The Impact of Higher Education on Unemployment

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Abstract

This paper explores the relationship between higher education and unemployment using regression analysis. Our hypothesis is that the greater the government expenditure on higher education, the lower a state's unemployment will be. Other independent variables such as state GDP per capita, the percentage of the population with bachelor degrees or higher, the cost of college attendance, the share of manufacturing in the state economy, and financial aid as a percentage of state revenue were used in a multi-regression analysis in order to account for bias. Our results found that there is a strong negative relationship between higher education expenditures and unemployment.

I. Introduction

Unemployment is defined as the state of an individual without a job actively seeking a job. It is an extremely important economic concept because it indicates the state of the economy and the labor market. A low unemployment rate is a rate that is close to the natural rate of unemployment. For the United States, the natural rate of unemployment is around 4 to 5%. Conversely, a high unemployment rate is a rate that is far from the natural rate of employment. If an economy has a low unemployment rate, the economy is most likely strong and there is ample labor mobility and strong purchasing power for workers. With a low unemployment rate, individuals have numerous job opportunities, so there is high labor mobility. Employees also have increased purchasing power because employees have a disposable income to spend thus increasing over economic consumption. A high unemployment rate indicates a weak economy where there is less labor mobility and less purchasing power. High unemployment reduces consumers purchasing power because individuals have less disposable to spend thus reducing consumption which can limit GDP growth. This project uses unemployment rates in all 50 states and correlates these figures with higher education government expenditures. Then we used multi-regression analysis to include state GDP, the percentages of people with bachelor degrees, cost of attending university, the share of manufacturing in the state economy, and financial aid as a percentage of state revenue in order to reduce bias.

We hypothesize that unemployment decreases with the increase of higher education government expenditures because human capital theory suggests that increased education reduces labor cost because employees are more productive and require less job training. The human capital theory is the idea that personality traits, knowledge, and habits contribute to an individual's ability to perform labor and thus are of economic value. There are four types of human capital: economic, cultural, social, and symbolic. This paper focus on how economic capital is related to unemployment. Economic capital is education, training, and skills that increase the knowledge of individuals making them more productive and thus increasing their wages and marketability. The rationale behind our hypothesis is that more educated workers are more attractive to firms because their increased knowledge results in higher productivity and less on the job training. Thus, they are more likely to get hired. Furthermore, more educated populations will have lower unemployment rates.

II. Literature Review

The first paper that we analyzed was a paper written by researchers Riddell & Song (2011) that investigated the relationship between unemployment and the transitions between unemployment to reemployment. They begin by establishing that there is clear evidence that the labour market is rapidly changing since roughly 10% of jobs perish and another 10% are newly created every year (Davis and

Haltiwanger, 1999). There are numerous studies that also support the claim that there is a direct relationship between greater levels of education and the rate of incidence for reemployment due to increased adaptability to the fluctuating job market. However, this relationship could be affected by variables other than level of education such as better social networks, higher income, or greater innate ability. In order to eliminate confounding variables that would reduce the endogeneity of education, Riddell and Song (2011) have distinguished their paper by focusing specifically on the transitions to reemployment and eliminate the previously listed variables that would affect results. In order to accomplish this, the researchers used data from the 1980 census and the 1980-2005 Current Population Survey due to the creation of instrumental variables (IV) from compulsory schooling laws and child labor laws as well as conscription risk during the Vietnam War. The IV estimates yielded higher estimates than standard OLS regression. Based on their findings, it was concluded that graduating from high school increases one's chances of reemployment by 40 percentage points and another 4.7 percentage points with each additional year of schooling. In terms of the transition from employment to unemployment, evidence for a relationship between education and incidence of unemployed has mixed results. There is a negative correlation between education and job loss especially for post-secondary education. However, there is no evidence of a causal relationship at the secondary schooling level. Overall, the results support the human capital theory that investment in an individual's ability can increase one's adaptability in a changing job market.

In another paper from September 1991, Columbia University researcher Jacob Mincer (1991) explores how higher educational levels as a function of human capital investment affect the duration and frequency of unemployment. Using longitudinal data on male labor rates from PSID (Panel Study of Income Dynamics), Mincer (1991) tries to answer three questions. The first question is whether there is a positive relationship between job training and education. The results show that there is a positive relationship because education enhances the productivity of job training. Additionally, those who invest in human capital such as education are likely to invest in other types of human capital such as job training. However, in the long-run education serves as a substitute for job training which is the reason for the decline in apprenticeships. The second question is if turnover is negatively related to education. Mincer found that there is a negative relationship which can be attributed to the positive relationship between training and education. Employees that receive lots of training are less likely to move from firm to firm, and employers are less likely to lay off these workers because they want to reap the investments of training. The third question is does education affect labor mobility, apart from its relation to job training. Mincer (1991) found that education increases labor mobility because more educated individuals are more efficient at finding jobs. Educated workers also have greater geographical mobility as inter-regional migration is twice as frequent among workers with 16 or more years of schooling than for those

with 12 or less. Even though educated workers are more likely to migrate, they change jobs less frequently. Overall, the paper found that the probability of unemployment was more significant than the duration of unemployment which supports previous research findings. Unlike other research, this study focused on how education and job training incentivize firms to keep workers because of the firm's high fixed costs from job training.

In our last paper, researchers Lavrinovicha, Lavrinenko, and Teivans-Treinovskis use methods of frequency, correlation, and multi-regression analysis to examine the effect of education on unemployment and income in Latvia. The researchers note that with a more technologically based economy, higher education is increasingly important in finding a high paying job and education differences make up 25% of income inequalities. The paper also incorporates job competition theory as rationale which argues that employers give more preference to candidates who he less likely to spend money on. Essentially, the employer will hire the more experienced and educated candidate regardless of the level of qualifications for the job. Thus, the study hypothesizes that if education levels increase, unemployment decreases and income increases. This study uses cross-series data from 2002-2013 collected by the University of Latvia. The independent variables are primary education, secondary education, and higher education levels which are regressed against the dependent variable - income. The multi-regression analysis confirms the positive correlation between education levels and income. Chi-square analysis of unemployment and education levels demonstrate the negative relationship between unemployment and education levels. Overall, the study empirically confirms the hypothesis which supports human capital and job competition theory.

Our paper will contribute to the literature by analyzing the effect of government spending on education and unemployment across all fifty states. This study, like previous studies, uses multi regression analysis an incorporates relevant factors to education like income, cost of attending college, graduation rates, and the percentage of people with bachelor degrees or higher. Unlike previous research, our research looks at all fifty states and uses a different combination of independent variables. Most research compares countries or compares some states and looks at unemployment overtime in respect to likelihood of unemployment and duration of unemployment. Our paper looks at unemployment rates at one point in time from 1988, 2011, to 2015 as we use cross-series data.

III. Data

In order to analyze this relationship, we correlated the unemployment rate and the higher education expenditure using a simple linear regression and added five more variables in our multiple linear regression. The data used in this paper is drawn from six different credible sources. All data is taken from datasets regarding the year 2015. Every variable has observations encompassing each of the 50 U.S. states. We did not include the city of Washington D.C. as a 51st observation because our datasets

were not consistent in this aspect: some did not all have the data for D.C. included in their datasets and others listed it as a separate observation.

Simple Linear Regression

1. Unemployment Rate

Our dependent variable is the annual average of unemployment for each US state in 2015. The unemployment rate only includes individuals who are actively looking for work. The unemployment data comes from the Bureau of Labor Statistics which is an agency of the U.S. Statistical System. Its purpose is to collect, analyze, and disseminate information related to labor economics to the U.S. government and public.

2. Higher Education Government Expenditure Per Capita (in thousands of USD)

Our main independent variable is the amount of money each state spent on higher education expenditure spent by each state for each resident. We chose this as our main independent variable because we believe that the amount of money spent by the state government on higher education should translate into more effective educational programs such as better school infrastructure and higher quality employees. The higher education expenditure data comes from a marketing research company called Statista. It is one of the top databases as it has 4 million monthly users and over 1.5 million statistics on 80,000 topics. The population per state statistics come from the US Census Bureau. We then divided the amount of money (in billions of USD) and the population for each state (in millions) to create our own dataset of higher education government expenditure per capita. Most staticians usually multiply the resulting variable by 100,000 to represent per capita for every 100,000 people when the unit of the resulting variable is very small (ie. federal criminals in a population). However, the total amount of higher education government expenditure is already in billions so we did not do this. Our resulting variable was measuring in units of thousands of US dollars.

Multiple Linear Regression

3. State GDP per Capita (in thousands of US Dollars)

In addition to independent variable previously stated, the state GDP per capita is also expected to affect the unemployment rate. Presumably, a higher state GDP should translate into a lower unemployment rate because a high state GDP indicates higher production and income levels. This variable is measured in units of thousands of USD. The data on state GDP per capita comes from the Bureau of Economic Analysis which is an agency of the US Department of Commerce seeking to provide policy makers with accurate information on the economy.

4. Percent Estimate with a Bachelor's Degree or Higher

A higher percent estimate of people with a bachelor's degree would indicate more people with at least 16 years of schooling. This would indicate a more educated population. If this variable is positively correlated with unemployment, this would support the hypothesis that higher education leads to lower unemployment rates. The data on this variable comes from the National Information Center for Higher Education Policy Making and Analysis. It is part of the NCHEMS private non-profit organization which seeks to provide relevant data and information for policy makers.

5. Average Cost of University Attendance for 1 school year (in thousands of USD)

The cost of education for an individual can affect the likeliness of them completing a higher education. A higher cost of attendance can deter people from attending university. Our calculation for the cost of university attendance includes tuition, room, board, and fees since these are the bulk of university attendance cost. The data on the cost of college attendance comes from the National Center for Education Statistics which is a branch of the US Department of Education that seeks to collect, analyze, and disseminate statistics on education and public district finances.

6. Share of Manufacturing in State Economy

The share of manufacturing variable is the percentage of people employed in the manufacturing sector in each state. This variable was included because it accounts for employment not captured by higher education variables because manufacturing jobs do not require higher education. The data comes from the Bureau of Economic Analysis, the same data source at our state GDP per capita variable.

7. Federal Aid as Percentage of State General Revenue

The federal aid variable is the federal aid as a percentage of state revenue. This aid goes towards Medicaid, education, transportation, and other entitlement programs. There is no overlap between this variable and higher education expenditure per capita variable because all aid is in the form of federal grants and is not captured in state higher education expenditures. The source of this data is the US Census Bureau, the same data source as our higher education government expenditure per capita variable.

The following table is a summary of each of the previously utilized variables. The standard deviations of some of the variables such as state GDP are large as absolute values. However, the coefficient of variation (calculated by taking standard deviation divided by mean) is not relatively large, so there is no noticeably large variability for any of the variables.

Table 1 - Summary Statistics.

Variable	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**
Unemployment Rate	50	5.03	1.07	2.7	6.9
Higher Education Govt Expenditure	50	0.90	0.23	0.51	1.45

Per Capita (in Thousands of USD)					
State GDP per Capita (in Thousands of USD)	50	48.06	8.85	31.89	66.84
Percent Estimate with a Bachelor's Degree or Higher	50	31.01	5.42	20.95	44.14
Average Cost of Tuition, Fees, and Room/Board (in Thousands of USD)	50	18.89	3.42	13.34	26.01
Share of Manufacturing in State Economy	50	8.82	3.44	2.1	17.1
Federal Aid as Percentage of State General Revenue	50	31.64	5.13	16.8	40.9

Gauss Markov Assumptions

The first Gauss-Markov assumption states that the model should be linear in parameters. This assumption's justification is shown in the linear regression results section. The second assumption pertains to random sampling. Since the data was either obtained from national government agencies that conduct annual surveys of randomly selected members of the population or reputable private organizations, the second assumption is met. The third Gauss-Markov assumption is the assumption of no perfect collinearity. As long as no two variables are perfectly collinear, this assumption will be met. There is no reason to assume perfect collinearity for any of the variables as evidenced by the results in Table 4. The fourth assumption has to do with zero conditional mean; the error *u* has an expected value of zero given any values of the independent variables. The last assumption is heteroskedasticity which also concerns *u*. As seen in Figures 1-2, the residuals show variances that do not vary randomly in each model. Therefore, there is no discernable pattern for either figures and the last assumption is satisfied for both figures.

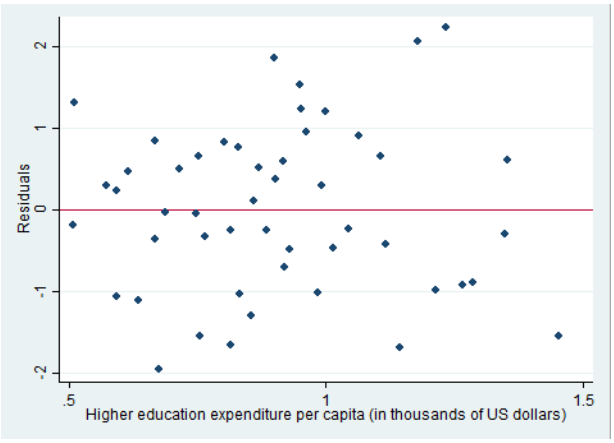

Figure 1: Residual of Simple Regression Model

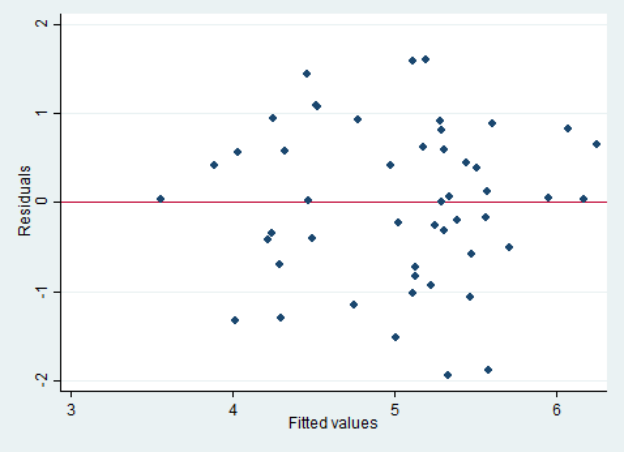

Figure 2: Residual of Multiple Regression Model

III. Results

Simple Linear Regression

$$unemploy = \beta_0 + \beta_1\, popeducexp + u$$

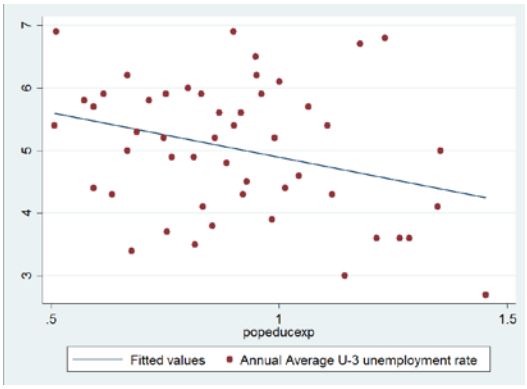

Figure 3: Regression Line and Scatter Plot

In regards to the simple regression equation, the dependent variable is the annual average U-3 unemployment rate, more generally referred to as the unemployment rate, in each state. The independent variable is the higher education expenditure per capita in each state, in thousands of US dollars. From our initial look at the regression plotted atop the scatterplot, we are able to see a negative relationship between the two variables, as we had predicted. Generally, the regression coefficient for β_1 shows that a $1,000 increase in higher education expenditure per capita will lead to a 1.42% decrease in the unemployment rate. This relationship follows the rationale that a state with a greater emphasis on higher education will have a lower unemployment rate because of the human capital theory's claim that secondary education leads to less on-site job training, which therefore decreases the cost of hiring another employee.

The nuances of this regression are seen in other measurements of the Stata output, though. First, we looked at the hypothesis testing in order to determine the significance of the coefficient (β_1). We determined the significance of β_1 through both the $P > |t|$ value and the t-value. We found that the coefficient is considered statistically significant on 95% confidence interval. To be statistically significant, at this level, the $P > |t|$ value needs to be .05 or below, and it is .03. We were able to prove the statistical significance of our coefficient by interpreting the t-value. For the sample size of our data, which is 50, a t-statistic of 2.021 or greater is considered statistically significant. Looking at the t-statistic, we reaffirmed our prior conclusion that the coefficient is statistically significant, with an absolute t-value of 2.24.

The R-Squared value is also an important statistic to evaluate. In this case, the R-squared is .0949. This value indicates that 9.49% of the variance in the unemployment rate can be explained by the higher education expenditure per capita. The association is quite small and indicates that the regression is not as strong as possible - more variables need to be included in order to help control for more variance. Another important statistic that we must look at is the Root MSE, or Root Mean Squared Error, which shows the standard deviation of the error term. This value is 1.029 which demonstrates a relatively high deviation of actual values from the estimated values.

Multiple Linear Regression

$$\textit{Model 1: unemploy} = \beta_0 + \beta_1 \textit{ popeducexp} + \beta_2 \textit{ degree} + \beta_3 \textit{ tuition} + \beta_4 \textit{ stategdp} + u$$

In order to prevent omitted variable bias in our regression model, we accounted for more of the variation by using a multiple regression. In our first multiple regression model, we tried to explain the

changes in the unemployment rate by including the percent estimate of people with bachelor's degree or higher, tuition costs, and state GDP per capita in addition to higher education expenditure per capita.

In this model, the β_1 coefficient indicates that a $1,000 increase in higher education expenditure per capita leads to a 1.39% decrease in unemployment, holding all other variables constant. At a 95% confidence interval, this variable still remains statistically significant, with an absolute t-value of 2.15.

In the following variables, as a practice, we will hold all other factors constant when interpreting what the coefficient means in terms of the effect on unemployment. A 1% increase of people with a bachelor's degree or higher leads to a .134% decrease in the unemployment rate. A $1,000 increase in tuition leads to a .120% increase in unemployment. Lastly, a $1,000 increase in state GDP per capita leads to a .023% increase in unemployment.

A trend we observed was that when there are more people with secondary degrees, the unemployment decreases, and when the cost of tuition increases, unemployment increases. The tuition and degree variables were also concluded to be statistically significant on a 95% confidence interval. Both had t-values that were above 2.021, with absolute value t-values of 3.40 and 2.32 respectively. The t-value of state GDP per capita could not be concluded as statistically significant at even a 90% confidence interval, with a t-statistic of only 1.09.

Ultimately, the multiple regression was stronger than the simple regression. We can prove this by noting that the Root Mean Squared Error now lies under 1, while it was above 1 previously. More importantly, the R-squared value is now .2942, meaning 29.42% of the variance in the unemployment rate can be explained by the variables used in this regression. This R-squared is approximately 3 times the size of the simple regression R-squared.

$$\textit{Model 2: unemploy} = \beta_0 + \beta_1 \textit{popeducexp} + \beta_2 \textit{degree} + \beta_3 \textit{tuition} + \beta_4 \textit{stategdp} + \beta_5 \textit{manu} + \beta_6 \textit{fedaid} + u$$

After reviewing our variables once more, we determined that additional variables could be included in the model in order to explain our regression better. Thus, we included two more independent variables: the share of the manufacturing in the state's economy and federal aid as percentage of the state's general revenue. The inclusion of these variables did lower the significance of our β_1. The coefficient for higher education expenditure per capita now indicates that a $1000 increase in said expenditure per capita leads to a 1.12% decrease in the unemployment rate, but the t-statistic falls just below that of which we could declare the coefficient as being statistically significant at a 90% confidence interval. It is important to note that no other variable is dramatically lowered in its statistical significance and that the two added variables cannot be concluded statistically significant at a 90% confidence interval.

This model is strengthened primarily by its increase in the R-Squared value. Now, 33.13% of the variation in the unemployment rate can be explained by the independent variables used in this model. To further examine our second multiple regression model, we ran further tests to look for joint significance between the state GDP per capita and the federal aid.

$$\textit{Model 3: unemploy} = \beta_0 + \beta_1 \textit{popeducexp} + \beta_2 \textit{degree} + \beta_3 \textit{tuition} + \beta_4 \textit{manu} + u$$

After looking at the results and coefficients for Model 2, we recognized that the state GDP per capita and the federal aid variables were extremely insignificant, so we dropped both of these variables (we test for joint significance in the following section). Upon dropping these variables, our primary independent variable coefficient, *popeducexp*, regained its statistical significance, as well as allowed all other variables to also either maintain or gain statistical significance. All variables are significant at, at least, a 90% confidence interval.

When we removed these two variables, our R-Squared only decreased by a small amount. Therefore, our final model accounts for 32.56% of the variation in the unemployment rate and the Root Mean Squared Error is at its lowest, at .9173. This final model accounts for potential omitted variable bias while also excluding insignificant variables.

Table 2 - Statistical Inference.

Dependent Variable: unemploy				
Independent Variables	**Simple Linear Regression**	**Multiple Linear Regression: Model 1**	**Multiple Linear Regression: Model 2**	**Multiple Linear Regression: Model 3**
popeducexp	-1.422244 (.634)**	-1.397579 (.649)**	-1.116927 (.677)	-1.034436 (.581)*
degree	--	-.1340587 (.039)***	-.1315355 (.0405)***	-.1263735 (.033)***
tuition	--	.1202684 (.051)**	.1369263 (.053)**	.1387097 (.052)***
stategdp	--	.0233536 (.021)	.0131698 (.0439)	--

manu	--	--	-.0669345 (.043)	-.0725119 (.039)*
fedaid	--	--	.0139858 (.035)	--
Intercept	6.319061 (.591)***	7.058889 (1.047)***	7.049044 (2.14)***	7.905331 (1.090)***
Root MSE	1.029	.93845	.93447	.9173
R-squared	.0949	.2942	.3313	.3256
Significant at 10%*, 5%**, or 1%*** confidence interval Note: Standard Errors in parentheses				

IV. Extensions

F-Test

Restricted Model: $unemploy = \beta_0 + \beta_1\ popeducexp + \beta_2\ degree + \beta_3\ tuition + \beta_4\ manu + u$

After adding more variables to our second multiple regression model, we noticed that both state GDP per capita and federal aid as a percentage of state general revenue were not statistically significant and had the potential be jointly significant. We thought they had the potential to be jointly significant because a state with higher GDP per capita would probably need less federal aid than those with lower GDP per capita. In the test that follows, the unrestricted model is the Multiple Linear Regression: Model 2 (listed in the previous section), and the restricted model is stated above.

Table 3 - F-Statistic.

statedgp + fedaid	
SSR Unrestricted Model	37.549
SSR Restricted Model	37.865
Numerator Degrees of Freedom	2
Denominator Degrees of Freedom	43
F-Statistic	.197

Upon seeing the F-statistic, we see these two variables as being neither independently significant nor jointly significant. This observation is evident because the critical value for a 95% confidence interval given the numerator and denominator degrees of freedom is 3.23. Quite simply, the F-statistic of .197 lays drastically below this critical value, which means that the variables are not jointly significant. Due to this F-test, our third model still holds in our decision to drop both of the variables being tested.

Multicollinearity

Table 4 - Multicollinearity.

	Bachelor's degree or higher	**Cost of attendance**	**Higher education expenditure per capita**	**Per capita real GDP**	**Share of manufacturing**	**Federal aid a percentage of state revenue**
Bachelor's degree or higher	x	0.6324*	0.0063	0.6302*	-0.193	-0.527*
Cost of attendance	x	x	-0.1686	0.3276*	0.0304	-0.2537
Higher education expenditure per capita	x	x	x	0.3304*	0.022	-0.2882
State GDP per Capita	x	x	x	x	-0.3727*	-0.6204*
Share of manufacturing	x	x	x	x	x	0.2175
Federal aid a percentage of state revenue	x	x	x	x	x	x

Unsurprisingly, several of the variables have some multicollinearity because the variables are related. The strong relationships are denoted with an asterisk. The strong relationship between cost of attendance and percentage of people with bachelor's degrees or higher can be explained through the law of demand. As degrees demanded increase, the cost of degrees supplied increases. There is also a strong relationship between percentage of people with bachelor degrees or higher and state GDP per capita because more educated people have higher wages thus increasing GDP. There is a strong negative relationship between percentage of people with bachelor degrees or higher and federal aid as a percentage

of state revenue because the federal government is less likely to give educational aid to states that have more available funding. This relationship is demonstrated by the strong negative correlation between state GDP per capita and federal aid as a percentage of state revenue. States have more available funding when they have more taxable revenue which is evidenced by the strong correlation between higher education expenditure per capita and state GDP per capita. More educated populations have higher wages; thus, the government have more taxable revenue and can increase its budget. Conversely, manufacturing is a field with lower wages, so there is a strong negative relationship between state GDP per capita and share of manufacturing jobs. Since our model has some multicollinearity, some variables may need to be eliminated from the model. For example, state GDP per capita could be removed from the model because it has a strong degree of multicollinearity with four of the five other variables. Thus, its characteristics are mostly controlled for by the other variables and are not necessary to include.

V. Conclusion

Throughout our analysis, we chose not to include dummy variables because we did not have qualitative data. We also determined that there was not enough variation among regions of the United States to draw conclusions significant differences across them. This also has the potential to be caused by the fact that the research only utilizes 50 observations. Regarding the use of functional form, we have cleaned all of our data to be in one of two units: either percentage points or thousands of U.S. Dollars. This allows for easy interpretation of correlation coefficients and allows us to avoid the need for a functional form. It is also important to mention that our regression line plotted on top of our data does indeed show a generally linear correlation.

Due to the results of the research we conduct and consideration for possible bias factors, we believe more states should invest money into higher education expenditures since it directly leads to a significant reduction in a state's unemployment rate. More specifically, our third and final model shows us that a $1000 increase in higher education expenditures leads to a 1.03% decrease in the unemployment rate, given a 90% confidence interval. In order to control for outside variables within the regression, we use percentage of people with a bachelor's degree or higher, the cost of attendance, and the share of the economy that is comprised of manufacturing. Throughout our testing, we were able to drop variables that were not significant, such as per capita state GDP and the share of federal aid provided to the state in relation to revenue. Through earlier testing, we also observed that the high school graduation rate does not have a significant effect on the unemployment rate. The final regression model explains 32.56% of variation in unemployment rates. We believe it would beneficial to run this regression again with more observations and more variables in order to get a stronger model.

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Appendix

List of States	
Alabama	Montana
Alaska	Nebraska
Arizona	Nevada
Arkansas	New Hampshire
California	New Jersey
Colorado	New Mexico
Connecticut	New York
Delaware	North Carolina
Florida	North Dakota
Georgia	Ohio
Hawaii	Oklahoma
Idaho	Oregon
Illinois	Pennsylvania
Indiana	Rhode Island
Iowa	South Carolina
Kansas	South Dakota
Kentucky	Tennessee
Louisiana	Texas
Maine	Utah
Maryland	Vermont
Massachusetts	Virginia
Michigan	Washington
Minnesota	West Virginia
Mississippi	Wisconsin
Missouri	Wyoming

Stata Outputs

Simple Linear Regression

```
. regress unemploy popeducexp
```

Source	SS	df	MS	Number of obs	=	50
				F(1, 48)	=	5.03
Model	5.32774599	1	5.32774599	Prob > F	=	0.0295
Residual	50.821054	48	1.05877196	R-squared	=	0.0949
				Adj R-squared	=	0.0760
Total	56.1488	49	1.14589388	Root MSE	=	1.029

unemploy	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
popeducexp	-1.422244	.634021	-2.24	0.030	-2.697029	-.1474596
_cons	6.319061	.5919234	10.68	0.000	5.128919	7.509203

Multiple Linear Regression: Model 1

```
. regress unemploy popeducexp degree tuition stategdp
```

Source	SS	df	MS	Number of obs	=	50
				F(4, 45)	=	4.69
Model	16.5180727	4	4.12951818	Prob > F	=	0.0030
Residual	39.6307273	45	.880682828	R-squared	=	0.2942
				Adj R-squared	=	0.2314
Total	56.1488	49	1.14589388	Root MSE	=	.93845

unemploy	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
popeducexp	-1.397579	.6494255	-2.15	0.037	-2.705589	-.0895688
degree	-.1340584	.0394157	-3.40	0.001	-.2134457	-.054671
tuition	.1202684	.0518642	2.32	0.025	.0158085	.2247282
stategdp	.0233536	.0215016	1.09	0.283	-.0199529	.0666602
_cons	7.058887	1.047218	6.74	0.000	4.949682	9.168092

Multiple Linear Regression: Model 2 (Unrestricted Model)

```
. regress unemploy popeducexp degree tuition stategdp manu fedaid
```

Source	SS	df	MS	Number of obs	=	50
				F(6, 43)	=	3.55
Model	18.5994254	6	3.09990424	Prob > F	=	0.0061
Residual	37.5493746	43	.873241269	R-squared	=	0.3313
				Adj R-squared	=	0.2379
Total	56.1488	49	1.14589388	Root MSE	=	.93447

unemploy	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
popeducexp	-1.116927	.6773162	-1.65	0.106	-2.482866	.2490111
degree	-.1315355	.0405151	-3.25	0.002	-.2132421	-.049829
tuition	.1369263	.0529131	2.59	0.013	.0302169	.2436357
stategdp	.0131698	.0241623	0.55	0.589	-.0355581	.0618978
manu	-.0669345	.0439188	-1.52	0.135	-.1555052	.0216363
fedaid	.0139858	.034868	0.40	0.690	-.0563322	.0843038
_cons	7.049044	2.142964	3.29	0.002	2.727345	11.37074

Multiple Linear Regression: Model 3 (Restricted Model)

```
. regress unemploy popeducexp degree tuition manu
```

Source	SS	df	MS	Number of obs	=	50
				F(4, 45)	=	5.43
Model	18.2838384	4	4.5709596	Prob > F	=	0.0012
Residual	37.8649616	45	.841443591	R-squared	=	0.3256
				Adj R-squared	=	0.2657
Total	56.1488	49	1.14589388	Root MSE	=	.9173

unemploy	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
popeducexp	-1.034436	.5812955	-1.78	0.082	-2.205225	.1363529
degree	-.1263735	.0328779	-3.84	0.000	-.192593	-.0601541
tuition	.1387097	.0518456	2.68	0.010	.0342872	.2431322
manu	-.0725119	.0397172	-1.83	0.075	-.1525065	.0074827
_cons	7.905331	1.09005	7.25	0.000	5.709858	10.10081