# Impact of Education on the Individual Mandate Component of the Affordable Care Act

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## I. Introduction

How does education impact health insurance uptake as a result of the individual mandate component of the Patient Protection and Affordable Care Act of 2010? The Affordable Care Act (ACA) has been a very controversial piece of legislation designed to increase insurance coverage. The merits of it are still being debated, as are the impacts. There are four major mechanisms by which the ACA was designed to increase insurance coverage. The first is the "Young Adult Mandate," which allowed children to stay on their parents' plans until age 26. It expanded Medicaid eligibility in states that passed Medicaid expansion. It set up state insurance marketplaces, also known as health exchanges, which are organizations in each state through which people are able to purchase health insurance. Lastly, the ACA imposed an individual mandate, requiring all individuals to purchase health insurance unless they were able to claim an exemption under the law, usually for reasons relating to income or religious exemption. In the event that individuals do not purchase insurance, they are subject to a fine, instituted via a tax. The government provides subsidies to low-income individuals for whom the cost of healthcare is an excessive burden. The individual mandate component of the Affordable Care Act is one of the most controversial components. Though it was instituted on January 1, 2014, the penalty for the individual mandate will be repealed effective January 1, 2019, with the Tax Cuts and Jobs Act of 2017.

The goal of such a mandate was to diversify risk pools and to combat the problem of adverse selection where the sick and elderly (individuals more likely to make health insurance claims) would opt into the health insurance and the healthy individuals wouldn't. This causes health insurance pools to lack the diversification that allows insurance to function, and they end up paying out more in claims than they take in via premiums, which is unsustainable. Under the individual mandate, in the event that you do not have health insurance, you are required to pay a tax penalty of $695 or 2.5% of household income, whichever is higher. The goal of the individual mandate and the ACA as a whole was also to increase the number of individuals covered by health insurance, as when an uncovered individual seeks medical treatment, the cost of the treatment is borne by rest of the population.

As a result of the individual mandate and the rest of these ACA reforms, many previously uninsured individuals took up health insurance either through employers, private providers, public providers (via the expansion of Medicaid and other ways), as well as through the health

insurance state marketplaces created by the ACA. The National Center for Health Statistics reports that 20.0 million fewer people went without insurance in 2010 compared to 2016, and estimates from the 2016 National Health Interview Survey report that 11.2 million persons under the age of 65 are now covered by private health plans obtained through the Health Insurance Marketplace or state-based exchanges (Cohen, Zammitti, & Martinez, 2016). While this take-up is a very significant result of the ACA reforms, not much research has been conducted into determining by what mechanism insurance increased, and more importantly, which groups were most impacted.

Throughout this paper, I specifically focus on how education impacts the rate of insurance uptake as a result of the individual mandate component of the ACA. I seek to isolate the effects of the individual mandate part of the ACA using a Difference-in-Difference-in-Differences (DDD) approach, using various cutoff levels of education as the treatment, though primarily the effects of holding a college degree. Although this specification is intended to isolate the effects of the individual mandate component of the Affordable Care Act, due to the multitude of changes that occurred during this time period, around the "post" cutoff of January 1, 2014, there is significant potential for spillover effects. Some of these include the guarantee of new essential benefits, prohibiting individuals with pre-existing conditions from being denied insurance, increase in individuals acquiring insurance due to caps on out of pocket expenditures, etc. As a result, there is potential for some of the analysis to represent a more general insurance expansion, rather than the sole impact of the individual mandate.

Using the DDD approach, I am able to compare those at various levels of educations and see how the rate of having any insurance coverage differs. The underlying hypothesis is that individuals who are of lower education levels will take up insurance at a higher rate than those with higher levels of education when legally compelled to (under the individual mandate). Those at higher levels of education may already hold health insurance plans due to their better understanding of the benefits of insurance or the increased resources that their education provides them with.

The remainder of this paper proceeds as follows. Section II gives a more in-depth explanation of the current policy and provides a review of the current literature surrounding the impacts of the ACA with special consideration given to the affordable mandate component. Section III describes the data used for the analysis. Section IV provides a detailed description of

empirical methods and my identification strategy. Section V presents a comprehensive depiction of the main results. Section VI offers a discussion of future implications and concludes.

## II. Policy Background and Review of Literature

The Affordable Care and Patient Protection Act of 2010 was one of the most comprehensive health insurance reform in the United States in recent history. It instituted reforms to both the public and private insurance markets, with the goal of increasing health insurance coverage. The key provisions of the ACA are as follows (The Henry J. Kaiser Family Foundation, 2012).

The goal of the ACA is to expand health insurance coverage, especially to low-income individuals. The most pertinent mechanism to this goal worked by allowing states to expand access to Medicaid to individuals with adjusted gross incomes up to 138% of the Federal Poverty Level (FPL), $15,415 for an individual and $31,809 for a family of four in 2012. To facilitate this, the federal government provided substantial federal funding to states for such Medicaid expansions (covering at least 90% of the costs). Next, the ACA provided for states to create health exchange marketplaces where individuals and small employers could purchase insurance. These exchanges offered four different tiers of plans, and all of the plans offered are required to have a minimum standard set of coverage, known as "essential benefits".

There were also reforms made to the private insurance market. Under the law, private insurers are prohibited from denying coverage for any reason (including pre-existing conditions and health status) and were prohibited from charging people more based on their health status and gender. The costs of premiums were only able to vary in cost based on the characteristics of age, geographic area, tobacco usage, and the number of family members. The reforms also required a minimum set of services to be offered with every health insurance plan (except catastrophic insurance), i.e. comprehensive coverage, and caps to individual annual out-of-pocket spending. Increases in health plan premiums are now subject to review, and insurers are now required to spend at least 80% of premium payments collected on medical costs or else they must pay rebates back to customers. Employers of more than 50 full-time employees are required to offer health insurance coverage to their full-time employees, or else are subject to penalties of $2,000 to $3,000 per employee. Young adults are also allowed to stay on their parents' insurance plans until age 26 with the "Young Adult Mandate" component of the ACA.

The reform most relevant to this paper is the individual mandate component. Beginning January 1, 2014, with some certain exemptions, all individuals are required to have health insurance or pay an annual financial penalty equivalent to (as of 2016) $695 per person, or 2.5% of household income, whichever is greater. The reasons for exemption consist of financial hardship, religious exemptions, for Native Americans and American Indians, those with insurance gaps lasting three months or less, and those below the federal income tax filing threshold.

While this mandate did place hefty health insurance requirements on many individuals, to make an insurance mandate more feasible and affordable, the government offered premium and cost-sharing subsidies to low-income individuals. Premium subsidies are provided to families without access to other coverage and fall within 100% to 400% of the federal poverty level to help them purchase health insurance through the state exchanges. The subsidy amount works to ensure that the cost of insurance premiums is limited to between 2% and 9.5% of annual income. Cost-sharing subsidies are available to individuals with incomes between 100-250% of the FPL, with the goal of limiting out-of-pocket spending (The Henry J. Kaiser Family Foundation, 2012).

The individual mandate component of the ACA is commonly regarded as the most contentious component. Some argue that the mandate is necessary to reduce adverse selection in healthcare, yet others say that the ACA as a whole may encourage adverse selection, as it prohibits insurers from discriminating in terms of price or coverage, against applicants on the basis of health. This regulation has the potential increasing premiums on healthy individuals, driving them to exit the insurance market which would cause premiums to rise even more, forcing others out of the insurance market, perpetuating cycles of exiting the market, and creating "death spirals" (Chandra, Gruber, & McKnight, 2011).

Very similar health care reforms to the ACA were first implemented in Massachusetts as part of a state reform. Massachusetts implemented a similar mandate, offered heavily subsidized insurance available to residents with incomes below 300% of the FPL, and automatically enrolled those who were eligible for free insurance (below 150% of the FPL). Chandra, Gruber, and McKnight (2011) researched these reforms by examining the characteristics of the subsidized insurance pool before and after the mandate went into effect and addressed how much of an effect the mandate had. They concluded that, at the beginning of the mandate's phase-in period, there was a greater increase in the number of healthy enrollees than in the number of

enrollees with a chronic illness. When the mandate was in full effect, there ended up being many more "healthy people" than non-healthy individuals into the risk pool, which the authors attribute to a causal role of the mandate improving risk selection. However, the values of the subsidies were much greater in Massachusetts than those provided by the federal government with the Affordable Care Act. So although we see this effect in Massachusetts, it may not generalize to the entire population under the ACA (Chandra et al., 2011). Additionally, because of such strong subsidies, it is hard to disentangle this subsidy effect from the individual mandate and other general insurance-related gains of the reform.

Many argue that the individual mandate is not the driving factor in the large increases in insurance changes that we have seen. As previously mentioned, the 2016 National Health Interview Survey report that 11.2 million persons under the age of 65 are now covered by private health plans obtained through the Health Insurance Marketplace or state-based exchanges (Cohen et al., 2016). Yet, this increase in insurance for the population of interest may not be attributed to the individual mandate. Using the Agency for Healthcare Research and Quality's Medical Expenditure Panel Survey of households and data from the Kaiser Family Foundation's annual survey of employer health plans to simulate the effect of the Affordable Care Act with and without the coverage mandate, Sheils and Haught (2011) determine that coverage wouldn't decrease as significantly as thought by many other estimates without the individual mandate. They determine that if the mandate were lifted, premiums would increase in cost by 12.6 percent and coverage would decrease by 7.8 million people, which is less than the coverage loss of 16-24 million people predicted by others such as the Congressional Budget Office and Economist Jonathan Gruber's microsimulation model. Sheils and Haught include the effects of other components such as subsidies in determining the impact of increases in health insurance coverage, which they find have a much greater impact (Gruber, 2011; Sheils & Haught, 2011).

One profound impact of the individual mandate is the take up of Medicaid in place of "conditional coverage." Many individuals who are eligible for Medicaid don't have coverage through Medicaid because they don't use it and the process to get it is excessively complicated. In the event that an eligible individual needed intense medical treatment, they would obtain insurance through Medicaid then, effectively making them conditionally covered (D. Cutler & Gruber, 1997). However, when the individual mandate comes into effect, those who are eligible for Medicaid formally take up the insurance at a high rate. This is because the group of people

who are eligible but uninsured constitute a large portion of the uninsured population, and taking up Medicaid is a mechanism to avoid paying the individual mandate penalty. In Massachusetts, amongst those who were eligible for Medicaid, enrollment increased by 16.3 percentage points, and for those without private insurance yet eligible for Medicaid, Medicaid participation increased by 19.4 percentage points (Sonier, Boudreaux, & Blewett, 2013).

There is ample evidence that health insurance coverage increased during the time of the ACA reforms. When looking at Medicaid, compared to the average pre-treatment uninsured rate, the ACA increased the proportion of residents with insurance by nearly double the amount in states that expanded Medicaid compared to those that didn't. This caused some crowd out in the private insurance market among low-income individuals, yet increases in private insurance did occur in non-group and employer-provided coverage (Courtemanche, Marton, Ukert, Yelowitz, & Zapata, 2016).

While these theoretical and simulated impacts are important to consider, there have been two empirical analyses recently conducted on the impact of the individual mandate on health insurance take-up under the Affordable Care Act. The provisions of the ACA that went into effect on January 1, 2014, were Medicaid expansion, premium subsidies for coverage obtained through the health exchanges, as well as the individual mandate. Disentangling these effects is essential to establishing the causal impact of the individual mandate, yet very difficult to successfully accomplish.

Frean, Gruber, and Sommers (2017) attempt to estimate the impact of each of the aforementioned components on insurance gains. Utilizing data from the American Community Survey from 2012 to 2015, and a difference-in-difference-in-differences approach that looks to exploit variation by income, geography, and time, they determined that the individual mandate has very little effect on the increase in insurance coverage. Their analysis looks at the first two years before and after the ACA implementation, by utilizing identification for state decisions on Medicaid expansion and estimates of private insurance subsidies based on the variation in subsidy rates across income and geographic region. Using this model, the authors are able to account for 60% of the increase in insurance coverage of the ACA, believing that the remaining 40% can be attributed to the effect of increased insurance purchase rates through the creation of marketplaces, increase in consumption due to essential benefits, and a generalized insurance effect. Of what the authors are able to explain in terms of insurance increases, they determine

that 44% of the gains are due to enrollment of previously eligible adults and children, including the 2011-2013 early Medicaid expansions, a potential anticipatory effect of the individual mandate. 19% of the coverage gains were due to enrollment of adults who became eligible for Medicaid in 2014 Medicaid expansion. They concluded no significant reduction in private coverage as a result of the increase in the population on Medicaid. Premium subsidies were responsible for 37% of coverage gains and were nearly twice as effective at increasing coverage in states with state insurance exchanges compared to those using the federal exchanges. Their conclusion also determined no significant effect of the individual mandate on coverage in 2014, however, believed that a more general effect of the individual mandate to boost enrollment is still possible. The authors claim that the mandate encourages people to obtain coverage through one of the already established mechanisms, thus, the "direct" impact of the individual mandate is negligible (Frean et al., 2017).

Another very recent used using administrative tax data to measure the amount paid in penalties. This study determined that a larger penalty used to enforce the individual mandate results in a higher increase in coverage, and found a positive effect of the individual mandate (through its penalty) on increasing coverage. At lower income levels the individual mandate has a large coverage effect which is concentrated primarily in public insurance gains and a crowd out of private insurance. At higher income levels, the individual mandate has a smaller coverage effect that is concentrated among individuals in the individual insurance market. Regardless of income, the individual mandate has a significant impact causing individuals to take up health insurance (Heim, Lurie, & Sacks, 2018).

Given that the individual mandate hasn't been in effect that long, there lacks much literature on the effects. The two most prominent studies, mentioned above, find contradictory results, and no study has yet to look at the impact by education level. This paper seeks to add to the literature by attempting to determine the impact of the individual mandate, specifically how education impacts the effects of the individual mandate.

## III. Data

The data for the analysis will come from three sources. The majority of the data will come from the American Community Survey (ACS), but will also be supplemented with Medicaid expansion information from the Kaiser Family Foundation and state economic trends

from the Bureau of Labor Statistics: Local Area Unemployment Statics. The ACS serves as an appropriate and best choice of data for a number of reasons. The data is collected by the U.S. Census Bureau and contacts over 3.5 million households annually, usually obtaining results from around 3 million people, nearing 1% of the US population. It has a very large sample size compared to other surveys that ask about health insurance, and has mandatory respondent participation, unlike the CPS or BRFSS, and has geographic identifiers, unlike the NHIS (Courtemanche, Marton, & Yelowitz, 2016). This will ultimately allow me to control for the effects of Medicaid expansion and state economic trends. The ACS is also one the primary sources used by the federal government to evaluate health insurance coverage (Finegold et al., 2014; Smith & Medalia, 2015).

Though there exists data for many years beyond what I am analyzing in the ACS, the timeline of analysis will be constrained to between 2011 and 2016. There are a number of reasons for this. First, it gives time to look at the before and after trends, given that the individual mandate component came into law in 2014. Additionally, beginning in 2011 allows the separation of other ACA impacts that came into effect earlier (i.e. ability to stay on parent's insurance until 26, removal of copays on preventative services, and review of health plan premium increases) from the effects of the individual mandate (Courtemanche, Marton, Ukert, Yelowitz, & Zapata, 2017).

The variable of interest, education, was constructed using the ACS variable for educational attainment, which identifies the highest "grade" of education completed. Using this data, I constructed an indicator variable for if someone is a college graduate. I consider someone to be a college graduate if they successfully completed four years of college. Though being a college graduate is the primary treatment of interest throughout my analysis, I also consider other levels of education in my estimates contained in Table 12, in order to see if the insurance take-up effects intensify with lower levels of education. In doing so, I create indicator variables for if someone attended college, as identified by the successful completion of at least one year of college, as well as an indicator variable for graduating high school, identified by someone successfully completing $12^{th}$ grade.

There are a number of variables intended to measure the outcomes of interest, insurance coverage. The main outcome of interest is whether someone has any insurance at all, a question directly asked on the ACS survey. The variable for having any health insurance coverage

consists of employer-provided insurance, Medicare, Medicaid, any other governmental insurance, TRICARE or other military insurance, and Veterans Administration-provided insurance. Since Indian Health Services policies are not comprehensive when it comes to healthcare, they are not included in having total coverage. However, I include them in the supplemental analysis because those with Indian Health Services "coverage" can claim an exemption from the individual mandate penalty of the Affordable Care Act, even though they aren't technically insured with comprehensive coverage (U.S. Centers for Medicare & Medicaid Services, 2018).

I also include dummy variables for whether an individual has public or private insurance as an outcome of interest in Table 9. Additionally, I stratify these categories into more specific types of insurance, i.e. employer provided, direct private purchase from healthcare company, Medicare, Medicaid, TRICARE, Veterans Affairs Insurance, and Indian Health Services in Table 10. While these dummy variables indicate the type of coverage each individual has, there are individuals that are double covered or may have multiple different types of insurance, and thus the variable for "any insurance" will be the most accurate and informative about insurance up-take, and will constitute the main results.

The data includes a slew of demographic variables, which will be used as controls. One advantage of the ACS is that it provides geographic identifiers, specifically, the state in which the individual is located. This allows me to link data from the Bureau of Labor Statistics (BLS) Local Area Unemployment Statistics (LAUS) to identify local unemployment rates, and thus control for state economic trends, as well as include state fixed effects. I am also able to link Kaiser Family Foundation (KFF) data on Medicaid expansion states in order to control for Medicaid expansion and utilize the somewhat exogenous variation in states that expanded Medicaid. Other demographic variables include age, sex, race, if an individual was foreign born, US citizenship status, Hispanic ethnicity, marital status, number of children, income, student status, employment status, veteran status, and disabled status.

Given the existence of Medicare, the ACA was not intended to impact the health insurance of seniors (65+). Additionally, to isolate the effects of the individual mandate, and not confound them with the provision allowing children 26 and under to stay on their parents' insurance, the primary sample of interest throughout will include only individuals between the ages of 27 and 64, inclusive. However, for reference, analysis will be conducted on the entire

sample that includes all ages (up to 97, in this sample) in order to confirm this hypothesis of the target age range (27 to 64) being most impacted by the individual mandate reforms.

Potential drawbacks to the data include the aforementioned problem with regards to double coverage and marital status, including those who are physically, but not legally separated from their spouse, which may impact the practical ability to be on their employer's insurance. Additionally, all income values that are negative have been dropped from the sample, however, this change did not cause a very significant change in sample size (decrease by 0.075%). Given that the ACS is a survey, there is potential for selection bias and self-reporting bias. The ACS data also comes with household weights to represent how many households in the U.S. population are represented by a given observation, and I utilize these throughout my data, including in both my summary statistics and regressions (with the sole exception of those in Table 13), in order to try and achieve as accurately representative a sample as possible.

As previously mentioned, in addition to data from the ACS, I include two other data sources to supplement the analysis. In order to control for state economic trends, I include an annual unemployment rate based on state unemployment data from the Bureau of Labor Statistics Local Area Unemployment Statistics. This rate is calculated as a simple average of each of the seasonally adjusted unemployment rate of the twelve months in that year. One potential drawback of this data is that it is a simple average, rather than a weighted average of employment over that year. Regardless, this should not have a large impact on the estimates. The deviations in the calculated unemployment would come from more people being in the workforce at various points throughout the year. However, seeing as most of these temporary jobs do not provide health insurance, we can safely disregard the impact that this might have on our estimates of interest.

Additionally, I use data from the Kaiser Family Foundation to identify which states have expanded Medicaid. The expansion variable used in the analysis looks at whether states expanded Medicaid by January 1, 2016. I extend the date this far to ensure that we have as conservative an estimate as possible for the individual mandate component, allowing Medicaid to absorb the impact. Both traditional Medicaid expansions, as well as states that approved Section 1115 waivers for Medicaid expansion, were included in the analysis ("Status of State Action on the Medicaid Expansion Decision," 2018).

**Table 1: Health Insurance Coverage Rates by Time Period**

| | Coverage Rates over Time | | | |
|---|---|---|---|---|
| **Type of Insurance** | **Pre-ACA** | **Post-ACA** | **Difference** | **Percentage Change** |
| Medicare | 4.3 | 4.6 | 0.3 | 7.0% |
| Medicaid | 10.2 | 13.5 | 3.3 | 32.4% |
| Employer Provided | 61.9 | 62.3 | 0.4 | 0.6% |
| Privately Purchased | 9.3 | 11.4 | 2.1 | 22.6% |
| Veterans Affairs | 2.0 | 1.9 | -0.1 | -5.0% |
| Indian Services | .4 | .4 | 0 | 0% |
| TRICARE | 2.4 | 2.4 | 0 | 0% |
| Public Insurance | 14.2 | 17.4 | 3.2 | 22.5% |
| Private Insurance | 70.3 | 73.2 | 2.9 | 4.1% |
| Any Coverage | 81.1 | 87.0 | 5.9 | 7.3% |

Note: Data for ages 27 to 64. Observations weighted by ACS household weights. N = 4,656,123 for the Pre-ACA sample, N = 4,651,488 for the Post-ACA sample. Percentage change is the change relative to Pre-ACA mean.

The trends in health insurance over time show an increase in health insurance coverage after the effects of the Affordable Care Act came into law. This is illustrated in both Table 1 as well as in Figure 1. Simply looking before and after the Affordable Care Act, the percentage of individuals with health insurance increased quite substantially. For individuals aged 27-64, there was a 5.9 percentage point increase in total coverage (see Table 1).

There was a 5.9 percentage point increase in total coverage, which corresponds to an approximate 7.3 percent increase, relative to pre-ACA coverage. When looking at public and private insurers, we see that after the ACA, there were increases in both public and private insurance, but a much greater increase in public insurance when looking in percentage terms. Compared to pre-ACA levels, the portion of individuals on public insurance increased by 22.5 percent compared to only 4.1 percent for private insurance. There is a visualization of this change for public vs. private insurance on the graph in Figure 2 in the appendix. Though it looks like public and private insurance have the same relative increase, the increase in public insurance is larger in percentage terms given its relatively lower baseline (pre-ACA) coverage rate. This large increase in public insurance is expected. Table 1 captures the change in coverage rates for all individuals between the age ranges of 27 to 64 but simply looks at the coverage rates before and after. It does not try to isolate the impact of the individual mandate or any component of the ACA. This table captures all insurance coverage related changes including Medicaid expansion.

This is one of the reasons why we see such a large change in Medicaid coverage, a 32.4 percent increase, and a large contributor to the gain in public insurance. Additionally, we would think that with an individual mandate and a large expansion of public related insurance options, we would observe a crowd-out effect of private insurance. Though we observe an increase in private insurance overall, in some low-income and low-educated populations, we would expect a decrease in private insurance and an increase in public insurance as a result of Medicaid expansion and other public health insurance related reforms. Some individuals will drop their private insurance for publicly subsidized insurance (D. M. Cutler & Gruber, 1996). The causal results end up confirming this, as in Table 9, we observe an increase in public insurance and a decrease in private insurance for those without a college degree.

As expected, the changes in coverage rates for Indian Services, TRICARE, and Veterans Affairs insurance are all insignificant. We wouldn't expect any changes in the proportion of veterans obtaining health insurance through the Veterans Affairs Administration, or other change in the proportion of individuals receiving insurance through the Armed Services TRICARE insurance as these individuals would likely have this insurance regardless. These types of insurance are not sensitive to the ACA reforms. This is a benefit of their armed service and they most likely wouldn't have changed their usage of these insurance services before or after the implementation of the ACA. Additionally, 69.55 percent of those who use Indian Health Services have another means of health insurance. It is unlikely that as a result of the ACA, more people would obtain Indian Health Services. The coverage rates of the different types of insurance are shown over time in Figures 3 and 4 in the appendix.

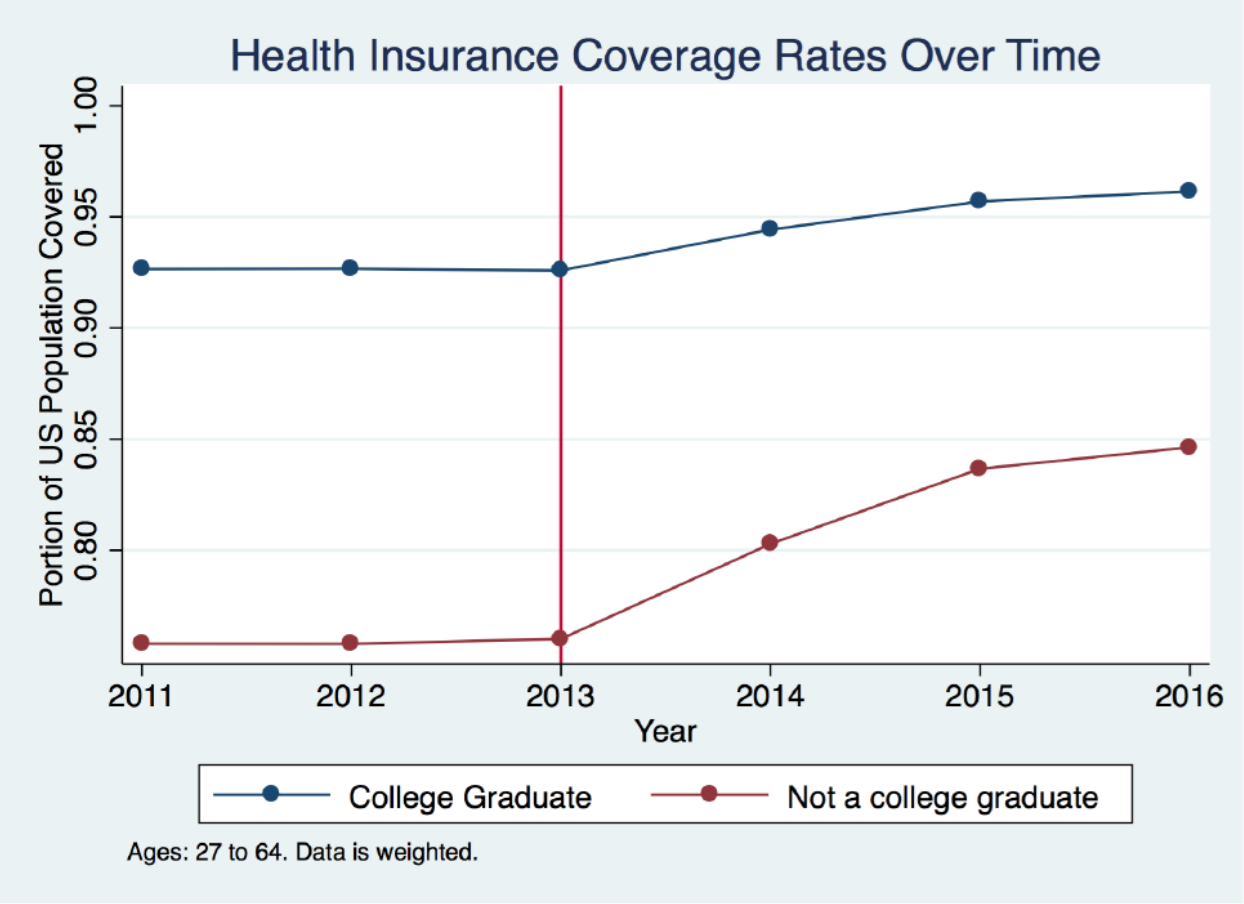
## IV. Methodology

Throughout this paper, I seek to determine the causal effect of education on health insurance take up as a result of the individual mandate component of the Affordable Care Act. Due to the multitude of policy changes that occurred around the "Post" indicator of the DDD model, the beginning of most ACA-related health insurance reforms (January 1, 2014), some of the effects that I estimate may be attributed to more generalized gains in health insurance, rather than specifically to the individual mandate component of the ACA. Using the aforementioned data from the American Community Survey, Bureau of Labor Statistics, and Kaiser Family Foundation, though I begin with a naïve difference-in-differences (DD) model, the primary

model I utilize is a difference-in-difference-in-differences (DDD) identification strategy. This allows me to utilize variation in treatment based on different education levels and somewhat exogenous variation from different states that expanded Medicaid soon after the passage of the Affordable Care Act.

Figure 1, below, shows the trend in health insurance coverage over our period of interest (2011-2016) for both college graduates and those who did not graduated college, restricted to the population of interest. The line at the year 2013 indicates the cutoff point and beginning of the "post" period, as beginning in 2014, individuals were under the effect of the individual mandate and were legally compelled to have health insurance. Prior to the cutoff point, the trends for health insurance are parallel for both college graduates and those who did not graduate college, which satisfies the parallel trends requirement of the difference-in-differences model.

**Figure 1: Health Insurance Coverage Rates Over Time**




Note: Figure shows health insurance coverage rates over time, stratified by if an individual holds a college degree. Observations restricted to ages 27-64 and weighted by ACS household weights. The line at 2013 to represent that insurance was required beginning Jan 1, 2014.

The first specification I utilize is a simple difference-in-differences (DD) approach with treatment being education level (in this case, a binary variable indicating holding a college degree) and a post variable for being after January 1, 2014, the implementation date of most ACA reforms, including the individual mandate. Equation 1.1, below, shows the DD model. "Post" is a dummy variable indicating that the person is under the effect of the individual mandate, i.e. the year is 2014 or beyond. "Educ" is the treatment variable in the DD model, indicating that a person is not a college graduate. "Expansion" is a dummy variable indicating whether an observation resided in a state that expanded Medicaid, which is thought to have accounted for a significant amount of gains in health insurance, and a supplier of somewhat exogenous variation. This Medicaid expansion indicator is not time-variant in order to prevent multicollinearity concerns. In equation 1.1, C is a vector of variables for economic indicators such as unemployment rates. D is a vector of demographic variables. Income is also included as a control in demographic variables, as it is thought to be heavily endogenous with both education and health insurance. "Year" is a fixed effect variable to control for changes that may have occurred during that year, such as economic trends, given that this occurred during the recovery from the great recession. "State" is a state fixed effects variable, aimed to control for different characteristics regarding attitudes towards health insurance, or other time-invariant characteristics of a given state.

$$\textbf{(1.1)} \quad \textbf{Health Insurance}_{ist} = \alpha_0 + \beta_1 \textbf{Post}_t + \beta_2 \textbf{Educ}_i + \beta_3 (\textbf{Post}_t * \textbf{Educ}_i) + \beta_4 \textbf{Expansion}_s + \beta\, \textbf{C}_i + \beta_6 \textbf{D}_i + \beta_7 \textbf{Year}_t + \beta_8 \textbf{State}_s + \varepsilon_i$$

In equation 1.1, above, the coefficient of interest is the estimate on $\beta_3$, the interaction term between the post variable and the education dummy variable. The interpretation of this coefficient is the change in the rate of health insurance coverage for those who are not college graduates after the beginning of the individual mandate component. For example, if $\beta_3 = 0.01$, this would mean that the effect of being not college educated, while under the impact of the ACA reforms (the individual mandate), results in a 1% increase in having any health insurance coverage. This model has several drawbacks, however. The inclusion of the "Expansion" variable, which represents being in a Medicaid expansion state, collects the impact of being in a state that expanded Medicaid. However, this doesn't measure the impact specifically for an observation who is not a college graduate under the impact of the individual mandate.

Additionally, since other components of the Affordable Care Act, aside from the individual mandate, went into effect on January 1, 2014, the interaction term between Post and Educ may account for other insurance-related increases for college-educated individuals, rather than the specific individual mandate component of the reform.

Resultantly, in order to account for some more of the variation for these observations at this time period, I utilize a difference-in-difference-in-differences model. The DDD model is more effective in capturing the majority of the effects of the individual mandate and subsidies on changes in health insurance coverage. The DDD model allows the estimates to better control for Medicaid expansion by interacting it with the Post and Educ terms both individually and jointly to create a DDD estimator coefficient. The DDD specification allows me to use the variation in treatment based on different education levels and different states who expanded Medicaid soon after the passage of the ACA. The model that I employ can be written as such:

$$\textbf{(1.2)} \quad \begin{aligned} \textbf{Health Insurance}_{ist} = {} & \alpha_0 + \beta_1 \textbf{Post}_t + \beta_2 \textbf{Expansion}_s + \beta_3 \textbf{Educ}_i + \beta_4 \\ & (\textbf{Post}_t * \textbf{Expansion}_s) + \beta_5 (\textbf{Post}_t * \textbf{Educ}_i) + \beta_6 (\textbf{Expansion}_s * \textbf{Educ}_i) + \gamma_7 \\ & (\textbf{Post}_t * \textbf{Expansion}_s * \textbf{Educ}_i) + \beta_8 \textbf{C}_i + \beta_9 \textbf{D}_i + \beta_{10} \textbf{Year}_t + \beta_{11} \textbf{State}_s + \varepsilon_i \end{aligned}$$

The interpretations of the variables and coefficients are largely the same as in specification 1.1. The interaction between Post and Expansion looks to explain the effect of being in the period of time under the individual mandate (as well as other components of the ACA) and being in a state that expanded Medicaid. Educ interacted with Expansion estimates the impact on insurance coverage of an individual being not college educated while in a state that expanded Medicaid. The variable of interest is the DDD estimator ($\gamma_7$), the interaction term between Post, Expansion, and Educ. This can be interpreted as the change in insurance coverage for an individual that is under the effect of the Individual Mandate, who is in a state that expanded access to Medicaid and does not hold a college degree.

In order to further examine the impacts of education on insurance coverage with the individual mandate, I utilize other education cutoffs. Each estimate using different education cutoffs will utilize the same model as the college cutoff, as seen in equation 1.2. One would think that as the bar for education decreases, the effect would increase. I hypothesize that we will observe a higher increase in insurance coverage when comparing an individual who attended college at all compared to someone who never attended college. The effect should be even stronger for someone who graduated high school, compared to someone who did not.

In order to determine insurance related gains by insurance type, I utilize the following model, equation 1.3.

$$\textbf{(1.3)}\quad \begin{aligned}\text{Insurance Type}_{ist} = {} & \alpha_0 + \beta_1\,\text{Post}_t + \beta_2\,\text{Expansion}_s + \beta_3\,\text{Educ}_i + \beta_4\,(\text{Post}_t*\text{Expansion}_s) + \beta_5\,(\text{Post}_t*\text{Educ}_i) \\ & + \beta_6\,(\text{Expansion}_s*\text{Educ}_i) + \gamma_7\,(\text{Post}_t*\text{Expansion}_s*\text{Educ}_i) + \beta_8\,C_i + \beta_9\,D_i + \beta_{10}\,\text{Year}_t + \beta_{11}\,\text{State}_s + \varepsilon_i\end{aligned}$$

In looking at insurance type, I analyze public insurance, private insurance, as well as the subset of each type of insurance: Medicare, Medicaid, employer-provided insurance, direct private purchase insurance, Veterans Affairs insurance, TRICARE, and Indian Health Services as the dependent variable of insurance type.

## V. Results

The basic difference-in-difference model is the first estimate I utilize to attempt to measure the effects of the individual mandate on a non-college educated individual. Using equation 1.1, I estimate the DD model, with results shown in Table 6 in their entirety, as well as summarized in Table 7 for both age groups. The increase in insurance coverage under the impact of the individual mandate and other Jan 1, 2014, related impacts for someone without a college degree is estimated to be an increase in insurance coverage of 4.36 percentage points. The impact of being in a Medicaid expansion state (generally, not restricted to solely post 2014) is an increase in insurance coverage of 1.2 percentage points. The 4.36 percentage point increase, caused by the mandate and likely other insurance-related gains associated with the passage of the ACA, constitutes a significant closing of the gap of the uninsured. Pre-ACA, the rate of insurance coverage for this group (ages 27 to 64) was 81.1 percent, meaning that 18.9 percent of this population was uninsured. Lessening that gap by 4.36 percentage points signifies that these reforms closed the gap of the uninsured population by approximately 23.1 percent. As expected, the effects for the entirety of society (all ages) is less than just the 27 to 64 year old population, however, it still accounts for a 3.66 percentage point increase. The unweighted estimate is located in Table 13.

While the DD model gives us an estimate of the impact, we are skeptical of the predicted values. This model is naïve in its analysis and doesn't account for the impact of Medicaid expansion on an individual, rather just the impacts of being in a state that expands Medicaid coverage. For that reason, I hypothesize that the coefficient estimating the increase in insurance

is overstated and biased upward. The DD estimate most likely captures some of the Medicaid expansion impact for individuals. However, I believe the model still captures the general trend, that non-college educated individuals take up insurance at a higher rate as a result of the individual mandate component of the Affordable Care Act.

In an attempt to get a more accurate estimate of the impacts, I utilize the DDD model specified in equation 1.2. The results of the main specification can be seen on the next page and of all relevant specifications on Table 8 in the appendix, as well as in their entirety on Table 6. The model predicts a statistically significant increase in the health insurance coverage rate for those who are not college graduates, compared to those who are, while in the post period (2014 and after), when the individual mandate component came into effect while controlling for the observation being in a Medicaid expansion state. The increase in health insurance is approximately 1.54 percentage points, which is less than the amount estimated in the DD model. Table 2, on the next page, summarizes the results of this estimation. The unweighted model, as shown in Table 13, has an effect of 1.38 percentage points. As demonstrated by the summarized results in Table 8, the estimate is not sensitive to the inclusion of state and year fixed effects. In practical terms, given that the pre-ACA mean coverage rate for individuals in that age group is 81.1 percent, this equates to closing 8.15 percent of the pre-ACA uninsured gap.

As expected, based on the estimate in column 1 of table 8, the effect is less intense for the entirety of the population, though only slightly. When expanding the age range to all ages in the sample, the effect is an increase of only 1.08 percentage points. Given that the mean coverage rate for this group prior to the ACA was 85.7 percent, this increase represents a closing of 7.55 percent of the uninsured gap. Column 5 of table 8 shows that, as expected, there is no statistically significant change in health insurance coverage for those in the age range of 65 and over. These individuals are covered by Medicare and the design of the Affordable Care Act should not have any tangible impact on them. The mean coverage rate of these individuals is already at 99.3%, so it is not plausible that this reform could even have an impact on them. There was a slight increase for the age range of below 26 years old, a 1.05 percentage point increase, as shown in column 6 of Table 8.

**Table 2: Difference-in-Difference-in-Differences Estimate**

| VARIABLES | Any Health Insurance Coverage |
|---|---|
| Post * Expansion * Not College Grad | 0.0154*** |
| | (0.00112) |
| Constant | 0.581*** |
| | (0.00346) |
| Observations | 9,091,824 |
| R-squared | 0.170 |
| Year FE | Yes |
| State FE | Yes |
| Ages | 27 to 64 |
| Mean Coverage Rate | .841 |

Note: This table shows the output of the difference-in-difference-in-differences regression shown in equation 1.2. This is a summary of the full model estimated in column 2 of Table 6, see note in Table 6. The observations are weighted by ACS household weights. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Column 5 of Table 8 shows that, as expected, there is no statistically significant change in health insurance coverage for those in the age range of 65 and over. These individuals are covered by Medicare and the design of the Affordable Care Act should not have any tangible impact on them. The mean coverage rate of these individuals is already at 99.3%, so it is not plausible that this reform could even have an impact on them. There was a slight increase for the age range of below 26 years old, a 1.05 percentage point increase, as shown in column 6 of Table 8.

This ultimately indicates that the individual mandate component of the Affordable Care Act resulted in an increase in insurance coverage and a closing of the gap of the uninsured for the lower educated populations. This estimate most likely also includes broader insurance related coverage gains associated with the Affordable Care Act and other insurance-related reforms that occurred around January 1, 2014.

In order to identify the mechanism by which insurance increased, it is important to analyze the type of insurance increases. When examining where these gains occurred I utilize the

model in equation 1.3. Table 9 shows that the individual mandate resulted in an increase in the take-up of public insurance by 2.94 percentage points, and a decrease in the consumption of private insurance by 1.23 percentage points for the age range of interest (27 to 64). The impacts for the entire age range are less in magnitude, a 2.08 percentage point increase in public insurance and a 0.99 percentage point decrease in the consumption of private insurance. This represents a crowd out of private insurance, as many lesser educated individuals are opting in to public insurance due to subsidies and dropping their private coverage as a result. The increase in public insurance coverage can also be demonstrated by the table below. Table 3 (below) shows that the gain in public insurance under the ACA (though not individual mandate specific) for those without a college degree is an increase from 18.4 percent to 22.7 percent, whereas those with a college degree hold public insurance at a much lower rate and see a smaller percentage point increase in public insurance. The individual mandate did cause some people to take up private health insurance and provided subsidies for individuals to obtain private insurance. Given that those without a college degree hold public insurance at a much higher level than those with a college degree, we observe an aggregate increase in the amount of private insurance held overall, yet a crowd out effect of private insurance among those without a college degree.

**Table 3: Public and Private Insurance Rates Before and After the ACA**

| | Pre-ACA (before 2014) | | Post-ACA (2014 and after) | |
|---|---|---|---|---|
| | **No College Degree** | **College Degree** | **No College Degree** | **College Degree** |
| **Public Insurance** | .184<br>(.387) | .050<br>(.219) | .227<br>(.419) | .066<br>(.249) |
| **Private Insurance** | .613<br>(.487) | .899<br>(.302) | .644<br>(.479) | .913<br>(.292) |

Note: This table shows mean coverage rates by insurance category before and after the individual mandate (January 1, 2014). Pre-ACA: no college degree n= 7,390,943, college degree: n= 1,959,258. Post-ACA: no college degree n= 7,276,905, college degree: n= 2,152,840. Observations weighted by ACS household weights. Standard deviations in parentheses.

In looking at the change in insurance coverage levels by insurance type in Table 10, there is a statistically significant increase for Medicaid, and statistically significant decreases for the only two categories of private insurance, employer-provided and direct private purchase. As

shown in Table 10, the increase in Medicaid is 2.90 percentage points, and the decreases for employer-provided insurance and direct private purchase insurance are 0.056 percentage points and 0.088 percentage points, respectively. This further shows the crowd out effect of private insurance with the expansion of public insurance. The lack of a change for the other insurance categories is largely expected. No individual between the age range of 27 to 64 is eligible for Medicare unless they are disabled or have end-stage renal disease, so we shouldn't expect to have any significant change in that category. Additionally, the other three main categories of insurance are TRICARE, Veterans Affairs, and Indian Health Services. Each of these types of insurance had no statistically significant increase with the individual mandate. The individual mandate did not result in more people joining the military or becoming veterans for the purpose of obtaining TRICARE or Veterans Affairs Insurance. The same logic applies to Indian Health Services; additional individuals would not choose to select into tribal health services when they otherwise wouldn't have with the imposition of the individual mandate.

Another means of determining the impact of the individual mandate and other insurance-related expansions, I analyze what races were most impacted by the reforms still with the treatment of education. Table 11 shows the estimated impact of the individual mandate using the model in equation 1.2 while restricting the population to each different race. The racial categories of Native Americans, Pacific Islanders, and White had statistically significant increases in their insurance coverage rates at the 1% level. For the categories of Black and other races, they similarly observed increases in coverage rates, however, they were generally lower in magnitude than the aforementioned categories and were only statistically significant at the 10% level. For the category of Asian, there was a slight decrease by about a percentage point, but this is also statistically significant only at the 10% level. The effects of the individual mandate on various races have some potentially very profound impacts on the equity and practical implications of the policy and is a question for further research and investigation.

In examining how the individual mandate has an impact on education, in addition to analyzing the impacts on completing college, I utilize equation 1.2 to look at other educational cutoffs. As previously stated, for the targeted population (ages 27 to 64), the impact of having a college degree under the individual mandate results in an increase in insurance coverage by approximately 1.54 percentage points. As shown in Table 12, the effect intensifies when the educational bar is decreased. The change in the rate of insurance coverage is an increase of 2.04

percentage points when the individual mandate is in effect, in a state that expanded Medicaid, for someone who has not attended college, which corresponds to closing 10.8 percent of the insured coverage gap. This effect increases to 3.70 percentage points when the cutoff becomes whether someone graduated high school, which corresponds closing of 19.6 percent of the uninsured gap. As expected, the lower the educational cutoff bar is, the more of an impact the individual mandate has on increasing insurance coverage. Education clearly has an impact on the change in the rate of any health insurance coverage under the individual mandate, and the effect is monotonic. As education levels decrease, there is a greater impact of the individual mandate on health insurance take-up.

## VI. Discussion, Conclusion, and Policy Implications

It is safe to conclude that the individual mandate did have an effect on closing the gap of the uninsured, and especially more so of those with lower levels of education. As the cutoff for the level of education decreased, the impact of the individual mandate increased, as there was a higher increase in any insurance coverage. This would tend to mean the individual mandate was successful in its goal of getting more people covered by health insurance, especially those of lower levels of education who otherwise may lack health insurance.

Given that the individual mandate penalty is repealed as part of the Tax Cuts and Jobs Act of 2017, we would expect a decrease in the insurance rate with the removal of the penalty. This a potential impact of the law that will go into effect January 1, 2019, and merits additional research and analysis.

This conclusion is based on the DDD strategy employed throughout the paper, which does have significant limitations. The limitations of this analysis and conclusions are important to recognize in interpreting the results. The most obvious and overwhelmingly important limitation is the potential for the estimates to have encompassed other insurance-related gains in addition to the individual mandate. The estimates included the effect of subsidies, which may have accounted for the majority of the insurance gains, however, using available data, that amount is not discernable. Additionally, the estimates are based on survey data which poses some accuracy issues and is a significant drawback of the data. The ability to utilize administrative tax data to determine the impact of insurance coverage on being subjected to a penalty would go a long way to establish a more casual impact of the individual mandate component of the ACA. Income is

highly endogenous with both health insurance coverage and education, so there may have been a better way to control for that factor. ACS household weights are used throughout the analysis, so the accuracy of the conclusions is also highly dependent on the weighting accuracy.

The results in Table 12 with regards to race are very interesting and warrant more in-depth analysis to see how race is impacted by the individual mandate, as that could have profound impacts on equity with its repeal. One would hypothesize that, with the exception of Native Americans due to their exemption criteria, there should not be disparate impacts of the individual mandate dependent on race, yet this is different than what was concluded.

While I believe there is some bias in the coefficients with regards to the impact of the individual mandate, given that all estimates showed a positive impact for the lower educated, I tend to believe that it is safe to conclude that if the individual mandate does indeed have an impact, it is increasing in the lower educated.

When evaluating whether this is a worthwhile policy, it is important to consider the costs of the reform and whether any other components are more cost-effective in increasing the proportion of individuals insured. Some considerations should also be given to the implications of requiring insurance for certain populations, specifically young people. Young people end up being required to obtain insurance with minimum coverage standards that the most likely won't use in order to subsidize the cost of medical expenditures to the older population. When you consider that they are paying into a number of other social insurances, such as social security, and that the majority of them aren't making high wages in the early stages of their careers, it is important to think about how this impacts young individuals financially.

My conclusions support the findings of Heim, Lurie, & Sacks (2018) in observing a positive impact of the individual mandate and observing a crowd out effect of private insurance amongst the lower educated populations. I also contribute to the literature by starting to examine who was impacted by the individual mandate, rather than current literature that seeks to explain what the impact is and quantifying it. By examining education levels, I hope to begin to draw attention to how the repeal of the individual mandate impacts lower educated members of society. Once the individual mandate is no longer in effect, it will be important to analyze the health insurance rates of lower educated populations to confirm or refute these findings.

**References:**


Chandra, A., Gruber, J., & McKnight, R. (2011). The Importance of the Individual Mandate — Evidence from Massachusetts. *New England Journal of Medicine*, *364*(4), 293–295. https://doi.org/10.1056/NEJMp1013067

Cohen, R. A., Zammitti, E. P., & Martinez, M. E. (2016). National Health Interview Survey Early Release Program Health Insurance Coverage: Early Release of Estimates From the National Health Interview Survey, 2016. Retrieved from https://www.cdc.gov/nchs/data/nhis/earlyrelease/insur201705.pdf

Courtemanche, C., Marton, J., Ukert, B., Yelowitz, A., & Zapata, D. (2016). Impacts of the Affordable Care Act on Health Insurance Coverage in Medicaid Expansion and Non-Expansion States. *NBER Working Paper Series*, (22182). Retrieved from http://www.nber.org/papers/w22182

Courtemanche, C., Marton, J., Ukert, B., Yelowitz, A., & Zapata, D. (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. https://doi.org/10.1002/pam.21961

Courtemanche, C., Marton, J., & Yelowitz, A. (2016). Who Gained Insurance Coverage in 2014, the First Year of Full ACA Implementation? *Health Economics*, *25*(6), 778–784. https://doi.org/10.1002/hec.3349

Cutler, D., & Gruber, J. (1997). Medicaid And Private Insurance: Evidence And Implications. *Health Affairs*, *16*(1), 194–200. https://doi.org/https://doi.org/10.1377/hlthaff.16.1.194

Cutler, D. M., & Gruber, J. (1996). Does Public Insurance Crowd out Private Insurance? *The Quarterly Journal of Economics*, *111*(2), 391–430. https://doi.org/10.2307/2946683

Finegold, K., Gunja, M. Z., Sommers, B. D., Musco, T., Burke, A., & Mcdowell, A. (2014). ASPE ISSUE BRIEF SURVEY DATA ON HEALTH INSURANCE COVERAGE FOR 2013 AND 2014. *New England Journal of Medicine*. https://doi.org/10.1056/NEJMsr1406753

Frean, C., Gruber, J., Sommers, B., Frean, M., Sommers, B. D., & Chan, H. T. (2017). Premium Subsidies, the Mandate, and Medicaid Expansion: Coverage Effects of the Affordable Care Act Coverage Effects of the Affordable Care Act. *Journal of Health Economics*, *53*, 72–86. https://doi.org/10.1016/j.jhealeco.2017.02.004

Gruber, J. (2011). *Health Care Reform without the Individual Mandate Replacing the Individual Mandate would Significantly Erode Coverage Gains and Raise Premiums for Health Care Consumers*. Retrieved from https://cdn.americanprogress.org/wp-content/uploads/issues/2011/02/pdf/gruber_mandate.pdf

Heim, B., Lurie, I., & Sacks, D. W. (2018). *Does the individual mandate affect insurance coverage ? Regression kink evidence from the population of tax returns ∗*.

Sheils, J. F., & Haught, R. (2011). Without The Individual Mandate, The Affordable Care Act Would Still Cover 23 Million; Premiums Would Rise Less Than Predicted. *Health Affaris*, *30*(11), 2177–2185. https://doi.org/10.1377/hlthaff.2011.0708

Smith, J. C., & Medalia, C. (2015). Health Insurance Coverage in the United States: 2014. Retrieved from https://www.census.gov/content/dam/Census/library/publications/2015/demo/p60-253.pdf

Sonier, J., Boudreaux, M. H., & Blewett, L. A. (2013). Medicaid "Welcome-Mat" Effect Of Affordable Care Act Implementation Could Be Substantial. *Health Affairs*, *32*(7), 1319–1325. https://doi.org/10.1377/hlthaff.2013.0360

Status of State Action on the Medicaid Expansion Decision. (2018). Retrieved April 9, 2018, from https://www.kff.org/health-reform/state-indicator/state-activity-around-expanding-medicaid-under-the-affordable-care-act/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D

The Henry J. Kaiser Family Foundation. (2012). *Summary of Coverage Provisions in the Affordable Care Act*. Menlo Park, CA. Retrieved from https://kaiserfamilyfoundation.files.wordpress.com/2013/01/8023-r.pdf

U.S. Centers for Medicare & Medicaid Services. (2018). Exemptions for American Indians & Alaska Natives. Retrieved April 25, 2018, from https://www.healthcare.gov/american-indians-alaska-natives/exemptions/

**Table 4: Descriptive Statistics by Age Range**

| VARIABLES | All Ages | | Ages 27-64 | |
|---|---|---|---|---|
| | Mean | Standard Deviation | Mean | Standard Deviation |
| **Demographic Variables** | | | | |
| U.S. Citizen | .932 | .252 | .904 | .294 |
| Foreign Born | .129 | .346 | .191 | .393 |
| Hispanic | .168 | .374 | .153 | .360 |
| Age | 38.383 | 23.034 | 45.509 | 10.806 |
| Unemployed | .047 | .211 | .046 | .210 |
| Disabled | .002 | .049 | .001 | .034 |
| Student | .260 | .438 | .050 | .219 |
| Veteran | .082 | .275 | .064 | .244 |
| Female | .512 | .500 | .513 | .500 |
| Individual Income | 36,307.84 | 53,368.89 | 44,952.29 | 58,866.01 |
| State Unemployment Rate | 6.785 | 1.887 | 6.796 | 1.887 |
| Married | .419 | .493 | .636 | .481 |
| Number of Children | .531 | .986 | .951 | 1.191 |
| Native American | .016 | .127 | .016 | .124 |
| Asian | .061 | .239 | .063 | .242 |
| Black | .134 | .341 | .127 | .332 |
| Pacific Islander | .004 | .062 | .003 | .058 |
| White | .765 | .424 | .765 | .424 |
| Other Race | .052 | .221 | .048 | .215 |
| **Insurance Variables** | | | | |
| Medicare | .167 | .373 | .045 | .206 |
| Medicaid | .189 | .392 | .119 | .324 |
| Employer Provided | .545 | .498 | .621 | .485 |
| Private Purchase | .129 | .335 | .104 | .305 |
| Veterans Affairs | .022 | .148 | .019 | .138 |
| Indian Services | .005 | .069 | .004 | .065 |
| Tricare | .030 | .171 | .024 | .152 |
| Public Insurance | .331 | .470 | .158 | .365 |
| Private Insurance | .665 | .472 | .717 | .450 |
| Any Coverage | .880 | .345 | .841 | .366 |
| Expansion | .592 | .492 | .595 | .491 |
| **Education Variables** | | | | |
| College Graduate | .213 | .410 | .321 | .467 |
| At least some college | .401 | .490 | .563 | .496 |
| At least HS graduate | .680 | .466 | .901 | .299 |

Note: All variables from ACS Data, except State Unemployment Rate (BLS LAUS), and Expansion (KFF) For the all ages group, the number of observations is 18,779,946 for all variables except unemployed (15,280,139), veteran (15,035,737), and income (15,520,873). For the 27-64 age group, the number of observations is 9,307,611. All variables are dummies except age, income, state unemployment rate, and number of children. Observations weighted by ACS household weights.

**Table 5: Descriptive Statistics by Time Period (Pre vs. Post)**

| VARIABLES | Pre-ACA Mean | Pre-ACA Standard Deviation | Post-ACA Mean | Post-ACA Standard Deviation |
|---|---|---|---|---|
| **Demographic Variables** | | | | |
| U.S. Citizen | .905 | .293 | .903 | .296 |
| Foreign Born | .186 | .389 | .196 | .397 |
| Hispanic | .149 | .356 | .158 | .365 |
| Age | 45.473 | 20.734 | 45.545 | 10.878 |
| Unemployed | .056 | .229 | .037 | .189 |
| Disabled | .001 | .034 | .001 | .034 |
| Student | .053 | .224 | .048 | .213 |
| Veteran | .070 | .255 | .058 | .233 |
| Female | .513 | .500 | .513 | .500 |
| Individual Income | 43,041.45 | 55,459.61 | 46,844.71 | 61,997.54 |
| State Unemployment Rate | 8.149 | 1.589 | 5.456 | .988 |
| Married | .641 | .480 | .632 | .482 |
| Number of Children | .955 | 1.192 | .947 | 1.190 |
| Native American | .015 | .123 | .016 | .125 |
| Asian | .060 | .237 | .065 | .247 |
| Black | .126 | .332 | .128 | .334 |
| Pacific Islander | .003 | .057 | .004 | .060 |
| White | .770 | .421 | .760 | .427 |
| Other Race | .047 | .211 | .050 | .218 |
| **Insurance Variables** | | | | |
| Medicare | .043 | .204 | .046 | .209 |
| Medicaid | .102 | .304 | .135 | .341 |
| Employer Provided | .619 | .486 | .623 | .485 |
| Private Purchase | .093 | .291 | .114 | .318 |
| Veterans Affairs | .020 | .139 | .019 | .137 |
| Indian Services | .004 | .064 | .004 | .065 |
| Tricare | .024 | .153 | .024 | .152 |
| Public Insurance | .142 | .349 | .174 | .379 |
| Private Insurance | .703 | .457 | .732 | .442 |
| Any Coverage | .811 | .391 | .870 | .337 |
| Expansion | .596 | .491 | .594 | .491 |
| **Education Variables** | | | | |
| College Graduate | .313 | .464 | .328 | .469 |
| At least some college | .557 | .497 | .568 | .495 |
| At least HS graduate | .899 | .302 | .903 | .297 |

Note: See note on Table 4. In Pre-ACA period, the number of observations for all variables is 4,656,123. In Post-ACA period, the number of observations for all variables is 4,651,488. Observations weighted by ACS household weights.

**Table 6: Full Difference-in-Difference and Difference-in-Difference-in-Differences Estimates**

| VARIABLES | (1)<br>Any Health Insurance Coverage | (2)<br>Any Health Insurance Coverage |
|---|---|---|
| Post-ACA (2014) | -0.00263** | 0.00130 |
| | (0.00128) | (0.00133) |
| Expansion | 0.0120*** | -0.0359*** |
| | (0.00229) | (0.00236) |
| Not College Grad | -0.105*** | -0.137*** |
| | (0.000424) | (0.000692) |
| Post*Expansion | | -0.00256*** |
| | | (0.000776) |
| Post*Not College Grad | 0.0436*** | 0.0345*** |
| | (0.000533) | (0.000904) |
| Expansion * Not College Grad | | 0.0571*** |
| | | (0.000848) |
| Post * Expansion * Not College Grad | | 0.0154*** |
| | | (0.00112) |
| US Citizen | 0.203*** | 0.204*** |
| | (0.000843) | (0.000853) |
| Foreign Born | -0.0441*** | -0.0444*** |
| | (0.000604) | (0.000608) |
| Hispanic | -0.0753*** | -0.0754*** |
| | (0.000638) | (0.000645) |
| Age | 0.00218*** | 0.00216*** |
| | (1.49e-05) | (1.54e-05) |
| Unemployed | -0.196*** | -0.197*** |
| | (0.000941) | (0.000955) |
| Disabled | 0.0626*** | 0.0624*** |
| | (0.00455) | (0.00457) |
| Student | 0.0258*** | 0.0241*** |
| | (0.000694) | (0.000713) |
| Veteran | 0.0745*** | 0.0731*** |
| | (0.000504) | (0.000505) |

| | | |
|---|---|---|
| Female | 0.0506*** | 0.0500*** |
| | (0.000312) | (0.000314) |
| Income | 5.92e-07*** | 5.91e-07*** |
| | (2.20e-09) | (2.19e-09) |
| Unemployment Rate | -0.0102*** | -0.00935*** |
| | (0.000286) | (0.000294) |
| Married | 0.0851*** | 0.0851*** |
| | (0.000350) | (0.000353) |
| Number of Children | 0.00541*** | 0.00527*** |
| | (0.000145) | (0.000147) |
| Native American | -0.0521*** | -0.0524*** |
| | (0.00142) | (0.00144) |
| Asian | 0.0677*** | 0.0692*** |
| | (0.00124) | (0.00125) |
| Black | 0.0130*** | 0.0143*** |
| | (0.00122) | (0.00124) |
| Pacific Islander | 0.0169*** | 0.0155*** |
| | (0.00265) | (0.00266) |
| White | 0.0219*** | 0.0223*** |
| | (0.00117) | (0.00119) |
| Other Race | 0.00420*** | 0.00234 |
| | (0.00145) | (0.00147) |
| Constant | 0.560*** | 0.581*** |
| | (0.00340) | (0.00346) |
| R-squared | 0.169 | 0.170 |
| Model | DD | DDD |

Note: Column 1 shows a Difference-in-Differences regression with a dummy variable for any health insurance coverage as the dependent variable, and the variable of interest as Post* Not College Grad. Column 2 shows a Difference-in-Difference-in-Differences regression with a dummy variable for any health insurance coverage as the dependent variable, and the variable of interest being Post * Expansion * Not College Grad. Each coefficient * 100 signifies a percentage point increase. All variables are dummy variables with the exception of age, income, unemployment rate, and the number of children. The model also includes state and year fixed effects. All regressions are weighted by ACS household weights. The DD regression has n=9,307,611. The DDD regression has n=9,091,824. The age range for both models is restricted to ages 27 to 64, and the years of data span from 2011to 2016. For information on data, see tables 4 and 5. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

**Table 7: Simplified Difference-in-Differences Model**

| VARIABLES | (1)<br>Any Health Insurance Coverage | (2)<br>Any Health Insurance Coverage |
|---|---|---|
| Medicaid Expansion State | 0.00523*** | 0.0120*** |
| | (0.00168) | (0.00229) |
| Post* Not College Grad | 0.0366*** | 0.0436*** |
| | (0.000409) | (0.000533) |
| Constant | 0.542*** | 0.560*** |
| | (0.00257) | (0.00340) |
| Observations | 15,035,737 | 9,307,611 |
| R-squared | 0.167 | 0.169 |
| Ages | All | 27 to 64 |
| Mean Coverage Rate | .880 | .841 |

Note: Both regressions show a difference-in-differences model estimated using equation 1.1. See the full output for column 2 on Table 6, as well as the note on Table 6. Table 6 also references the variables included in the regression in column one, just with the inclusion of all ages. Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

**Table 8: Simplified Difference-in-Difference-in-Differences Estimates**

| VARIABLES | (1) Any Health Insurance Coverage | (2) Any Health Insurance Coverage | (3) Any Health Insurance Coverage | (4) Any Health Insurance Coverage | (5) Any Health Insurance Coverage | (6) Any Health Insurance Coverage |
|---|---|---|---|---|---|---|
| Post * Expansion * Not College Grad | 0.0108*** | 0.0154*** | 0.0155*** | 0.0154*** | 0.000443 | 0.0105*** |
| | (0.000854) | (0.00112) | (0.00112) | (0.00112) | (0.000543) | (0.00321) |
| Constant | 0.561*** | 0.524*** | 0.581*** | 0.581*** | 0.830*** | 1.104*** |
| | (0.00259) | (0.00208) | (0.00267) | (0.00346) | (0.00244) | (0.00827) |
| R-squared | 0.168 | 0.165 | 0.169 | 0.170 | 0.081 | 0.154 |
| Year FE | Yes | Yes | No | Yes | Yes | Yes |
| State FE | Yes | No | Yes | Yes | Yes | Yes |
| Ages | All | 27 to 64 | 27 to 64 | 27 to 64 | 65+ | 0 to 26 |
| Mean Coverage Rate | .880 | .841 | .841 | .841 | .992 | .889 |

Note: Each column represents a regression utilizing a difference-in-difference-in-differences regression where the dependent variable is a dummy variable for having any health insurance coverage. The reported variable is the DDD estimator. All demographic and economic variables are controlled for. Observations are weighted by ACS household weights. Coefficients show the effect size of the individual mandate and potentially other insurance-related changes as it accounts for the change in health insurance coverage rates for an observation in the Post-ACA implementation period (after January 1, 2014), who is located in a state that expanded Medicaid and does not hold a college degree. Robust standard errors are reported in parentheses. For column one (all observations), n=15,035,737. For columns 2-4 (ages 27 to 64), n=9,091,824. For column 5 (ages 65+), n=3,355,345. For column 6 (ages 0-26), n=2,472,781. *** p<0.01, ** p<0.05, * p<0.1

**Table 9: Public vs. Private Insurance Coverage Estimates**

| VARIABLES | (1)<br>Public Insurance | (2)<br>Private Insurance | (3)<br>Public Insurance | (4)<br>Private Insurance |
|---|---|---|---|---|
| Post * Expansion * | 0.0208*** | -0.00994*** | 0.0294*** | -0.0123*** |
| Not College Grad | (0.000984) | (0.00111) | (0.00103) | (0.00129) |
| Constant | -0.331*** | 0.602*** | 0.0741*** | 0.491*** |
| | (0.00287) | (0.00324) | (0.00333) | (0.00394) |
| Observations | 15,035,737 | 15,035,737 | 9,307,611 | 9,307,611 |
| R-squared | 0.342 | 0.184 | 0.121 | 0.238 |
| Ages | All | All | 27 to 64 | 27 to 64 |
| Mean Coverage Rate | .331 | .665 | .158 | .717 |

Note: Each column shows a regression using a dummy variable for insurance type (public or private) as the defendant variable regressed using the DDD model in equation 1.3 and the variables included in column 2 of table 6. All regressions in the table include state and year fixed effects. Interpretation is that not being a college graduate under the impact of the individual mandate in a Medicaid expansion state changes the rate of insurance by (estimated coefficient * 100) percentage points. Mean coverage rate looks over the entire time period (2011-2016), not just pre-ACA. All observations weighted by ACS household weights. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

**Table 10: Health Insurance Coverage Change by Type of Insurance**

| VARIABLE | (1) Direct Purchase | (2) Employer Provided Insurance | (3) TRICARE Insurance | (4) Medicare | (5) Medicaid | (6) Veterans Affairs Insurance | (7) Indian Health |
|---|---|---|---|---|---|---|---|
| Post* Expansion * Not College Grad | -0.00564*** (0.00112) | -0.00876*** (0.00154) | 0.000672 (0.000585) | 0.000861 (0.000586) | 0.0290*** (0.000884) | 0.000818* (0.000424) | 0.000126 (0.000177) |
| Constant | 0.0491*** (0.00286) | 0.458*** (0.00433) | 0.00578*** (0.00155) | -0.0512*** (0.00188) | 0.118*** (0.00298) | -0.0109*** (0.00120) | 0.0723*** (0.000916) |
| R-squared | 0.017 | 0.185 | 0.071 | 0.055 | 0.107 | 0.230 | 0.239 |
| Mean Coverage Rate | .103 | .621 | .024 | .045 | .119 | .019 | .004 |

Note: Each column represents a DDD regression with a dummy variable for each type of insurance coverage as the dependent variable. The reported variable is the DDD estimator. All demographic and economic variables are controlled for. Includes state and year fixed effects. Observations were restricted to ages 27-64 and are weighted by ACS household weights. Coefficients show the effect size of the individual mandate and potentially other insurance-related changes as it accounts for the change in health insurance coverage rates for an observation in the Post-ACA implementation period (after January 1, 2014), who is located in a state that expanded Medicaid and does not hold a college degree. Mean coverage rates are reported over the entire time period (2011-2016). N=9,307,611. Robust standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

**Table 11: Health Insurance by Race**

| VARIABLES | (1) Any Insurance Coverage | (2) Any Insurance Coverage | (3) Any Insurance Coverage | (4) Any Insurance Coverage | (5) Any Insurance Coverage | (6) Any Insurance Coverage |
|---|---|---|---|---|---|---|
| Post * Expansion * Not College Graduate | 0.0357*** | -0.0101* | 0.00653* | 0.0725*** | 0.0134*** | 0.0206* |
| | (0.0119) | (0.00602) | (0.00386) | (0.0275) | (0.00119) | (0.0112) |
| Constant | 0.365*** | 0.859*** | 0.526*** | 0.714*** | 0.563*** | 0.413*** |
| | (0.0273) | (0.0153) | (0.0106) | (0.0763) | (0.00363) | (0.0251) |
| Observations | 176,836 | 552,964 | 1,040,213 | 31,665 | 7,338,361 | 368,276 |
| R-squared | 0.144 | 0.110 | 0.130 | 0.128 | 0.169 | 0.226 |
| Race | Native American | Asian | Black | Pacific Islander | White | Other race |

Note: See note on Table 8. This represents the same type of regression, just repeated with observations restricted to each race throughout. Includes state and year fixed effects, age rage restricted to 27-64. Robust standard errors in parentheses. Interpretation of coefficients is the same. *** p<0.01, ** p<0.05, * p<0.1

**Table 12: Health Insurance by Education Levels**

| VARIABLES | (1)<br>Any Health Insurance Coverage | (2)<br>Any Health Insurance Coverage | (3)<br>Any Health Insurance Coverage |
|---|---|---|---|
| Post * Expansion * Not College Graduate | 0.0154***<br>(0.00112) | | |
| Post * Expansion * Never Attended College | | 0.0204***<br>(0.00127) | |
| Post * Expansion * Not High School Graduate | | | 0.0370***<br>(0.00262) |
| Constant | 0.581***<br>(0.00346) | 0.552***<br>(0.00346) | 0.510***<br>(0.00346) |
| Observations | 9,091,824 | 9,091,824 | 9,091,824 |
| R-squared | 0.170 | 0.172 | 0.169 |

Note: See note on Table 8. This constitutes the same type of regression, simply using different educational cutoffs. Column 1 is exactly the same as column 4 of table 8, using a college degree as a cutoff. Column 2 uses college attendance as a cutoff. Column 3 uses high school graduation as a cutoff. Each model includes state and year fixed effects. Observations are weighted by ACS household weight and are restricted to ages 27-64. N=9,091,824. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

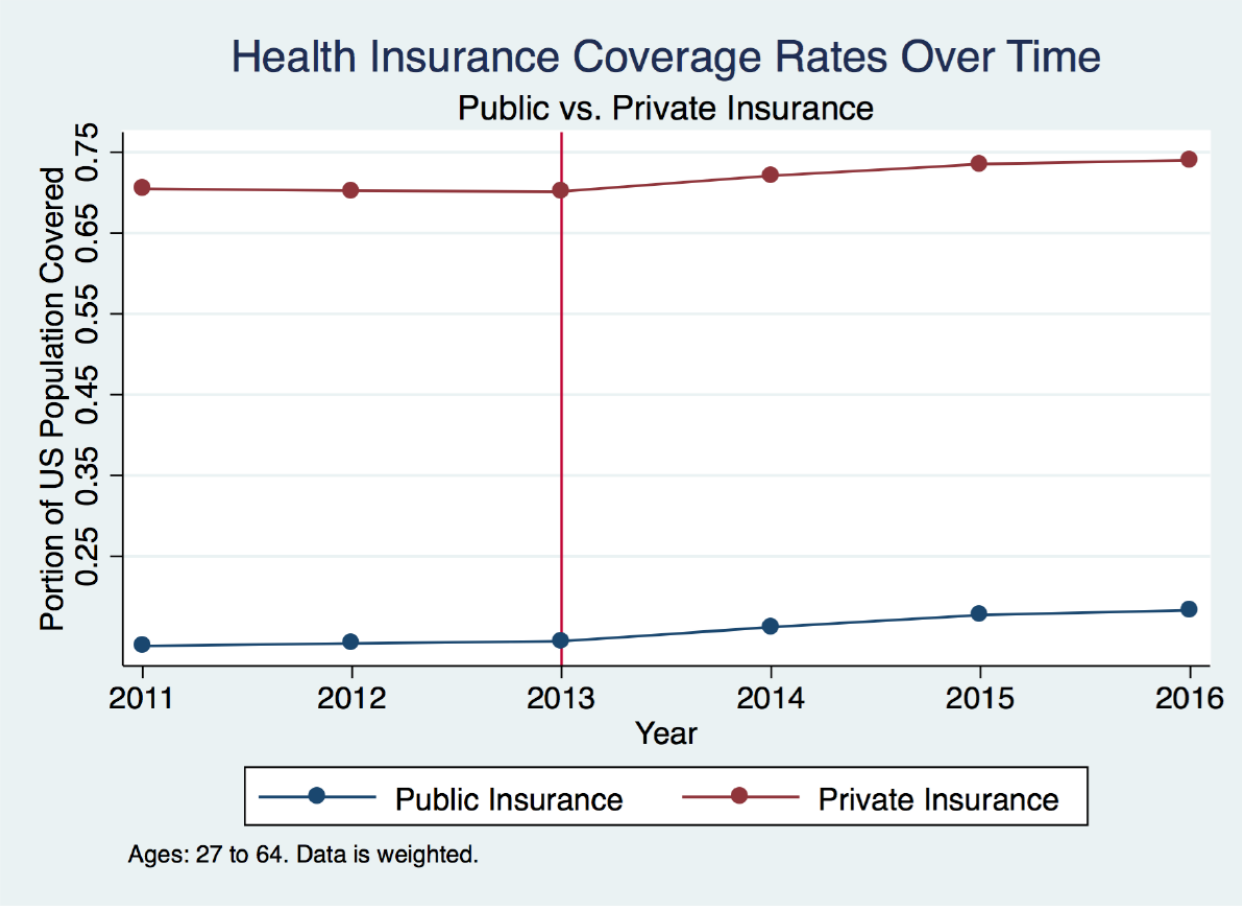
**Table 13: Unweighted Difference-in-Difference and Difference-in-Difference-in-Differences Estimates**

| VARIABLES | (1)<br>Any Health Insurance Coverage | (2)<br>Any Health Insurance Coverage |
|---|---|---|
| Post-ACA (2014) | -0.00419*** | -0.000840 |
| | (0.000940) | (0.000975) |
| Expansion | 0.0112*** | -0.0346*** |
| | (0.00167) | (0.00173) |
| Not College Grad | -0.101*** | -0.133*** |
| | (0.000311) | (0.000505) |
| Post*Expansion | | -0.00247*** |
| | | (0.000565) |
| Post*Not College Grad | 0.0434*** | 0.0354*** |
| | (0.000391) | (0.000661) |
| Expansion * Not College Grad | | 0.0557*** |
| | | (0.000620) |
| Post * Expansion * Not College Grad | | 0.0138*** |
| | | (0.000819) |
| US Citizen | 0.189*** | 0.189*** |
| | (0.000655) | (0.000662) |
| Foreign Born | -0.0359*** | -0.0361*** |
| | (0.000452) | (0.000454) |
| Hispanic | -0.0715*** | -0.0717*** |
| | (0.000486) | (0.000491) |
| Age | 0.00229*** | 0.00227*** |
| | (1.12e-05) | (1.16e-05) |
| Unemployed | -0.191*** | -0.191*** |
| | (0.000720) | (0.000730) |
| Disabled | 0.0825*** | 0.0818*** |
| | (0.00315) | (0.00317) |
| Student | 0.0219*** | 0.0202*** |
| | (0.000531) | (0.000545) |
| Veteran | 0.0730*** | 0.0717*** |
| | (0.000374) | (0.000375) |

| | | |
|---|---|---|
| Female | 0.0514*** | 0.0507*** |
| | (0.000230) | (0.000232) |
| Income | 5.70e-07*** | 5.68e-07*** |
| | (1.69e-09) | (1.68e-09) |
| Unemployment Rate | -0.0102*** | -0.00939*** |
| | (0.000211) | (0.000216) |
| Married | 0.0845*** | 0.0845*** |
| | (0.000261) | (0.000263) |
| Number of Children | 0.00605*** | 0.00593*** |
| | (0.000108) | (0.000110) |
| Native American | -0.0647*** | -0.0654*** |
| | (0.00107) | (0.00108) |
| Asian | 0.0656*** | 0.0675*** |
| | (0.000953) | (0.000965) |
| Black | 0.00819*** | 0.0103*** |
| | (0.000945) | (0.000957) |
| Pacific Islander | 0.0151*** | 0.0131*** |
| | (0.00198) | (0.00200) |
| White | 0.0309*** | 0.0315*** |
| | (0.000907) | (0.000919) |
| Other Race | 0.00956*** | 0.00825*** |
| | (0.00114) | (0.00115) |
| Constant | 0.565*** | 0.585*** |
| | (0.00252) | (0.00256) |
| R-squared | 0.157 | 0.158 |
| Model | DD | DDD |

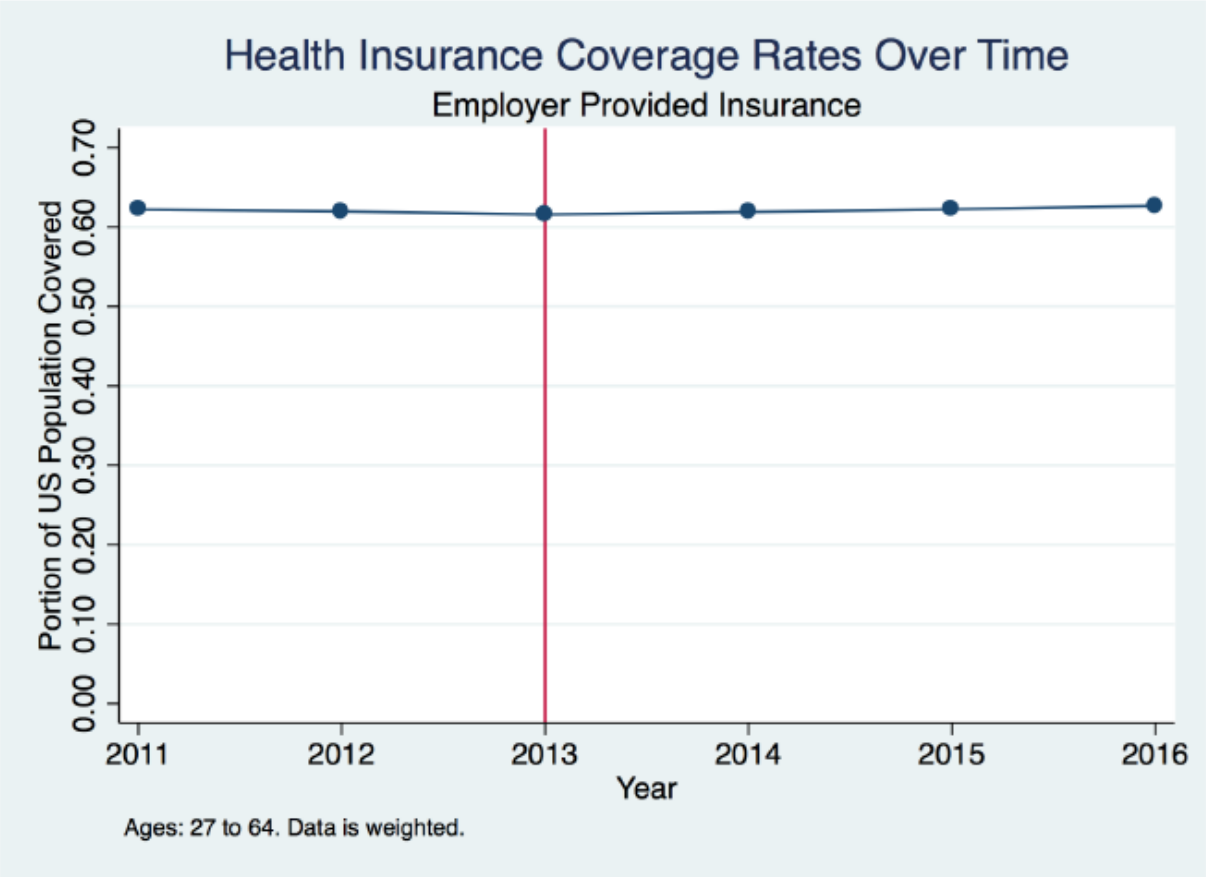
Note: Column 1 shows a Difference-in-Differences regression with a dummy variable for any health insurance coverage as the dependent variable, and the variable of interest as Post* Not College Grad. Column 2 shows a Difference-in-Difference-in-Differences regression with a dummy variable for any health insurance coverage as the dependent variable, and the variable of interest being Post * Expansion * Not College Grad. Each coefficient * 100 signifies a percentage point increase. All variables are dummy variables with the exception of age, income, unemployment rate, and the number of children. The model also includes state and year fixed effects. The regressions are left unweighted. The DD regression has n=9,307,611. The DDD regression has n=9,091,824. The age range for both models is restricted to ages 27 to 64, and the years of data span from 2011to 2016. For information on data, see Tables 4 and 5. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

**Figure 2: Public vs. Private Health Insurance Coverage Rates**



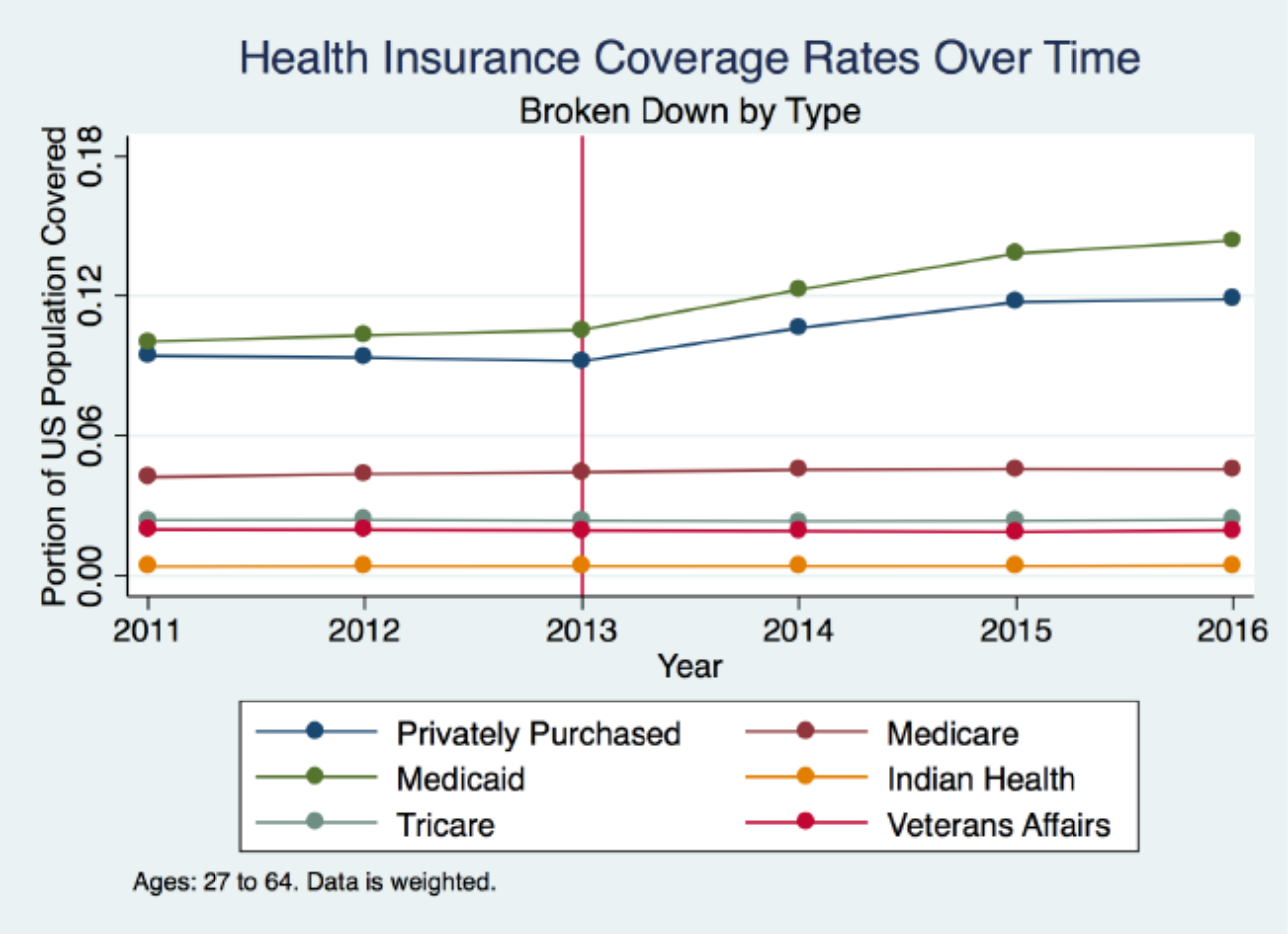

Note: Figure shows health insurance coverage rates over time for both public and private health insurance. Observations restricted to ages 27-64 and weighted by ACS household weights. The line at 2013 to represent that insurance was required beginning Jan 1, 2014.

**Figure 3: Health Insurance Coverage Rates for Employer Provided Insurance**




Note: Figure shows health insurance coverage rates over time for insurance provided by an employer. Observations restricted to ages 27-64 and weighted by ACS household weights. The line at 2013 to represent that insurance was required beginning Jan 1, 2014.

**Figure 4: Health Insurance Rates by Type of Insurance**




Note: Figure shows health insurance coverage rates over time for types of insurance (privately purchased (not from employer), Medicare, Medicaid, TRICARE, Veterans Affairs, and Indian Health Services). Observations restricted to ages 27-64 and weighted by ACS household weights. The line at 2013 to represent that insurance was required beginning Jan 1, 2014.