(2)	(3)	(4)
2010*Uninsured 2013	6.46***	6.17***	6.88***	-1.97**
	(1.90)	(1.68)	(1.62)	(0.86)
2011* Uninsured 2013	6.84***	5.19**	3.06**	-0.15
	(2.37)	(2.22)	(1.20)	(0.73)
2012* Uninsured 2013	1.98	1.14	1.42***	-0.30
	(1.42)	(1.42)	(0.40)	(0.32)
2014* Uninsured 2013	-2.18**	-1.61***	-0.77***	-0.36
	(0.97)	(0.49)	(0.25)	(0.47)
2015* Uninsured 2013	-5.79	-4.83*	-2.44**	-1.34
	(3.62)	(2.68)	(1.09)	(2.07)
2016* Uninsured 2013	-7.09	-6.23*	-3.19***	-1.57
	(5.09)	(3.48)	(0.85)	(2.14)
2017* Uninsured 2013	-8.13*	-6.74**	-3.17***	-1.74
	(4.33)	(2.89)	(0.72)	(1.82)
2010*Medicaid Expansion*Uninsured 2013	-1.41	-2.03	-0.78	1.26
	(2.94)	(2.09)	(2.58)	(0.97)
2011*Medicaid Expansion* Uninsured 2013	-2.42	-2.17	1.03	0.44
	(3.47)	(2.46)	(2.73)	(0.98)
2012*Medicaid Expansion* Uninsured 2013	3.28	2.24	2.79	1.31
	(3.15)	(2.20)	(2.36)	(0.84)
2014*Medicaid Expansion* Uninsured 2013	1.93*	1.02	1.46	0.40
	(0.98)	(0.71)	(0.97)	(0.56)
2015*Medicaid Expansion* Uninsured 2013	2.96	2.16	1.47	1.17
	(3.32)	(2.49)	(1.07)	(2.26)
2016*Medicaid Expansion* Uninsured 2013	3.64	2.65	1.72*	1.43
	(4.84)	(3.32)	(0.98)	(2.28)
2017*Medicaid Expansion* Uninsured 2013	3.73	2.09	1.21	1.19

	(3.93)	(2.69)	(0.96)	(2.06)
Economic conditions	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes
State-year fixed effects	Yes	Yes	Yes	Yes
Baseline mean	2.61	1.74	0.43	0.46
Joint significance F test	11.42	12.42	8.20	5.39
P-value	0.00	0.00	0.00	0.00
# Obs.	15,744	15,744	15,744	15,744

NOTE: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. Each cell reports coefficients of indicated variables. Column (1) includes graduates in CIPCODE 51; (2) includes graduates in CIPCODEs 51.38, 51.39, 51.07, 51.08; (3) includes graduates with award level equal to 1; (4) includes graduates in institutions with sector codes 3, 6, and 9. Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with populations of fewer than 10,000. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate at the county level. Baseline year is 2013. Joint significance F test for coefficients of pre-2014 interactions jointly equal 0. All regressions are weighted by 2010 county population. Heteroskedasticity-robust, state-clustered standard errors in parentheses. SOURCE: IPEDS 2010–17. Health uninsurance rate from SAHIE 2013; unemployment rate, BLS; median household income and poverty rate, SAIPE; population count, Census Bureau.

Table C4 Full Event Study Regression of Dose Response Model for Graduates in Selected Health Care Professions

	Registered, clinical nursing, nursing admin, and research	Allied health and medical assisting services	Health and medical admin services	Practical nursing, vocational nursing, and nursing assistants
	(1)	(2)	(3)	(4)
2010* Uninsured 2013	-1.69	3.31***	5.59*	-0.31
	(1.38)	(0.93)	(2.97)	(0.58)
2011* Uninsured 2013	-1.81	4.23***	2.88**	0.22***
	(1.58)	(1.04)	(1.07)	(0.08)
2012* Uninsured 2013	-1.13	1.84***	0.67***	-0.16
	(0.74)	(0.60)	(0.18)	(0.20)
2014* Uninsured 2013	0.81	-1.75	0.05	-0.49***
	(0.58)	(1.12)	(0.26)	(0.18)
2015* Uninsured 2013	0.83	-1.73**	-1.61	-2.08
	(0.54)	(0.81)	(1.17)	(1.34)
2016* Uninsured 2013	0.43	-2.28**	-2.14	-1.96*
	(0.51)	(1.03)	(1.64)	(1.12)
2017* Uninsured 2013	1.12	-3.03***	-2.02	-2.30**
	(0.86)	(1.01)	(1.28)	(1.10)
2010*Medicaid Expansion*Uninsured 2013	1.28	-0.95	-3.85	1.08
	(1.48)	(1.25)	(3.04)	(0.95)
2011*Medicaid Expansion*Uninsured 2013	1.82	-2.78**	-1.67	0.16
	(1.70)	(1.34)	(1.13)	(0.68)
2012*Medicaid Expansion*Uninsured 2013	1.35*	-0.35	0.08	0.75
	(0.78)	(0.86)	(0.86)	(0.72)
2014*Medicaid Expansion*Uninsured 2013	-0.32	1.24	-0.50	0.44*
	(0.57)	(1.14)	(0.45)	(0.24)
2015*Medicaid Expansion*Uninsured 2013	-1.21**	0.75	0.93	1.63
	(0.56)	(0.94)	(1.04)	(1.27)
2016*Medicaid Expansion*Uninsured 2013	-0.35	0.75	1.42	0.91
	(0.73)	(1.09)	(1.44)	(1.19)

2017*Medicaid Expansion*Uninsured 2013	-1.21	0.96	0.97	1.25
	(0.90)	(0.98)	(1.08)	(1.12)
Economic conditions	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes
State-year fixed effects	Yes	Yes	Yes	Yes
Baseline mean	0.64	0.49	0.42	0.18
Joint significance F test	1.41	27.79	9.45	8.51
P-value	0.24	0.00	0.00	0.00
# Obs.	15,744	15,744	15,744	15,744

NOTE: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. Each cell reports coefficients of indicated variables. Column (1) includes graduates in CIPCODE 51.38; (2) includes graduates in CIPCODE 51.08; (3) includes graduates in CIPCODE 51.07; (4) includes graduates in CIPCODE 51.39. Top 4 professions account for 65% of total health care workforce. Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with populations of fewer than 10,000. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate at the county level. Baseline year is 2013. Joint significance F test for coefficients of pre-2014 interactions jointly equal 0. All regressions are weighted by population count in 2010. Heteroskedasticity-robust, state-clustered standard errors in parentheses.
SOURCE: IPEDS 2010–17. Health uninsurance rate from SAHIE 2013; unemployment rate, BLS; median household income and poverty rate, SAIPE; population count, Census Bureau.

Appendix C References

Courtemanche, C., A. Friedson, A. P. Koller, and D. I. Rees. 2019. "The Affordable Care Act and Ambulance Response Times." *Journal of Health Economics* 67(September).

Courtemanche, C., J. Marton, B. Ukert, A. Yelowitz, and D. Zapata. 2017. "Early Impacts of the Affordable Care Act on Health Insurance Coverage in Medicaid Expansion and Non-expansion States." *Journal of Policy Analysis and Management* 36(1): 178–210.

Appendix D. Supplementary Analysis on Extensive Margin

1. Full Event Study Regression for Having a Program

We use the following specification to model the extensive margin (results are presented in Table D1).

$$\mathbf{Pr}(y_{c,s,t} > 0) = \beta_0 + \sum_{t=2010}^{2017} \beta_t * \mathbf{1}[year = t] * Expansion_s + \alpha_2 X_{c,s,t} + \tau_c + \theta_t + \varepsilon_{c,s,t}$$

Where $y_{c,s,t} > 0$ is whether a county has a program, *Expansion*$_s$ is whether state expanded Medicaid, $\boldsymbol{X_{c,s,t}}$ is a vector of time-variant county characteristics, τ_c is a vector of county fixed effects, θ_t is a vector of year fixed effects, and $\varepsilon_{c,s,t}$ is the error term.

Table D1 Full Event Study Regression of Having a Program

Dependent variable: Having a program	All health care	Top 4 professions	Less than one year	For-profit institution	Registered, clinical nursing, nursing admin, and research	Allied health and medical assisting services	Health and medical admin services	Practical nursing, vocational nursing, and nursing assistants
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2010*Medicaid Expansion	-0.000	0.000	-0.041**	-0.014	0.01	0.02	0.01	0.02
	(0.003)	(0.004)	(0.016)	(0.020)	(0.01)	(0.02)	(0.02)	(0.02)
2011*Medicaid Expansion	0.001	0.000	-0.043**	-0.002	0.01	0.01	0.00	0.02
	(0.003)	(0.003)	(0.016)	(0.014)	(0.00)	(0.01)	(0.01)	(0.02)
2012*Medicaid Expansion	0.002	0.002	-0.027**	-0.002	0.00	0.01	-0.00	-0.01
	(0.004)	(0.004)	(0.011)	(0.012)	(0.00)	(0.01)	(0.01)	(0.02)
2014*Medicaid Expansion	-0.004	-0.009**	-0.003	-0.009	-0.00	0.01	-0.02**	0.00
	(0.003)	(0.004)	(0.010)	(0.005)	(0.00)	(0.01)	(0.01)	(0.01)
2015*Medicaid Expansion	-0.007*	-0.016***	-0.021*	-0.028	0.00	0.00	-0.01	0.01
	(0.004)	(0.005)	(0.012)	(0.019)	(0.01)	(0.01)	(0.01)	(0.01)
2016*Medicaid Expansion	-0.007	-0.019***	-0.009	-0.044**	-0.00	0.00	0.00	-0.00
	(0.005)	(0.006)	(0.020)	(0.017)	(0.01)	(0.01)	(0.01)	(0.01)
2017*Medicaid Expansion	-0.013**	-0.023***	-0.047***	-0.033**	-0.00	-0.00	-0.01	-0.02
	(0.006)	(0.008)	(0.015)	(0.013)	(0.01)	(0.01)	(0.01)	(0.02)
Economic conditions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	No	No	No	No
County fixed effects	No	No	No	No	Yes	Yes	Yes	Yes
Baseline mean	0.86	0.84	0.69	0.57	0.78	0.73	0.76	0.71
Joint significant F test	0.26	0.15	2.68	0.46	1.38	0.40	0.59	1.09
P-value	0.85	0.93	0.06	0.71	0.26	0.75	0.62	0.37
# Obs.	15744	15744	15744	15744	15744	15744	15744	15744

NOTE: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. The table displays the indicated coefficients from OLS regressions. Sample excludes early (CA, CT, MN, NJ, WA) and late (AK, IN, LA, MT, NH, PA) expansion states. Column (1) includes graduates in health care sector (CIPCODE 51); (2) includes graduates with award level equal to 1; (3) includes graduates in institutions with sector codes 3, 6, and 9; (4) includes graduates in CIPCODEs 51.38, 51.07, 51.08, 51.39; (5) includes graduates in CIPCODE 51.38; (6) includes graduates in CIPCODE 51.07; (7) includes graduates in CIPCODE 51.08; (8) includes graduates in CIPCODE 51.39. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate. See Appendix B for detailed coding definitions. Baseline year is 2013. Joint significance F test of pre-2014 interactions jointly equal 0. All regressions are weighted by population count at the county level in 2010. Standard errors, heteroscedasticity-robust and clustered by state, are in parentheses.
SOURCE: IPEDS 2010–17. Unemployment rate from BLS; median household income and poverty rate, SAIPE.

Table D2 Dose Response Model for Having a Program in Health Care, Top 4 Professions, in Less than One Year, and at For-Profit Institutions

Dependent variable: Having a program	All health care	Top 4 professions	Less than one year	For-profit institution
	(1)	(2)	(3)	(4)
Panel A1. Regression Coefficients: Dependent Variable: Having Graduates				
Post X uninsured	-0.26*	-0.34**	0.02	0.02
	(0.15)	(0.14)	(0.12)	(0.25)
Post X uninsured X Medicaid expansion	0.34*	0.48**	-1.43*	0.20
	(0.17)	(0.18)	(0.81)	(0.32)
Panel A2. Implied Effects at Mean Pretreatment Uninsured Rate				
ACA w/o Medicaid expansion	-0.04*	-0.06**	0.00	0.00
	(0.03)	(0.02)	(0.02)	(0.04)
Medicaid expansion	0.06*	0.08**	-0.24*	0.03
	(0.03)	(0.03)	(0.14)	(0.05)
Full ACA (with Medicaid expansion)	0.01	0.02	-0.24*	0.03
	(0.01)	(0.02)	(0.13)	(0.03)
Economic conditions	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes
State-year fixed effects	Yes	Yes	Yes	Yes
Pre-period mean of dependent variable	0.86	0.84	0.68	0.57
# Obs.	15,744	15,744	15,744	15,744

NOTE: * $p < 0.10$; ** $p < 0.05$. Each cell reports coefficients of indicated variables. Column (1) includes graduates in CIPCODE 51; (2) includes graduates in CIPCODEs 51.38, 51.39, 51.07, 51.08; (3) includes graduates with award level equal to 1; (4) includes graduates in institutions with sector codes 3, 6, and 9. Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with populations of fewer than 10,000. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate at the county level. All regressions are weighted by population count at the county level in 2010. Heteroskedasticity-robust, state-clustered standard errors in parentheses.
SOURCE: IPEDS 2010–17. Health uninsurance rate from SAHIE 2013; population count, Census Bureau; unemployment rate, BLS; median household income and poverty rate, SAIPE.

Table D3 Dose Response Model for Having a Program in Selected Profession

Dependent variable: Having a program	Registered, clinical nursing, nursing admin, and research	Allied health and medical assisting services	Health and medical admin services	Practical nursing, vocational nursing, and nursing assistants
	(1)	(2)	(3)	(4)
Panel A1. Regression Coefficients: Dependent Variable: Having Graduates				
Post X uninsured	-0.14	-0.35**	-0.14	-0.17
	(0.10)	(0.13)	(0.15)	(0.19)
Post X uninsured X Medicaid expansion	0.17	0.36	0.12	0.12
	(0.23)	(0.32)	(0.31)	(0.52)
Panel A2. Implied Effects at Mean Pretreatment Uninsured Rate				
ACA w/o Medicaid expansion	-0.02	-0.06**	-0.02	-0.03
	(0.02)	(0.02)	(0.02)	(0.03)
Medicaid expansion	0.03	0.06	0.02	0.02
	(0.04)	(0.05)	(0.05)	(0.09)
Full ACA (with Medicaid expansion)	0.00	0.00	-0.00	-0.01
	(0.03)	(0.05)	(0.04)	(0.08)
Economic conditions	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes
State-year fixed effects	Yes	Yes	Yes	Yes
Pre-period mean of dependent variable	0.78	0.73	0.76	0.71
# Obs.	15,744	15,744	15,744	15,744

NOTE: ** $p < 0.05$. Each cell reports coefficients of indicated variables. Column (1) includes graduates in CIPCODE 51.38; (2) includes graduates in CIPCODE 51.08; (3) includes graduates in CIPCODE 51.07; (4) includes graduates in CIPCODE 51.39. Top 4 professions account for 65% of total health care workforce. Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with populations of fewer than 10,000. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate at the county level. All regressions are weighted by population count at the county level in 2010. Heteroskedasticity-robust, state-clustered standard errors in parentheses.
SOURCE: IPEDS 2010–17. Health uninsurance rate from SAHIE 2013; population count, Census Bureau; unemployment rate, BLS; median household income and poverty rate, SAIPE.

3. Event Study Regression for Dose Response Model of Having a Program

We use the following event study specification for dose response model of having a program (results are presented in Tables D4 and D5).

$$\mathbf{Pr}\left(y_{c,s,t} > 0\right) = \gamma_0 + \sum_{t=2010}^{2017}(\gamma_{1,t} \times \mathit{Uninsurance}\ 2013_{c,s} \times 1[year = t]) + \sum_{t=2010}^{2017}(\gamma_{1,t} \times \mathit{Uninsurance}\ 2013_{c,s} \times \mathit{Expansion}_s \times 1[year = t]) + \alpha_2 \boldsymbol{X_{c,s,t}} + \tau_c + \theta_{s,t} + \varepsilon_{c,s,t}$$

Where $y_{c,s,t} > 0$ is whether a county has a program, *Expansion*$_s$ is whether state expanded Medicaid, *Uninsurance 2013* is county-level uninsurance rate, $\boldsymbol{X_{c,s,t}}$ is a vector of time-variant county characteristics, τ_c is a vector of county fixed effects, $\theta_{s,t}$ is a vector of state-year fixed effects, and $\varepsilon_{c,s,t}$ is the error term.

Table D4 Full Event Study Regression for Dose Response Model of Having a Program in Healthcare, Top 4 Professions, in Less than One Year, and at For-Profit Institutions

	All health care	Top 4 professions	Less than one year	For-profit institution
Dependent variable: Having a program	(1)	(2)	(3)	(4)
2010* Uninsurance 2013	0.05	0.06	-0.85*	0.17
	(0.05)	(0.12)	(0.46)	(0.36)
2011* Uninsurance 2013	0.04	-0.01	-0.70	-0.15
	(0.05)	(0.06)	(0.54)	(0.27)
2012* Uninsurance 2013	-0.03	-0.00	-0.41	-0.17
	(0.04)	(0.04)	(0.26)	(0.27)
2014* Uninsurance 2013	-0.23*	-0.32**	-0.28	-0.24
	(0.13)	(0.14)	(0.40)	(0.15)
2015* Uninsurance 2013	-0.24	-0.32**	-0.55*	-0.06
	(0.16)	(0.16)	(0.30)	(0.23)
2016* Uninsurance 2013	-0.26	-0.37*	-0.68**	0.02
	(0.17)	(0.19)	(0.31)	(0.28)
2017* Uninsurance 2013	-0.28	-0.31	-0.52	0.25
	(0.19)	(0.20)	(0.32)	(0.27)
2010*Medicaid Expansion*Uninsurance 2013	-0.06	-0.09	1.05*	0.19
	(0.10)	(0.13)	(0.59)	(0.53)
2011*Medicaid Expansion*Uninsurance 2013	-0.12	-0.11	1.09	0.22
	(0.08)	(0.15)	(0.66)	(0.29)
2012*Medicaid Expansion*Uninsurance 2013	0.04	-0.02	0.68*	0.30
	(0.05)	(0.06)	(0.39)	(0.29)
2014*Medicaid Expansion*Uninsurance 2013	0.30*	0.38**	0.09	0.23
	(0.15)	(0.14)	(0.49)	(0.19)
2015*Medicaid Expansion*Uninsurance 2013	0.27	0.38**	0.43	0.54
	(0.17)	(0.17)	(0.39)	(0.48)
2016*Medicaid Expansion*Uninsurance 2013	0.28	0.46**	0.16	0.53
	(0.18)	(0.21)	(0.58)	(0.48)
2017*Medicaid Expansion*Uninsurance 2013	0.35	0.50	-3.70	0.22
	(0.22)	(0.32)	(2.47)	(0.47)
Economic conditions	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes
State-year fixed effects	Yes	Yes	Yes	Yes
Baseline mean	0.86	0.84	0.68	0.57
Joint significance F test	4.85	0.35	1.6	0.79
P-value	0	0.91	0.17	0.58

# Obs.	15,744	15,744	15,744	15,744

NOTE: * $p < 0.10$; ** $p < 0.05$. Each cell reports coefficients of indicated variables. Column (1) includes graduates in CIPCODE 51; (2) includes graduates in CIPCODEs 51.38, 51.39, 51.07, 51.08; (3) includes graduates with award level equal to 1; (4) includes graduates in institutions with sector codes 3, 6, and 9. Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with populations of fewer than 10,000. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate at the county level. Baseline year is 2013. Joint significance F test of pre-2014 interactions jointly equal 0. All regressions are weighted by population count at the county level in 2010. Heteroskedasticity-robust, state-clustered standard errors in parentheses.
SOURCE: IPEDS 2010–17. Health uninsurance rate from SAHIE 2013; population count, Census Bureau; unemployment rate, BLS; median household income and poverty rate, SAIPE.

Table D5 Full Event Study Regression for Dose Response Model of Having a Program in Selected Health Care Professions

Dependent variable: Having a program	Registered, clinical nursing, nursing admin, and research	Allied health and medical assisting services	Health and medical admin services	Practical nursing, vocational nursing, and nursing assistants
	(1)	(2)	(3)	(4)
2010* Uninsurance 2013	-0.11	0.46**	-0.35***	0.43
	(0.18)	(0.21)	(0.11)	(0.41)
2011* Uninsurance 2013	0.03	0.29***	-0.11	0.32
	(0.10)	(0.06)	(0.13)	(0.37)
2012* Uninsurance 2013	-0.00	-0.04	-0.05	0.16
	(0.02)	(0.07)	(0.11)	(0.21)
2014* Uninsurance 2013	-0.09	0.09	-0.46***	0.02
	(0.07)	(0.11)	(0.12)	(0.08)
2015* Uninsurance 2013	0.03	-0.29	-0.25	0.06
	(0.12)	(0.23)	(0.23)	(0.10)
2016* Uninsurance 2013	-0.30	-0.27	-0.23	0.05
	(0.20)	(0.21)	(0.21)	(0.16)
2017* Uninsurance 2013	-0.33*	-0.31	-0.12	0.06
	(0.17)	(0.23)	(0.26)	(0.17)
2010*Medicaid Expansion*Uninsurance 2013	-0.10	-0.65	0.81**	-0.78
	(0.22)	(0.46)	(0.35)	(0.51)
2011*Medicaid Expansion*Uninsurance 2013	-0.10	-0.65*	1.01**	-0.53
	(0.11)	(0.35)	(0.45)	(0.45)
2012*Medicaid Expansion*Uninsurance 2013	-0.04	-0.14	0.25	0.44
	(0.05)	(0.37)	(0.19)	(0.40)
2014*Medicaid Expansion*Uninsurance 2013	0.25	0.05	0.89***	0.15
	(0.16)	(0.29)	(0.26)	(0.46)
2015*Medicaid Expansion*Uninsurance 2013	-0.17	0.05	0.72*	0.01
	(0.27)	(0.46)	(0.41)	(0.48)
2016*Medicaid Expansion*Uninsurance 2013	0.17	-0.02	0.42	0.09
	(0.31)	(0.44)	(0.32)	(0.49)
2017*Medicaid Expansion*Uninsurance 2013	0.19	-0.13	0.53	-0.66
	(0.29)	(0.47)	(0.46)	(1.12)
Economic conditions	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes

State-year fixed effects	Yes	Yes	Yes	Yes
Baseline Mean	0.78	0.73	0.76	0.71
Joint significance F test	0.68	7.53	3.09	3.67
P-value	0.66	0	0.01	0.01
# Obs.	15,744	15,744	15,744	15,744

NOTE: * $p < 0.10$ **; $p < 0.05$; *** $p < 0.01$. Each cell reports coefficients of indicated variables. Column (1) includes graduates in CIPCODE 51.38; (2) includes graduates in CIPCODE 51.08; (3) includes graduates in CIPCODE 51.07; (4) includes graduates in CIPCODE 51.39. Top 4 professions account for 65% of total health care workforce. Sample excludes early expansion states (CA, CT, MN, NJ, WA), late expansion states (AK, IN, LA, MT, NH, PA), and counties with populations of fewer than 10,000. Expansion equals 1 if state expanded Medicaid in Jan. 2014. Post equals 1 if in 2014 or after. Economic conditions include unemployment rate, median household income and poverty rate at the county level. Baseline year is 2013. Joint significance F test for coefficients of pre-2014 interactions jointly equal 0. All regressions are weighted by population count in 2010. Heteroskedasticity-robust, state-clustered standard errors in parentheses.
SOURCE: IPEDS 2010–17. Health uninsurance rate from SAHIE 2013; unemployment rate, BLS; median household income and poverty rate, SAIPE; population count, Census Bureau.