# Education and Unemployment Levels Before and After the Great Recession

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**Abstract**

This study analyzes the unemployment rates and the education levels before, during, and after the Great Recession in all fifty U.S. states, primarily focusing on the extent to which the amount of education affects the ability of the labor force to react to economic changes. Our hypothesis was that the greater a person's educational attainment was, it was less likely that person was to become unemployed. We divided our data into three different time periods of 2006, 2009, and 2012, to illustrate the extent of the relationship between the percent of adults with a certain educational attainment level on unemployment rate, in addition to utilizing other explanatory variables such as the median age of adults, per capita GDP, and the percent of U.S. earnings from manufacturing. Our data shows that there is a significant negative correlation between adults with a high school diploma as well as with an Associate's Degree or higher and the unemployment rate per state; however, there was no significance between adults with a Bachelor's degree or higher and unemployment rate. Our observations indicate that having a high school diploma significantly decreased an individual's unemployment rate. Having an Associate's degree or higher is not as significant, but there is still a noticeable effect on unemployment rate in 2009 that implies the Recession did not impact adults with higher educational attainment levels.

Keywords: Unemployment, education level, Recession

## I. Introduction

By the start of the Great Recession in late 2007, aggregate employment declined by about 8.5 million people. By the fourth quarter of 2008, the U.S. economy lost 1.2 million jobs, the largest quarterly decline since the end of WWII. By late 2009, the unemployment rate raised to 10.1 percent, a 27-year high record. By the Great Recession's peak in October 2009, 15.6 million U.S. citizens were without a job. All of these statistics illustrate the brevity of the financial crisis and its effect on the U.S. labor market.

Our main motivation in pursuing a focus on the Great Recession is that the decrease in demand in the housing market and manufacturing production caused an increase in unemployment, especially impacting those with lower education attainment levels who were affected by both factors.

Despite the various factors that can manipulate the unemployment rates in the U.S., such as geography, natural resources, competition, etc., there have been studies that investigate the difference in companies and metropolitan areas of the labor pool and its effect on the overall unemployment rates. Specifically, there was a discrepancy between education attainment levels and the effect of the Recession on each education attainment levels' unemployment rates.

This study focuses on analyzing unemployment rates before, during, and after the Great Recession because of the drastic effect it had on the decline in manufacturing production as well as in the housing market. The widely known and analyzed increase overall unemployment levels shows the increase in structural unemployment. This study will explore the changes in conditional unemployment across levels of education. The economic rationale behind this study is based on the assumption that most of the manufacturing sector is employed by a lower educated group, which implies that this group was significantly impacted by the declines in production and housing prices, and ultimately leading to the question: To what extent does education attainment level affect the unemployment rates before, during, and after the Great Recession? Before we developed our regression analysis, our hypothesis is as the number of years of education increase, the less significant the correlation between education level and unemployment rate became. Using the two models of adults with a high school diploma and adults with a bachelor's degree, we developed and compared data across 2006, 2009, and 2012 to support the idea that the lower educational attainment level of a high school diploma was more affected by the Recession than the higher educational attainment level of a bachelor's degree.

## II. Literature Review

### 2.1 Has the Great Recession Raised U.S. Structural Unemployment?

In “Has the Great Recession Raised U.S. Structural Unemployment?”, the introduction focuses on the overall labor market situation and how it was impacted by the financial crisis. Although this IMF working paper’s main purpose was to answer the question of whether or not the Great Recession has raised the U.S. structural unemployment, the researchers Estevão and Tsounta specifically analyze the extreme disparities across states to explain the primary mismatches between the demand and supply of skills and in housing market performance, and to ultimately illustrate the impact on unemployment rates. Although the study focuses primarily on the skill mismatch index and its implications on unemployment rates, it demonstrates the general trend that the U.S. unemployment rate followed before and after the Great Recession and the importance of skill mismatch, especially with the statistic that the impact of skill mismatches and higher foreclosure rates may have raised the natural rate of unemployment by about 1.5 percentage points since the onset of the housing market collapse at the end of 2006.

2.2 Education, Job Openings, and Unemployment in Metropolitan America

A study done by Jonathan Rothwell revealed that top metropolitan areas “require more education than all existing jobs, and more education than the average adult has attained”. Statistics such as out of the top 100 largest metropolitan areas, 43% of job openings require at least a bachelor’s degree, but only 32% of adults 25 and older have earned one demonstrate the discrepancy in education levels in the U.S. Similar to the research study done by Estevão and Tsounta, Rothwell found the statistic that unemployment rates are actually 2 percentage points higher in large metro areas with a shortage of educated workers relative to demand, and have shown consistently higher percentage points since even before the Great Recession. This indicates an effect on unemployment rates due to the skill mismatch between the supply and demand of jobs in the labor market, and how education attainment levels can drive a gap between employment and unemployment rates in the labor market.

2.3 Education and Unemployment

In “Education and Unemployment” written by Jacob Mincer, the underlying factors of unemployment and their relation to one’s level of education are analyzed. Mincer dives beyond the simple correlation of those two key variables and looks at other factors that affect the overall unemployment rate. Mincer looks at factors such as the probability of unemployment, the likelihood of being separated from a firm, the likelihood of becoming unemployed given that one was separated, and then the duration of unemployment. All of these factors are compared across different education levels. Mincer specifically

looks at those with less than a high school education, those with a high school education, those with some college, those with a college degree, and finally those with further education.

His research showed that some of these underlying factors were even more strongly correlated with education level than the overall rate of unemployment. One of the main theories of his study was that those among higher education levels have access to other means that effectively lower the rate of unemployment and the probability that they become unemployed. Those with greater education generally fill more specialized roles and receive more training once employed. Firms that have a greater financial investment in an employee are much less likely to become separated from those employees.

## III. Data

We used the unemployment rate per state for the years 2006, 2009, and 2012 as our explained variable to demonstrate the varying effects of educational attainment level as well as the other independent variables we decided to use. The unemployment rate data we utilized is the percent the number of employed out of the total labor force in each state. We decided to use percentages in all of our variables because this allows us to account for the population differences in each state. We gathered this data from the Bureau of Labor Statistics, where the unemployment rate is defined as the percent of adults in the workforce who are not currently employed. This is the traditional definition of unemployment, people out of work, who have stopped seeking work are not qualified as members of the labor force and therefore not counted in these statistics.

The first independent variable we used was the percent estimate of adults 25 to 64 who have received a high school degree per each U.S. state. Our research suggested that there would be a more significant correlation between those with a high school degree and unemployment rates in contrast to the other educational attainment variables we chose. We used percentage estimates for this variable because it automatically factors in the proportion of high school graduates out of the total population per state. We obtained the data from each respective year's American Community Survey One-Year estimate, which is collected by the U.S. Census Bureau. Each year, the mandatory ACS samples a random small percentage of the population to get a general idea of the percent of the population with various levels of educational attainment. Each year's data set also contains a column for statistical errors, which is considered typical for sample surveys.

The second independent variable we used was the percent of adults who received a Bachelor's Degree or higher per each U.S. state. We expect that there is a negative correlation between those with a Bachelor's degree and the unemployment rate; however, we also expect that there won't be as significant of a correlation compared to those who only obtained a high school diploma. Again, the data for the

percent of the population who have received an associate's degree or a bachelor's degree was collected through the annual ACS conducted by the U.S. Census Bureau.

The third independent variable chosen was the median age by U.S. state, which is data collected through ACS yearly estimates. The primary reason for utilizing the variable of median age is to determine if age has an effect on unemployment rates. We expect that the higher the age of a state, the higher the unemployment rate would be because the recession greatly affected those who didn't have more than a high school diploma, which was a trend of the older generation.

The fourth independent variable used is the GDP per capita of each state. We gathered this data from the Bureau of Economic Analysis. This variable is intended to determine if GDP per capita affects the unemployment rate. We expect that the higher the GDP per capita, the lower the unemployment rate for that state. Therefore, a higher GDP per capita would help reinforce the idea that as a state has a higher GDP per capita and a higher education attainment level, there would not be a significant relationship between education level and unemployment rate.

The last independent variable we decided to use was the percent of each state's earnings that came from manufacturing, which includes both durable goods (i.e. machinery goods) and nondurable goods manufacturing (i.e. food manufacturing; textile mills). This statistic was found through the U.S. Bureau of Economic Analysis, which is organized by the U.S. Department of Commerce. Through our research, we expect that there is a positive significant correlation between the percent of manufacturing earnings and unemployment rate, mainly due to the fact that the decrease in manufacturing production was a major contributing factor to the Great Recession and also due to the responsiveness of this industry to fluctuations in unemployment.

Simple regression models were utilized for each year of 2006, 2009, and 2012, as well as for each educational attainment level of high school diploma, associate's degree, and bachelor's degree. This was divided to determine if there was notable significance between the educational attainment level in a state and the unemployment rate per each year. The statistical inference table, as shown by Table 19, demonstrates the models we used for our research.

In our models, we used data collected from the fifty states in the U.S. Initially, we noticed those with only a high school diploma were more affected by the Recession than the other education levels, as shown by Figure 1.

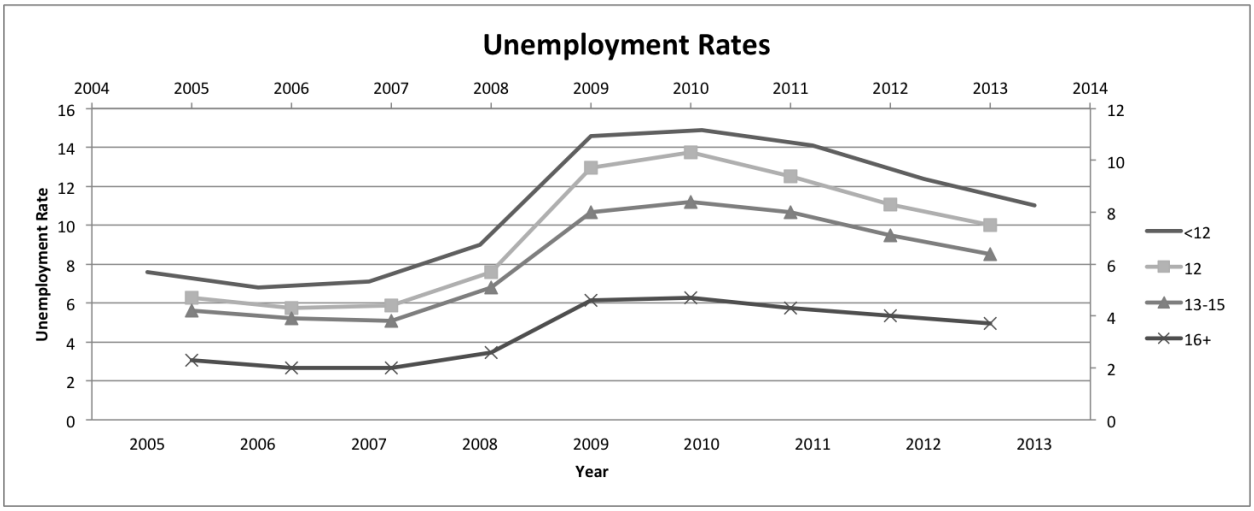


Figure 1. Unemployment Rates by Educational Attainment Level

3.1 Summary Statistics

We collected our data mostly as a percentage of each state's population, as shown by Table 1, 2, and 3. Overall, the averages of each variable increase by year, except for the percent earned by manufacturing. This meets expectations that as the years passed through the Recession, the percent of those with a high school diploma and bachelor's degree, median age, and GDP per capita should increase, but by varying amounts due to effects from the recession. On the other hand, the percent of each state's output earned from manufacturing remained at 2.00%, indicating that although manufacturing production was hurt by the recession, the percent of manufacturing earnings still remained the same on average. Also, the standard deviation of high school degree decreased from 3.54% to 3.09%, while the standard deviation of the other variables increased over the years. This indicates the variance of adults with a high school diploma decreased over the years, while the opposite occurred to the other variables.

Table 1. 2006: Before Recession

| | High school diploma (%) | Bachelor's degree (%) | Median age (years) | GDP per capita ($) | Manufacturing earnings (%) |
|---|---|---|---|---|---|
| **Min.** | 80.6 | 18.2 | 28.4 | 24062 | .1 |
| **Max.** | 94.3 | 40.8 | 41 | 59288 | 12.7 |
| **Mean** | 88.44 | 28.29 | 36.89 | 36292.3 | 2.0 |
| **St. Dev.** | 3.54 | 5.06 | 2.14 | 6388.49 | 2.27 |
| **No. obs.** | 50 | 50 | 50 | 50 | 50 |

Table 2. 2009: During Recession

| | High school diploma (%) | Bachelor's degree (%) | Median age (years) | GDP per capita ($) | Manufacturing earnings (%) |
|---|---|---|---|---|---|
| **Min.** | 81.3 | 19.3 | 28.9 | 28078 | .1 |
| **Max.** | 94.7 | 41.8 | 42.2 | 63264 | 13.1 |

| | | | | | |
|---|---|---|---|---|---|
| **Mean** | 89.1 | 29.01 | 37.18 | 40404.72 | 2.00 |
| **St. Dev.** | 3.47 | 5.10 | 2.34 | 8039.69 | 2.28 |
| **No. obs.** | 50 | 50 | 50 | 50 | 50 |

Table 3. 2012: After Recession

| | **High school diploma (%)** | **Bachelor's degree (%)** | **Median age (years)** | **GDP per capita ($)** | **Manufacturing earnings (%)** |
|---|---|---|---|---|---|
| **Min.** | 82.2 | 19.9 | 29.6 | 28944 | .1 |
| **Max.** | 95.1 | 42.6 | 43.2 | 61183 | 13 |
| **Mean** | 89.82 | 30.05 | 37.73 | 41942.7 | 2.00 |
| **St. Dev.** | 3.09 | 5.23 | 2.30 | 7873.52 | 2.31 |
| **No. obs.** | 50 | 50 | 50 | 50 | 50 |

3.2 Gauss-Markov Assumptions

The first Gauss-Markov Assumption states that the model is linear in parameters. This assumption is met, which is shown in the results section. The second assumption concerns random sampling and since we obtained the education attainment level and median age percentages from the ACS, which conducts annual surveys on a random selection of the population, as well as the BLS numbers for unemployment rates, and the GDP data which came from the Bureau of Economic Analysis, we assume random sampling for the purposes of the study. For the third assumption of no perfect collinearity, we checked to see if there was any correlation between each independent variable for each year.

| | UnEmR06 | HS06 | BD06 | MEDAGE06 | PCGDP06 | Man06 |
|---|---|---|---|---|---|---|
| UnEmR06 | 1.0000 | | | | | |
| HS06 | -0.3918 | 1.0000 | | | | |
| BD06 | -0.2547 | 0.5041 | 1.0000 | | | |
| MEDAGE06 | -0.0196 | 0.3191 | 0.1358 | 1.0000 | | |
| PCGDP06 | -0.1437 | 0.2418 | 0.6447 | -0.0139 | 1.0000 | |
| Man06 | 0.3318 | -0.3728 | 0.0692 | -0.1629 | 0.1619 | 1.0000 |

Table 4. Correlation for 2006 data

| | UnEmR09 | HS09 | BD09 | MEDAGE09 | PCGDP09 | Man09 |
|---|---|---|---|---|---|---|
| UnEmR09 | 1.0000 | | | | | |
| HS09 | -0.4777 | 1.0000 | | | | |
| BD09 | -0.1411 | 0.4212 | 1.0000 | | | |
| MEDAGE09 | 0.0338 | 0.3064 | 0.2171 | 1.0000 | | |
| PCGDP09 | -0.2452 | 0.3127 | 0.5326 | -0.1255 | 1.0000 | |
| Man09 | 0.4215 | -0.4160 | 0.1140 | -0.1141 | 0.0414 | 1.0000 |

Table 5. Correlation for 2009 data

| | UnEmR12 | HS12 | BD12 | MEDAGE12 | PCGDP12 | Man12 |
|---|---|---|---|---|---|---|
| UnEmR12 | 1.0000 | | | | | |
| HS12 | -0.5882 | 1.0000 | | | | |
| BD12 | -0.1426 | 0.4631 | 1.0000 | | | |
| MEDAGE12 | 0.0811 | 0.3015 | 0.1768 | 1.0000 | | |
| PCGDP12 | -0.1811 | 0.3167 | 0.6067 | -0.1297 | 1.0000 | |
| Man12 | 0.3789 | -0.4451 | 0.0790 | -0.1448 | 0.0709 | 1.0000 |

Table 6. Correlation for 2012 data

Looking at Tables 4, 5, and 6, there are no exact linear relationships between any of the explanatory variables, with correlations reaching only a high of 0.65 between GDP per capita and bachelor's degree in 2006. The fourth assumption concerns the zero conditional mean, which indicates that the error *u* has an expected value of zero given any values of the independent variables. The fifth assumption, heteroskedasticity, also concerns the error *u*, which should have the same variance given any value of the explanatory variables. There was no way to assure that both assumptions were held, so methods such as estimating a multivariate model will further reduce the likelihood of biasedness in the model.

## IV. Results

### 2006

Simple regression models were constructed through STATA to see the correlation between the variables of the percent of adults with a high school diploma and unemployment rate, and an additional model between the variables of the percent of adults with a bachelor's degree and unemployment rate for each designated year.

Additionally, we tested our hypothesis using multiple regression models, but divided each year by constructing separate models comparing those with a high school diploma and the other independent variables, and those with a bachelor's degree and the other independent variables.

The simple regressions for 2006 showed some interesting trends, shown in Table 7.

$$UnEmRate06 = 14.45 - .114HS06$$

The percent of high school graduates in a state greatly affects the unemployment rate in that state. The $\beta_0$ value of the high school model was found to be 14.45. This value correlates with the unemployment rate a state would be facing if it were to have no high-school graduates in 2006. The $\beta_1$ value was found to be -0.113. This indicates that for every percentage point the rate of high school graduates in a state increases, the unemployment rate in that state will decrease by 0.27%. A p-value equal to .005 and a t statistic of -2.9 indicates that this regression has a good bit of significance.

When looking at the percentage of adults with a bachelor's degree or higher, the results follow a similar trend, albeit with different numbers, as seen in Table 8.

$$UnEmRate06 = 5.85 - .052BD06$$

The $\beta_0$ value drops to 5.85 in this regression model. This drop in apparent unemployment rate might be explained by the relation of high school to college. As the number of college graduates increases, the number of high school graduates increases as well. The $\beta_1$ in this model is -0.52, around half of the value found in the previous regression. The p-value of the $\beta_1$ variable in this regression is .074, with a t-statistic of -1.82. This indicates that, depending on the level of rigor desired of this statistic, with a 5% confidence and 10% confidence being common, the regression will be significant for the 10% confidence but not the 5% confidence, indicating a marginal significance.

After running the two simple regressions, two multiple regressions were run, with GDP per capita, median age of states, and percent of states output from manufacturing as further explanatory variables, in addition to either High school diploma or Bachelor's degree. These regressions can be seen in Table 9 and Table 10.

$$UnEmR06=10.619 - .0896\ HS06 + .057MEDAGE06 - .000PCGDP06 + .115Man06 + u$$

When the additional explanatory variables were added to the High School diploma regression, the $\beta_0$ value decreased to 10.61, indicating a baseline level of unemployment of 10.6. This value is closer to the true unemployment rate of the United States at that time. The $\beta_1$ coefficient became -0.0897, a shrink from the previous High School Diploma regression. Its t-statistic also shrank in the multiple regression, although it remains statistically significant at the 5% interval. The variable median age carries a coefficient of 0.057, indicating that for every year increase in the average age of a state, the unemployment rate increases 0.57%. With a t-statistic of 0.85, this variable is statistically insignificant at most commonly accepted confidence intervals. GDP per capita is also insignificant, with a t-value of -0.76. The rate of participation in Manufacturing per state turned out to be significant, however. The $\beta_4$ coefficient was .115, with a t-statistic equal to 1.71, showing significance at the 10% level. Interpreting this data shows that for every percentage a state's workforce participation in manufacturing increases, the unemployment rate increases 0.115%. This supports our hypothesis that many of the jobs responsive to fluctuations in unemployment belong to this industry. In the Multiple Regression model that used a Bachelor's Degree instead of a High School diploma, the values of the coefficients compared to the baseline, as well as the t-statistics, were found to mirror the High School regression.

$$UnEmR06=4.416 - .0558BD06 + .0371MEDAGE06 - .000PCDGP06 + .166Man06 + u$$

Again, the rate of participation in Manufacturing proved to be the only statistically significant explanatory variable, with a $\beta_4$ coefficient of .166 and a t-statistic of 2.67, indicating an extremely high level of statistical significance.

The significance of all of these values was determined by a simple comparison of t-values to the critical value necessary for a 5% two-sided test and a 10% two-sided test, which, when taking into account the number of degrees of freedom, are 2.01 and 1.676 respectively.

**2009**

The simple regression for 2009, as shown by Table 11, returned very similar results from the regression of 2006 data.

$$UnEmR09 = -0.27HS09+u$$

The percent of high school graduates in a state greatly affects the unemployment rate in that state. With a β0 value of 32.41 the model shows that if a state had no high school graduates the unemployment rate would be at 32%. This extremely high starting rate is to be expected as the peak of the recession hit in 2009 and unemployment was up across the board. The β1 value of -0.27 shows that for every percentage point the rate of high school graduates in a state increases the unemployment rate will decrease by 0.27%. A p-value equal to 0 and a t statistic of -3.77 shows that the percentage of high school graduates is a very significant variable explaining unemployment. When looking at the percentage of adults with a bachelor's degree or higher, as seen in Table 12, the results are somewhat different.

$$UnEmR09 = 9.99-0.05BD09+u$$

The starting rate drops from 32.4% to 9.99%. This may be explained by the progression from high school to college. As the number of college graduates increases it can be assumed the number of high school graduates is increasing as well. The β1 in this model is -0.27 but it carries a very high p-value of 0.328. The t-statistic is equal to -0.99 showing that the percentage of bachelor's degree holders in a state is not a significant variable in determining the rate of unemployment.

After running the simple regression using both the percentage of high school graduates and the percentage of bachelor's degree holders we ran the multiple regression using GDP per capita, median age of states, and percent of states output from manufacturing as further explanatory variables. As these other variables were added the results follow a similar pattern, as shown by Table 13.

$$UnEmR09 = 22.51-0.21HS09+0.14MEDAGE09 - 0.00003PCGDP09 - 0.25Man09$$

When running the multiple regression with the percentage of high school graduates the β0 decreases from 32.4% to 22.51%. The β1 coefficient becomes -0.21 but it also becomes a little less significant. It is still significant at a 5% level but it is not as strong of an indicator when controlling for the other variables. The variable median age carries a coefficient of 0.14 indicating that as the median age of a state increase 1 year the unemployment rate increases 0.14%. With a high p-value and a t-statistic of 1.25 this variable is statistically insignificant. GDP per capita also turns out to be insignificant with a very small coefficient and a p-value of 0.374. The only variable that proved to be significant outside of the

percentage of high school graduates was the manufacturing rate of each state. The β4 coefficient was .25 and the p-value was equal to 0.038. This shows significance at the 5% level. Interpreting this data shows that for every percentage a states manufacturing increases, the unemployment rate increases 0.25%. This goes with our original theory that many of the jobs responsive to fluctuations in unemployment belong to this industry so as the industry increases, unemployment increases as well. The trend is exactly the same for a multiple regression using percentage of adults with a bachelor's degree. However, like in the simple regression, the β1 value is insignificant itself. In the multiple regression manufacturing percentage is the only variable that is statistically significant.

We also computed an F-test to determine if the hypothesis β0=β1=β2=β3=β4 holds true. Using the residual sum of squares with a numerator degrees of freedom=4 and a denominator *dof*=45 we returned an F-stat=1.79. Comparing this to the critical value of F for F,4,45=2.58 we would fail to reject that hypothesis. This supports what we have determined so far, outside of the percentage of high school graduates, these variables are not statistically significant in determining the unemployment rate.

**2012**

For the year 2012, we continued to use STATA to do a simple regression between the variables of unemployment rate and percent of adults who have received a high school diploma. The model, as shown in Table 15, resulted as:

$$UnEmR12 = 36.89 - .33HS12$$

There is still a continued negative correlation between unemployment and the high school attainment level. The $R^2$ for the regression is 0.33, which indicates low correlation. The simple regression model indicates similar results from both the regressions of the 2006 and 2009 data. The percent of high school graduates in a state greatly affects the unemployment rate in that state, shown by the fact that the t-statistic of -5.04, with a p-value of 0, indicates that the variable of the percentage of high school graduates has a significant correlation with the unemployment rate. The β0 value of 36.89 implies that if a state had no high school graduates, the unemployment rate would be almost 37%. The β1 value of -0.33 signifies that for every percentage point increase in the rate of high school graduates, the unemployment rate decreases by 0.33%.

Using STATA to construct a simple regression model between the unemployment rate and percent of adults with a bachelor's degree in 2012, which can be seen in Table 16, resulted in:

$$UnEmR12 = 8.71 - .05*BD12$$

The percent of adults that had a bachelor's degree did not greatly affect the unemployment rate for 2012. The β0 value of 8.71 indicates that if the state had no bachelor's degree receivers, the unemployment rate would be about 5%. This supports our expectations that unemployment would be

tremendously lower for those who obtained a bachelor's degree. On the other hand, looking at the β1 value of -.05 signifies that for every percentage increase in the rate of bachelor's degrees, the unemployment rate decreases by 0.05%. This statistic allows us to see that the percent of adults with a bachelor's degree is not significant, and therefore, through the Recession, having a bachelor's degree did not have a great effect on one's unemployment rate. The $R^2$ value for this model was .02, which indicates a very weak correlation. Also, this model had a t-statistic of -1.00, with a p-value of 0.323. This indicates no significance at any of the levels; however, compared to the percent of those with a high school diploma and the unemployment rate, our hypothesis is further supported because the simple regression models for high school diploma for each year demonstrate that having a high school diploma significantly affects unemployment rate, but having a bachelor's degree did not have a significant correlation with unemployment rate.

Next, using STATA to construct our multiple regression models, we looked at the relationship between the percentage of high school graduates, the median age of states, GDP per capita, and the percent of states' output from manufacturing as additional explanatory variables, as shown by Table 17. The resulting model was:

$$UnEmR12 = 29.99 - 0.35HS12 + 0.22MEDAGE12 + 0.00PCGDP12 + 0.10Man12$$

Also, we ran another multiple regression model between the percentage of adults who received a bachelor's degree and the additional explanatory variables, which can be seen in Table 18, and resulted in:

$$UnEmR = 4.71 - 0.05BD12 + 0.11MEDAGE12 - 0.00PCGDP12 + 0.31Man12$$

Looking at both of the models, it is evident that β0 decreased for both; however, both β1 values resulted with different implications. The β1 value for high school graduates decreased from -0.33 to -0.35, with its t-statistic increasing from -5.05 to -4.48. Since the p-value remained the same at 0, the variable of having a high school diploma remains statistically significant at the 1% level. The β1 value for adults with a bachelor's degree remains the same, at -0.05, with a t-statistic increasing from -1.00 to -0.78, and a p-value increasing from 0.323 to 0.442. This continues to support our hypothesis that having a bachelor's degree does not have a significant correlation with unemployment rate.

The variable of median age was significant for high school graduates in 2012 at the 5% level, which indicates that after the Recession, older high school graduates were less unemployed, due to increased national consumption or increased job openings in all industries. The β2 value of 0.22 for the first model indicates that as the median age of a state increases one year, the unemployment rate increases 0.22%. On the other hand, median age was not statistically significant for those with a bachelor's degree, with a t-stat of 1.06 and a p-value of 0.293. GDP per capita also had a high p-value for both models. Similar to the 2006 and 2009 multiple regression models for adults with a bachelor's degree, the variable

of the percent of states' earnings from manufacturing was statistically significant at the 1% level, with a p-value of 0.003. This further supports our claim that manufacturing jobs were the most affected by the Recession, and even in 2012, those with a bachelor's degree who were in the manufacturing still had a significant correlation with the unemployment rate. On the other hand, looking at the first model, the p-value for manufacturing rate was 0.292 for high school graduates, which indicates the variable is statistically insignificant.

## V. Conclusions

When undertaking this research project we set out to determine if a person's level of education affected the probability of becoming unemployed. We compared three time periods, specifically around the recession, to explore the extent to which educational attainment could sway unemployment when other factors were driving it upwards. Our models proved that having at least a high school education can certainly increase the chances of remaining employed during a recession. While none of the other independent variables we chose to test proved to be statistically significant factors, our original hypothesis still holds true, and as the number of years of schooling increased by four years from high school to a bachelor's degree, the correlation between education level and unemployment rate became less significant across all the time periods.

Despite the fact that this study only takes into account specific variables we chose, our conclusions confirmed our original assumption, and could be a good basis for further research. Some literature we collected emphasized housing foreclosures as another important factor on the unemployment rate during the Great Recession, and although we could not obtain information on housing foreclosures during that time period, we could include this variable in our models in the future to illustrate another independent variable that may have contributed to high school graduates being more affected by the Recession than other education attainment levels.

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**Appendix**

Appendix A. STATA Regression outputs

2006

Unemployment = B0 + B1 (Highschool Diploma 2006) + u

```
. regress UnEmR06 HS06
```

| Source | SS | df | MS | Number of obs = | 50 |
|---|---|---|---|---|---|
| | | | | F( 1, 48) = | 8.70 |
| Model | 7.95128944 | 1 | 7.95128944 | Prob > F = | 0.0049 |
| Residual | 43.8537132 | 48 | .913619024 | R-squared = | 0.1535 |
| | | | | Adj R-squared = | 0.1358 |
| Total | 51.8050026 | 49 | 1.05724495 | Root MSE = | .95583 |

| UnEmR06 | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| HS06 | -.1137036 | .0385423 | -2.95 | 0.005 | -.1911981 | -.036209 |
| _cons | 14.44594 | 3.411362 | 4.23 | 0.000 | 7.58694 | 21.30495 |

**Table 7: Simple Regression of High School Diploma versus Unemployment Rate, 2006**

Unemployment = B0 + B1 (Bachelor's Degree in 2006) + u

```
. regress UnEmR06 BD06
```

| Source | SS | df | MS | Number of obs = | 50 |
|---|---|---|---|---|---|
| | | | | F( 1, 48) = | 3.33 |
| Model | 3.35999062 | 1 | 3.35999062 | Prob > F = | 0.0743 |
| Residual | 48.445012 | 48 | 1.00927108 | R-squared = | 0.0649 |
| | | | | Adj R-squared = | 0.0454 |
| Total | 51.8050026 | 49 | 1.05724495 | Root MSE = | 1.0046 |

| UnEmR06 | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| BD06 | -.0517758 | .0283767 | -1.82 | 0.074 | -.1088309 | .0052794 |
| _cons | 5.854737 | .8152518 | 7.18 | 0.000 | 4.215564 | 7.493911 |

**Table 8: Simple Regression of Bachelor's Degree versus Unemployment Rate, 2006**

Unemployment = B0+B1(Highschool)+B2(Median Age)+B3(GDP per Capita)+B4 (Manufacturing)+u

```
. regress UnEmR06 HS06 MEDAGE06 PCGDP06 Man06
```

| Source | SS | df | MS | Number of obs = | 50 |
|---|---|---|---|---|---|
| | | | | F( 4, 45) = | 3.14 |
| Model | 11.3136134 | 4 | 2.82840334 | Prob > F = | 0.0231 |
| Residual | 40.4913892 | 45 | .89980865 | R-squared = | 0.2184 |
| | | | | Adj R-squared = | 0.1489 |
| Total | 51.8050026 | 49 | 1.05724495 | Root MSE = | .94858 |

| UnEmR06 | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| HS06 | -.0896729 | .0456937 | -1.96 | 0.056 | -.1817047 | .002359 |
| MEDAGE06 | .0570539 | .0671536 | 0.85 | 0.400 | -.0782003 | .1923082 |
| PCGDP06 | -.0000174 | .0000229 | -0.76 | 0.450 | -.0000635 | .0000286 |
| Man06 | .1146259 | .066915 | 1.71 | 0.094 | -.0201479 | .2493997 |
| _cons | 10.61949 | 3.971097 | 2.67 | 0.010 | 2.621291 | 18.61769 |

**Table 9: Multiple Regression of High School Diploma versus Unemployment, 2006**

Unemployment=B0+B1(Bachelor's Degree)+B2(Median Age)+B3(GDP Per Capita+B4(Manufacturing)+u

```
. regress UnEmR06 BD06 MEDAGE06 PCGDP06 Man06
```

| Source | SS | df | MS | Number of obs = | 50 |
|---|---|---|---|---|---|
| Model | 10.0436086 | 4 | 2.51090214 | F( 4, 45) = | 2.71 |
| Residual | 41.7613941 | 45 | .928030979 | Prob > F = | 0.0420 |
| | | | | R-squared = | 0.1939 |
| | | | | Adj R-squared = | 0.1222 |
| Total | 51.8050026 | 49 | 1.05724495 | Root MSE = | .96334 |

| UnEmR06 | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| BD06 | -.0557659 | .0362567 | -1.54 | 0.131 | -.1287907 | .0172589 |
| MEDAGE06 | .0370538 | .0663117 | 0.56 | 0.579 | -.0965049 | .1706124 |
| PCGDP06 | -4.07e-06 | .0000287 | -0.14 | 0.888 | -.0000619 | .0000537 |
| Man06 | .1661387 | .0621678 | 2.67 | 0.010 | .0409264 | .291351 |
| _cons | 4.415699 | 2.54325 | 1.74 | 0.089 | -.7066694 | 9.538067 |

**Table 10: Multiple Regression of Bachelor's Degree versus Unemployment, 2006**

```
. regress urate09 HS09
```

| Source | SS | df | MS | Number of obs = | 50 |
|---|---|---|---|---|---|
| Model | 42.7209259 | 1 | 42.7209259 | F( 1, 48) = | 14.19 |
| Residual | 144.467872 | 48 | 3.00974734 | Prob > F = | 0.0005 |
| | | | | R-squared = | 0.2282 |
| | | | | Adj R-squared = | 0.2121 |
| Total | 187.188798 | 49 | 3.82017955 | Root MSE = | 1.7349 |

| urate09 | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| HS09 | -.2690744 | .0714195 | -3.77 | 0.000 | -.412673 | -.1254758 |
| _cons | 32.40653 | 6.368208 | 5.09 | 0.000 | 19.60238 | 45.21067 |

**Table 11: Simple Regression of High School Diploma versus Unemployment, 2009**

```
. regress urate09 BD09
```

| Source | SS | df | MS | Number of obs = | 50 |
|---|---|---|---|---|---|
| Model | 3.72510653 | 1 | 3.72510653 | F( 1, 48) = | 0.97 |
| Residual | 183.463692 | 48 | 3.82216024 | Prob > F = | 0.3285 |
| | | | | R-squared = | 0.0199 |
| | | | | Adj R-squared = | -0.0005 |
| Total | 187.188798 | 49 | 3.82017955 | Root MSE = | 1.955 |

| urate09 | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| BD09 | -.0540347 | .054734 | -0.99 | 0.328 | -.1640848 | .0560155 |
| _cons | 9.999654 | 1.611834 | 6.20 | 0.000 | 6.758844 | 13.24046 |

**Table 12: Simple Regression of Bachelor's Degree versus Unemployment, 2009**

```
. regress urate09 HS09 MEDAGE09 PCGDP09 Man09

      Source |       SS       df       MS              Number of obs =      50
-------------+------------------------------           F(  4,    45) =    5.66
       Model |  62.6218652     4  15.6554663            Prob > F      =  0.0009
    Residual |  124.566933    45  2.76815407            R-squared     =  0.3345
-------------+------------------------------           Adj R-squared =  0.2754
       Total |  187.188798    49  3.82017955            Root MSE      =  1.6638

------------------------------------------------------------------------------
     urate09 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        HS09 |   -.2078469   .0865675    -2.40   0.021    -.3822028   -.0334909
   MEDAGE09 |    .1379171    .110397     1.25   0.218    -.0844339    .3602681
    PCGDP09 |   -.0000294   .0000328    -0.90   0.374    -.0000956    .0000367
      Man09 |    .2499438   .1171483     2.13   0.038     .0139951    .4858926
      _cons |    22.51303   7.148368     3.15   0.003     8.115477    36.91058
------------------------------------------------------------------------------
```

**Table 13: Multiple Regression of High School Diploma versus Unemployment, 2009**

```
. regress urate09 BD09 MEDAGE09 PCGDP09 Man09

      Source |       SS       df       MS              Number of obs =      50
-------------+------------------------------           F(  4,    45) =    3.88
       Model |  47.9575929     4  11.9893982            Prob > F      =  0.0087
    Residual |  139.231205    45  3.09402678            R-squared     =  0.2562
-------------+------------------------------           Adj R-squared =  0.1901
       Total |  187.188798    49  3.82017955            Root MSE      =   1.759

------------------------------------------------------------------------------
     urate09 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        BD09 |   -.0404698   .0625951    -0.65   0.521    -.1665429    .0856033
   MEDAGE09 |    .0698004   .1165553     0.60   0.552     -.164954    .3045549
    PCGDP09 |   -.0000479   .0000387    -1.24   0.222    -.0001259     .00003
      Man09 |     .386498   .1122713     3.44   0.001      .160372    .6126241
      _cons |    8.173095   4.475333     1.83   0.074    -.8406882    17.18688
------------------------------------------------------------------------------
```

**Table 14: Multiple Regression of Bachelor's Degree versus Unemployment, 2009**

```
regress UnEmR12 HS12

      Source |       SS       df       MS              Number of obs =      50
-------------+------------------------------           F(  1,    48) =   25.39
       Model |  50.9187802     1  50.9187802            Prob > F      =  0.0000
    Residual |  96.2494217    48  2.00519629            R-squared     =  0.3460
-------------+------------------------------           Adj R-squared =  0.3324
       Total |  147.168202    49  3.00343269            Root MSE      =   1.416

------------------------------------------------------------------------------
    UnEmR12 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       HS12 |   -.3294588   .0653793    -5.04   0.000    -.4609127   -.1980048
      _cons |    36.8873   5.876047     6.28   0.000     25.07272    48.70189
------------------------------------------------------------------------------
```

**Table 15: Simple Regression of High School Diploma versus Unemployment, 2012**

```
regress UnEmR12 BD12
```

| Source | SS | df | MS | Number of obs = | 50 |
|---|---|---|---|---|---|
| | | | | F( 1, 48) = | 1.00 |
| Model | 2.99347192 | 1 | 2.99347192 | Prob > F = | 0.3231 |
| Residual | 144.17473 | 48 | 3.00364021 | R-squared = | 0.0203 |
| | | | | Adj R-squared = | -0.0001 |
| Total | 147.168202 | 49 | 3.00343269 | Root MSE = | 1.7331 |

| UnEmR12 | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| BD12 | -.0472856 | .0473659 | -1.00 | 0.323 | -.1425211 | .0479498 |
| _cons | 8.714744 | 1.444106 | 6.03 | 0.000 | 5.811174 | 11.61831 |

**Table 16: Simple Regression of Bachelor's Degree versus Unemployment, 2012**

```
regress UnEmR12 HS12 MEDAGE12 PCGDP12 Man12
```

| Source | SS | df | MS | Number of obs = | 50 |
|---|---|---|---|---|---|
| | | | | F( 4, 45) = | 8.81 |
| Model | 64.6458935 | 4 | 16.1614734 | Prob > F = | 0.0000 |
| Residual | 82.5223083 | 45 | 1.83382907 | R-squared = | 0.4393 |
| | | | | Adj R-squared = | 0.3894 |
| Total | 147.168202 | 49 | 3.00343269 | Root MSE = | 1.3542 |

| UnEmR12 | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| HS12 | -.3540054 | .0807553 | -4.38 | 0.000 | -.5166549 | -.1913558 |
| MEDAGE12 | .2238986 | .0910306 | 2.46 | 0.018 | .0405535 | .4072436 |
| PCGDP12 | .0000106 | .0000277 | 0.38 | 0.704 | -.0000451 | .0000663 |
| Man12 | .1029252 | .0965994 | 1.07 | 0.292 | -.0916359 | .2974864 |
| _cons | 29.99561 | 6.666377 | 4.50 | 0.000 | 16.56884 | 43.42238 |

**Table 17: Multiple Regression of High School Diploma versus Unemployment, 2012**

```
regress UnEmR12 BD12 MEDAGE12 PCGDP12 Man12
```

| Source | SS | df | MS | Number of obs = | 50 |
|---|---|---|---|---|---|
| | | | | F( 4, 45) = | 3.00 |
| Model | 30.9576914 | 4 | 7.73942284 | Prob > F = | 0.0282 |
| Residual | 116.21051 | 45 | 2.58245579 | R-squared = | 0.2104 |
| | | | | Adj R-squared = | 0.1402 |
| Total | 147.168202 | 49 | 3.00343269 | Root MSE = | 1.607 |

| UnEmR12 | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| BD12 | -.045482 | .0586726 | -0.78 | 0.442 | -.1636548 | .0726908 |
| MEDAGE12 | .1143713 | .1075956 | 1.06 | 0.293 | -.1023374 | .3310799 |
| PCGDP12 | -.0000237 | .0000385 | -0.62 | 0.540 | -.0001013 | .0000538 |
| Man12 | .3143129 | .1009358 | 3.11 | 0.003 | .1110178 | .5176079 |
| _cons | 4.711998 | 4.244359 | 1.11 | 0.273 | -3.836579 | 13.26057 |

**Table 18: Multiple Regression of Bachelor's Degree versus Unemployment, 2012**

Appendix B. Table 19: Statistical Inference Table

| **Dependent Variable UnEmR<br>*Significant at 10%, **5%, ***1%** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Independent Variables | Simple Regression, 2006 | | Simple Regression, 2009 | | Simple Regression, 2012 | | Multiple Regression, 2006 | | Multiple Regression, 2009 | | Multiple Regression, 2012 | |
| HS | -2.95*** | | -3.77*** | | -5.04*** | | -1.96* | | -2.40** | | -4.38*** | |
| BD | | -1.82* | | -0.99 | | -1.00 | | -1.54 | | -0.65 | | -0.78 |
| MEDAGE | | | | | | | 0.85 | 0.56 | 1.25 | 0.60 | 2.46** | 1.06 |
| PCGDP | | | | | | | -0.76 | -0.14 | -0.90 | -1.24 | 0.38 | -0.62 |
| Man | | | | | | | 1.71* | 2.67*** | 2.13** | 3.44*** | 1.07 | 3.11*** |
| Intercept | 4.23*** | 7.18*** | 5.09*** | 6.20*** | 6.28*** | 6.03*** | 2.67*** | 1.74* | 3.15*** | 1.83*** | 4.50*** | 1.11 |
| No. of Obs. | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| R-square | .15 | .06 | .23 | .02 | .35 | .02 | .22 | .20 | .33 | .26 | .44 | .21 |