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Explaning the effects of unionization on unemployment at the state level

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EXPLANING THE EFFECTS OF UNIONIZATION ON UNEMPLOYMENT AT THE STATE LEVEL

by

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ABSTRACT

Many researchers have attempted to find a concrete link between unionization and unemployment. I use panel data regression and simultaneous equation regressions to determine the relationship between unionization and unemployment. Regressions were run on equations which featured private sector and public sector unionization. A separate regression featured public sector unionization but replaced private sector unionization with unionization in the construction industry and manufacturing industry. In all sets of the equation, the unionization variable was also accompanied by a corresponding location quotient, which measures industrial concentration. Both sets of equations also contain and interaction term which test the interaction between unionization and industrial concentration.

The project produced surprising conclusions. I did not expect the unionization variable and the interaction term to produce different signs in front of their respective coefficients. This only applied to those results in which the unionization variable and interaction term was statistically significant. Also, in many equations the unionization variable proved to not be statistically significant. This can easily be seen in the equations which featured unionization of the construction industry. Another surprising result involves the minimum wage variable. Recently, scholars who study minimum wage have found no statistically significant effect of minimum wage on unemployment. Results I found support this conclusion and may shed light on the debate over minimum wage.

DEDICATIONS

For Susan and Steven Robin, my parents, who always believe in me.

For my grandparents, Rita and Philip Podel, who provide me inspiration every single day.

For my teachers and professors who have given such immense knowledge throughout my schooling.

And for my friends who constantly support me during this tumultuous journey.

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Chapter 1: Introduction

Why Unions

While looking at various statistics of the U.S. economy, one aspect that interests me is the variation in state level statistics. Some states record unemployment rates much higher or lower than other states. This phenomenon suggests that other factors affect state level economic statistics besides national policies and trends. Unions interested me because its institution may affect state unemployment rate. Current news frequently mentions the importance of unions in politics and the economy. The governors of Wisconsin, Ohio, Indiana, and New Jersey all decry the power of unions and the negative effects they place on each respective state. In Wisconsin, Governor Scott Walker even faced a voter recall due to his attempts to limit the power of public sector unions. As Washington D.C. remains gridlocked, our federalist system allows states to craft policies to shape their destinies. Will limiting unionization assists states in creating better outcomes for its citizens?

Although one may argue both private and public sector unionization follow a national trend, variation in state unionization rates proves these numbers holds potential explanatory power to the question of variation in state level statistics. Determining the factors that affect state level statistics will give policymakers useful information regarding crafting effective public policies. Understanding the actual affect of unionization on the economies of the U.S. states sheds light on an important issue in current affairs. The purpose of this research is to examine the potential effect of unionization on state level statistics like unemployment.

Literature Review

Unions

The basis of this research project can be found in the work of Lou Pantuosco. He undertook three important studies examining the effect of unionization on state unemployment rates which will be referred to as Pantuosco et al (2001), Pantuosco (2002), and Pantuosco and Seyfried (2008). He used regression analysis by employing the simultaneous equation regression model to determine the effect of unionization on unemployment. Pantuosco used data from the U.S. Department of Labor, Bureau of Labor Statistics, Department of Commerce, Bureau of economic Analysis, United Slates Statistical Abstracts, Hirsh and McPherson, and Department of Labor, Employment, and Training Administration for all of his studies.[1] He also used the forty-eight contiguous U.S. states and the years 1978-1994 as parameters for Pantuosco et al (2001), Pantuosco (2002).[2] Pantuosco and Seyfried (2008) used the forty-eight contiguous states and included two time periods encompassing the years 1983-1996 and 1992-2005.[3]

Pantuosco et al (2001) differed from the other two by using six equations, paired two by two, for the simultaneous equation regressions. The equations in Pantuosco et al (2001) included unemployment, wage inflation, productivity, and gross state product, employment growth, and population growth as response variables.[4] The other two studies, Pantuosco (2002), and

[1] Pantuosco, Lou, Darrell Parker, and Gary Stone, "The Effect of Unions on Labor Markets and Economic Growth: An Analysis of State Data," Journal of Labor Research XXII, no.1 (2001): 195-205
[2] Pantuosco, Lou, "Macroeconomic Differences in Public and Private Union Density: An Analysis of US State Economies, Review of Regional Studies 32, no. 2 (2002): 171-186
[3] Pantuosco, Lou, William Seyfried, "The Effect Of Public And Private Unions On State Economic Activity: Evaluating The Benefits To Organized Workers, Policymakers, And Companies," Journal of Business & Economics Research 6, no. 2 (2008): 27-39
[4] Pantuosco, Lou, Darrell Parker, and Gary Stone, "The Effect of Unions on Labor Markets and Economic Growth: An Analysis of State Data," Journal of Labor Research XXII, no.1 (2001): 195-205

Pantuosco and Seyfried (2008), both used simultaneous equation regression but used only four equations paired two by two. The new collection of simultaneous equations tested four regression equations which included unemployment, wage inflation, productivity, and gross state product as response variables.[5] The authors used simultaneous equation regressions to account for multicollinearity and heteroskedasticity and were paired two by two by similarity to account for endogeneity between the various dependant variables. The authors also used rates of change and lagged variables to mitigate and control autocorrelation as well as fixed effect and random effect. [6]

The most important difference in Pantuosco's three studies revolves around the specific unionization variable used in each study. In the 2001 project, Pantuosco used the total union membership as his main independent variable.[7] He then adopts two measures of unionization, public and private unionization, instead of using the overall unionization statistic for his 2002 study.[8] Pantuosco decided to recreate his 2002 study but use different and extended time periods for his 2008 work.[9] These changes produced meaningful results in each project.

In Pantuosco et al (2001), the authors found that unions significantly increase unemployment rates and wage inflation while decreasing GSP growth and productivity. Unions

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[5] Pantuosco, Lou, "Macroeconomic Differences in Public and Private Union Density: An Analysis of US State Economies, Review of Regional Studies 32, no. 2 (2002): 171-186
[6] Pantuosco, Lou, Darrell Parker, and Gary Stone, "The Effect of Unions on Labor Markets and Economic Growth: An Analysis of State Data," Journal of Labor Research XXII, no.1 (2001): 195-205
[7] Pantuosco, Lou, Darrell Parker, and Gary Stone, "The Effect of Unions on Labor Markets and Economic Growth: An Analysis of State Data," Journal of Labor Research XXII, no.1 (2001): 195-205
[8] Pantuosco, Lou, "Macroeconomic Differences in Public and Private Union Density: An Analysis of US State Economies, Review of Regional Studies 32, no. 2 (2002): 171-186
[9] Pantuosco, Lou, William Seyfried, "The Effect Of Public And Private Unions On State Economic Activity: Evaluating The Benefits To Organized Workers, Policymakers, And Companies," Journal of Business & Economics Research 6, no. 2 (2008): 27-39

negatively and insignificantly affect employment growth.[10] Using public and private unionization instead of overall unionization created new results in Pantuosco (2002). Pantuosco found huge differences in the effect public and private unions have on the economy. Increases in private unionization decreases employment and productivity while increases in public unionization employment increase employment. Neither affects wage growth and public unions increase GSP.[11] Using different time periods also lead to new results. Pantuosco and Seyfried (2008) found that unions yielded different effect on economic statistics depending on the time period. Increases in private sector unionization lowered productivity throughout the entire time period (1983-2005). Increases in public sector unionization lowered unemployment rates in the time period 1983-1996, but the effects diminished for the 1992-2005 period. Contradicting the results of the previous study, public sector unions may not have a positive effect on the economy, while private sector unions still have a negative effect.[12]

The unionization rate can be broken down one step further. Pantuosco broke down the overall unionization rate to public and private unionization.[13] This project aims to break down the private sector term further. Hirsh and Macpherson recorded unionization rates for construction and manufacturing industries.[14] Using these two unionization rates and the public sector unionization rates will bring more insight into how unions affect the economy. Izraeli and

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[10] Pantuosco, Lou, Darrell Parker, and Gary Stone, "The Effect of Unions on Labor Markets and Economic Growth: An Analysis of State Data," Journal of Labor Research XXII, no.1 (2001): 195-205
[11] Pantuosco, Lou, "Macroeconomic Differences in Public and Private Union Density: An Analysis of US State Economies, Review of Regional Studies 32, no. 2 (2002): 171-186
[12] Pantuosco, Lou, William Seyfried, "The Effect Of Public And Private Unions On State Economic Activity: Evaluating The Benefits To Organized Workers, Policymakers, And Companies," Journal of Business & Economics Research 6, no. 2 (2008): 27-39
[13] Pantuosco, Lou, "Macroeconomic Differences in Public and Private Union Density: An Analysis of US State Economies, Review of Regional Studies 32, no. 2 (2002): 171-186
[14] "Union Membership and Coverage Database from the CPS," *unionstats.com*, February 4, 2012, http://unionstats.com/

Murphy (2003), Mizuno et al (2006), and Mollick and Varella (2008) researched how industrial diversity, concentration of specific industries in a geographic setting, affected various economic statistics. I believe the inclusion of industrial diversity as an interaction term with the previously mentioned unionization rates adds on to the work previously completed by Pantuosco. This next section will review the literature behind the use of the location quotient and the study of industrial diversity.

Industrial Diversity

In researching state unemployment I discovered the need for a more detailed regression equation to capture the effects of unionization on state unemployment rates. Industrial diversity presents itself as a potentially useful variable. Izraeli and Murphy (2003), Mizuno et al (2006), and Mollick and Varella (2008) researched the effect of industrial diversity on a variety of state level economic statistics. The three projects studied different locations and time periods. Izraeli and Murphy (2003) used seventeen U.S states and two sample periods ranging from around the 1970's-1987 and 1987-1998. The starting period in the decade of the 70’s differed for some states.[15] The data come from the Bureau of Labor Statistics, County Business Patterns web site, and United States Statistical Abstract.[16] Mizuno et al (2005) used 118 Japanese metro areas, for which the authors defined, and a cross section of data compiled in 1995. The authors averaged data from 1991-1997 for missing data. They also used data from The Population Census of

[15] Izraeli, Oded, Kevin J. Murphy, “The effect of industrial diversity on state unemployment rate and per capita income,” Annuls of Regional Science 37, no. 1 (2003): 1-14

[16] Izraeli, Oded, Kevin J. Murphy, “The effect of industrial diversity on state unemployment rate and per capita income,” Annuls of Regional Science 37, no. 1 (2003): 1-14

Japan, the Japanese Statistics Bureau, and the Management and Coordination Agency.[17] Mollick and Varella (2008) used MSA's located near the Mexican border from the time period 1990-2005. The data they used come from Bureau of Labor Statistics.[18]

Each study used different tactics to measure industrial diversity. Israeli and Murphy (2003) used the Herenfindahl index to measure industrial diversity. The authors used both pooled Ordinary Least Square (OLS) regression and fixed effects model to test the impact of industrial diversity on unemployment. Some models controlled for spatial heteorgeniety while others did not.[19] Mizuno et al (2006) used both the Herenfindahl index and the location quotient to measure industrial diversity. They used the standard OLS model to test the relationship and modeled six equations, all using a different set of location quotients.[20] Mollick used both the relative specialization index and the relative diversity index to measure industrial diversity by a Feasible Generalized Least Square model (FGLS) test. They also included two panels, border and non-border MSA’s, and the time trend as the independent variables. Both panels included the relative specialization as well as the relative diversity index.[21]

The authors of the three papers found similar results with respect to the impact of industrial diversity on unemployment. Israeli and Murphy (2003) found that industrial diversity reduces the state's unemployment rate when spatial heterogeneity is controlled, but there is no

[17] Mizuno, Keizo, Fumitoshi Mizutani. Noriyoshi Nakayama, “Industrial diversity and metropolitan unemployment rate,” Annuls of Regional Science 40, no. 1 (2006): 157-172
[18] Mollick, André Varella, “What explains unemployment in US–Mexican border cities?” Annuls of Regional Science 42, no.1 (2008): 169-192
[19] Izraeli, Oded, Kevin J. Murphy, “The effect of industrial diversity on state unemployment rate and per capita income,” Annuls of Regional Science 37, no. 1 (2003): 1-14
[20] Mizuno, Keizo, Fumitoshi Mizutani. Noriyoshi Nakayama, “Industrial diversity and metropolitan unemployment rate,” Annuls of Regional Science 40, no. 1 (2006): 157-172
[21] Mollick, André Varella, “What explains unemployment in US–Mexican border cities?” Annuls of Regional Science 42, no.1 (2008): 169-192

clear answer for the relationship between industrial diversity and income.[22] In Mizuno et al (2006) the authors found the Herfindahl index was not a significant predictor of unemployment rates as compared to the location quotient. Increases in both the location quotient for construction and manufacturing as well as education level significantly reduced unemployment.[23] Mollick and Varella (2008) found that the concentration of industries increases unemployment. The relative diversity index shows a stronger link than the relative specialization index.[24]

Minimum Wage

Minimum wage presents another important factor in regards to determining the unemployment rate of a particular state. Many who study minimum wage tend to research its effect on teen employment, a specific subgroup thought to be heavily affected by minimum wage laws. Allegretto, Dube, and Reich (2011) researched the effect of minimum wage laws on teen employment statistics. The author's hypothesis claimed many previous studies failed to account properly for spatial heterogeneity and long term growth rates of states. The authors used individual level repeated cross-section sample from the CPS Outgoing Rotation Group for the years 1990-2009. The authors later also used CPS data on teens but focused on the restaurant industry. They compared their restaurant study to Dube, Lester, and Reich (2010a) and Neumark and Wascher (2007a). Methodologically, the two experiments are similar. The authors used the same package of four regression equations to test both the individual level data and the restaurant

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[22] Izraeli, Oded, Kevin J. Murphy, "The effect of industrial diversity on state unemployment rate and per capita income," Annuls of Regional Science 37, no. 1 (2003): 1-14
[23] Mizuno, Keizo, Fumitoshi Mizutani. Noriyoshi Nakayama, "Industrial diversity and metropolitan unemployment rate," Annuls of Regional Science 40, no. 1 (2006): 157-172
[24] Mollick, André Varella, "What explains unemployment in US–Mexican border cities?" Annuls of Regional Science 42, no.1 (2008): 169-192

data. Each equation added more data than the previous equation. The first equation included standard information plus a time dummy and state-fixed effect variable. The second equation added a variable to capture differences in long-term growth rates of states, while the third equation only added a term for spatial heterogeneity. The fourth equation added terms for both differences in long-term growth rates and spatial heterogeneity. The results indicated increases in the minimum wage did not produce disemployment among teen groups. It also suggests the standard argument that increases in the minimum wage increases disemployment may be wrong.[25]

Contributions

This project focuses on the unionization statistic and how it affects unemployment. While viewing the results of the regression analysis, the main statistics of focus will be the p-values and adjusted r-squared scores of the models. These two statistics will determine the efficacy of the models and significance of the independent variables. This main contribution of this project is threefold. First, this project replaces the public private paradigm by including two specific private sectors, construction and manufacturing. Second, this project adds location quotient to the model as an exogenous variable. Third, project adds in an interaction term which takes into account how location quotient along with unionization affects unemployment.

Chapter 2: Data

[25] Allegretto, Sylvia A., Arindrajit Dube, Michael, "Do Minimum Wages Really Reduce Teen Employment? Accounting for Heterogeneity and Selectivity in State Panel Data," Industrial Relations 50, no. 2 (2011): 205-240

This section will describe the methodology used to collect and format the data into Stata 12. The data collected for this project came from many sources. These include the Bureau of Economic Analysis (BEA), the Department of Labor (DOL), the Census, the Bureau of Labor Statistics (BLS), and unionstats (a database created by Barry T. Hirsch and David A. Macpherson). Formatting techniques were made to allow for proper testing in Stata 12.

Sources

BEA

Data for each three of the Location Quotients (manufacturing, construction, and public administration) and population were found in the BEA regional data section. The BEA splits up the data into two time periods, 1963-1997 and 1997 to the present. The first time period, 1963-1997, uses the Standard Industrial Classification (SIC) system which uses a four digit code to classify all industries. The classification system was replaced by the North American Industry Classification System (NAICS) beginning in the year 1997. A joint effort from Canada, Mexico, and the United States created this new system which allowed for comparisons between all three countries.

Specifically, I will discuss the Location Quotient first. The BEA calculates the Location Quotient as an index and labeled it the Industry Specialization Index (ISI). This index is created by calculating the industry’s share of business in a state and dividing that number by the share of business of the industry in the entire United States. This number is then multiplied by 100. The resulting ISI can be categorized into three categories. First, a score of less than 100 signifies the industry is less important to a state when compared to its importance to the entire United States.

Second, a score of greater than 100 signifies the industry is more important to a state while compared to its importance to the entire United States. Third, a score of exactly 100 signifies the industry importance to the state is equal to its importance to the entire United States.

I also found data for state population at the BEA regional data section. The data list the total population for each state in the millions. The dataset did not need to be altered in order to run the regression analysis.

Minimum Wage

Data for minimum wage was found in the Department of Labor (DOL) Wage and Hour Division (WHD). This historical table is found on the State Labor Laws section and compiles data from two sources. The first source the WHD uses came from the Council of State Governments published work titled the Book of States 1968-1999 edition volume 32. This data set calculates the minimum wage for both state and federal government starting from the year 1968 till the year 1999. The second source which contained data starting from the year 2000 to the present was collected from the U.S. Department of Labor, Office of State Standards Programs Wage and Hour Division web site Minimum Wage and Overtime Pay Standards Applicable to Nonsupervisory NONFARM Private Sector Employment Under State and Federal Laws.[26]

[26] http://www.dol.gov/whd/state/stateMinWageHis.htm

This data set contained problems which need to be addressed order to utilized in my studies. First, some states adhere to minimum wage based off the number of employees in a company. Minimum wage laws in Arkansas, Illinois, Nebraska, and Virginia apply only to firms who hire four or more employees. Georgia and West Virginia contain similar minimum wage laws but they apply to firms who hire six or more employees. West Virginia takes its law one step further by stipulating it only applies to firms which hire six or more in one location. Also the minimum wage laws in Indiana and Vermont only apply to firms who hire more than two employees.

Overall these special characteristics could cause biases in the statistical analysis on unemployment, but if the bias does exist, it is likely minimal. According to the data compiled by the Census Bureau with help from the Small Business Administration (SBA) Office of Advocacy, while around half of all businesses in the 48 contiguous states contain around four to six workers, they only account for around ten percent of the total amount of employees in a state.[27] Because of this low percentage, I assume this discrepancy of minimum wage laws within states will not substantially bias my results.

The next problem involving minimum wage presents a much more complicated issue. Minnesota, Montana, Ohio, and Oklahoma all set two differing rates of minimum wage. The level of minimum wage the firm must comply with varies on the revenue of the company. Covering the time period January 1, 1991-January 1, 1997, Minnesota levied a minimum wage of $4.00 for businesses with less than $362,500 in annual receipts. Minnesota increased this rate

[27] http://archive.sba.gov/advo/research/data.html

to $4.90 for businesses with an increased amount of annual receipts, less than $500,000, covering the time frame January 1, 1998 - January 1, 2005. Montana levied a lower minimum wage of $4.00 for businesses who earned of gross annual sales of $110,000 or less covering the time period of January 1, 1992 - January 1, 2005. Ohio levied a lower minimum wage of $3.35 during the time period of January 1, 1991-January 1, 2005 for firms with gross annual sales from $150,000 to $500,000. They also levied another lower minimum wage of $2.50 for businesses that earned less than $150,000 in gross annual sales covering the time period of January 1, 1991-January 1, 2005. Oklahoma sets a lesser minimum wage for two distinct categories of businesses. They allow firms with less than 10 full-time employees at any one location and firms who earned less than $100,000 in annual gross sales to pay a minimum wage of $2.00. This covered the time period of January 1, 1991 - January 1, 2005.

In order to simplify the study, I will use the highest level of minimum wage for each of the four states that differentiate minimum wage on the basis of revenue, gross sales, annual sales, or receipts. I will use the following state minimum wage levels for Minnesota. For the years 1991 through 1997, 1998 through 2005, and 2006 through 2011 I will use $4.25, $5.15, and $6.15 respectively. Montana's state level minimum wage varies much more than Minnesota's. Montana changed its minimum wage level nine times since 1991. The first period containing differentiated minimum wages covered the years 1991 through 1996 ($4.25). The next eight changes occurred during the following time periods; 1997 ($4.75), 1998 through 2005 ($5.15), 2006 through 2007 ($6.15), 2008 ($6.25), 2010 ($6.90), 2011 ($7.35), and 2012 ($7.65). In contrast, Ohio only change its minimum wage twice under it's differentiate system which lasted from 1991 through 2005. In 1991 Ohio set the state minimum wage level at $3.80. Ohio changed the level in the next year to 4.25. This changed covered the years 1992 through 2005. Oklahoma used seven different state minimum wage levels during the years 1991 through 2012. The minimum wage levels list as follows; 1991 ($3.80), 1992 through 1996 (4.25), 1997 ($4.75), 1998 through 2007 ($5.15), 2008 ($5.85), 2009 ($6.55), 2010 through 2012 ($7.25).[28]

By using the highest of the stated state minimum wage, I am allowing for the possibility of bias in my estimate. By using the highest minimum wage as the states minimum wage I am overestimating the state's average minimum wage. I do not believe his problem regarding minimum wage data will significantly bias my estimates because this specific problem only occurs in four states.

Unemployment

Unemployment data was obtained from the Department of Labor's Bureau of Labor Statistics (BLS). The data currently encompasses the years 1991 through 2011. The data is separated by year and is offered in multiple formats; HTML, PDF, TXT. Each dataset contains the unemployment rate for all forty-eight contiguous states.[29] The data needed to be properly transferred to Stata via an Excel comma separated file (csv).

Unionization

All data pertaining to unions were found at unionstats.com. This website is the creation of Barry Hirsch from the Andrew Young School of Policy Studies in Georgia State University and David Macpherson from the Department of Economics in Trinity University. This collection of

[28] http://www.dol.gov/whd/state/stateMinWageHis.htm
[29] http://www.bls.gov/schedule/archives/all_nr.htm#SRGUNE

annually update datasets contains much information pertaining to unions. I am using the collection of data called, *State*: Union Membership, Coverage, Density, and Employment by State and Sector, 1983-2011. Each dataset contains an excel file corresponding to each year covered by the collection of data. Each data set contains estimations for the percent of people covered by unions (coverage) and the percent of workers who are members of a union (members). Both statistics are available for the three industries of concern in this project, construction, manufacturing, and public administration. These two statistics, coverage and members, are used in differing test as the measurement for overall unionization.[30]

One glaring problem exists in the dataset. Some of the samples contain a small amount of observations. The sample size for total unionization in the economy is over 1,000 observations for each state, but sample size decreases as I use the more specific unionization metrics (construction, manufacturing, and public administration). I will compensate this problem by using econometric methods to correct for a small sample size. The data needed to be formatted differently because each year contained its own excel page. After correctly formatting the data, no other problem appeared in the process of transferring the data to Stata.

Median Income

Data for state median income was obtained from the Census Department section on Income. This data calculates the median household income per state weighted by the 2011 CPI-U-RS.[31] This data presents a good tool to track wages over time, as wages are an important

[30] unionstats.com
[31] http://www.census.gov/hhes/www/income/data/statemedian/

component of income. Increased income should correspond to increase wages and vice versa. The dataset contained no issues and is easily transformed into Stata's format.

Chapter 3: Methods

Regression Model

Panel

The main panel of data used in this project is included in the model. The subscripts *s* and *y* represents states and years. The contiguous forty-eight U.S. states and the years 1991-2011 comprise the panel. Pantuosco used the forty-eight U.S. states in each of his projects. He also used 1978-1994, 1983-1996, and 1992-2005 as his time periods in each of his three projects respectively.[32] The unemployment rates for each states where found on the DOL website. I could only find data for the years 1991-2011. I decided to use a shorter panel because of the unemployment data. Being that the unemployment rate is my dependent variable, I determined that the total amount of years Include in the panel would be determined by the total amount of years of unemployment data I find.

Three types of regression equations were used in this analysis; panel model with no effects, panel model with fixed effects, simultaneous equation model with no effects, simultaneous equation model with fixed effects. Each presents various strengths and weaknesses which will be covered here. The equations will be presented first followed by a discussion of the regression method used in each test.

[32] Pantuosco, Lou, William Seyfried, "The Effect Of Public And Private Unions On State Economic Activity: Evaluating The Benefits To Organized Workers, Policymakers, And Companies," Journal of Business & Economics Research 6, no. 2 (2008): 27-39

Panel Regression

Equation 1- Panel Regression, No Fixed Effect

$$(1)\ UR_{sy} = \beta_0 + \beta_1 UNP_{sy} + \beta_2 UNM_{sy} + \beta_3 UNC_{sy} + \beta_4 LQP_{sy} + \beta_5 LQM_{sy} + \beta_6 LQC_{sy} + \beta_7 (UNP*LQP)_{sy} + \beta_8 (UNM*LQM)_{sy} + \beta_9 (UNC*LQC)_{sy} + \beta_{10} UR_{s(y-1)} + \beta_{11} POP_{sy} + \beta_{12} MIN_{sy} + \varepsilon$$

Equation 2 - Panel Regression, Fixed Effect

$$(2)\ UR_{sy} = \beta_0 + \beta_1 UNP_{sy} + \beta_2 UNM_{sy} + \beta_3 UNC_{sy} + \beta_4 LQP_{sy} + \beta_5 LQM_{sy} + \beta_6 LQC_{sy} + \beta_7 (UNP*LQP)_{sy} + \beta_8 (UNM*LQM)_{sy} + \beta_9 (UNC*LQC)_{sy} + \beta_{10} UR_{s(y-1)} + \beta_{11} POP_{sy} + \beta_{12} MIN_{sy} + \beta_{13} FE_y + \beta_{14} FE_s + \varepsilon$$

This test represents the most basic regression which will be conducted. This method test how each of the 11 exogenous variables affects the main dependant variable, state unemployment rates. This model encompasses equations 1 and 2. This model does not include wage because of concerns over endogeneity which will be discussed in the Econometric Issues section. These issues should bias the model leading to results poorer than the simultaneous equation regressions used in this project. Equations 1 and 2 should have the lowest and second lowest adjusted r-squared score respectively.

Simultaneous Equation Regression

Equation 3 - Simultaneous Equation Regression, No Fixed Effect

$$(3)\ UR_{sy} = \beta_0 + \beta_1 UNP_{sy} + \beta_2 UNM_{sy} + \beta_3 UNC_{sy} + \beta_4 LQP_{sy} + \beta_5 LQM_{sy} + \beta_6 LQC_{sy} + \beta_7 (UNP*LQP)_{sy} + \beta_8 (UNM*LQM)_{sy} + \beta_9 (UNC*LQC)_{sy} + \beta_{10} UR_{s(y-1)} + \beta_{11} POP_{sy} + \beta_{12} MIN_{sy}\ \beta_{13} WAGE_{sy} + \varepsilon$$

Equation 4- Simultaneous Equation Regression, Fixed Effect

$$(4)\ UR_{sy} = \beta_0 + \beta_1 UNP_{sy} + \beta_2 UNM_{sy} + \beta_3 UNC_{sy} + \beta_4 LQP_{sy} + \beta_5 LQM_{sy} + \beta_6 LQC_{sy} + \beta_7 (UNP*LQP)_{sy} + \beta_8 (UNM*LQM)_{sy} + \beta_9 (UNC*LQC)_{sy} + \beta_{10} UR_{s(y-1)} + \beta_{11} POP_{sy} + \beta_{12} MIN_{sy}\ \beta_{13} WAGE_{sy} + \beta_{14} FE_y + \beta_{15} FE_s + \varepsilon$$

Pantuosco uses simultaneous equation regression method in his works. He uses wage as his second endogenous variable.[33] Equations 3 and 4 list the first part of the simultaneous equation, unemployment with wage as an independent variable. Equations 5 and 6 describe the second equation of the simultaneous equation regression. Wage is the dependant variable of the second equation. Equation 3 should provide a higher adjusted r-square score than Equation 2 but Equation 4 should provide the highest adjusted r-squared score because of the inclusion if state and year fixed effects along the wage as an endogenous right-hand variable.

Equation 5 - Wage, No Effect

$$(5)\ W_{sy} = \beta_0 + \beta_1 UNPCI_{sy} + \beta_2 UNC_{sy} + \beta_3 UNM_{sy} + \beta_4 UNP_{sy} + \beta_5 UR_{sy} + \beta_6 POP_{sy} + \beta_7 MIN_{sy} + \varepsilon)$$

Equation 6 - Wage Fixed Effect

[33] Pantuosco, Lou, Darrell Parker, and Gary Stone, "The Effect of Unions on Labor Markets and Economic Growth: An Analysis of State Data," Journal of Labor Research XXII, no.1 (2001): 195-205

(6) $W_{sy} = \beta_0 + \beta_1 UNPCI_{sy} + \beta_2 UNC_{sy} + \beta_3 UNM_{sy} + \beta_4 UNP_{sy} + \beta_5 UR_{sy} + \beta_6 POP_{sy} + \beta_7 MIN_{sy} + \beta_8 FE_y + \beta_9 FE_s + \varepsilon$

Fixed Effects

Equations 2, 4, and 6 utilize the fixed effect model. All three equations include a dummy variable for each state and year. This allows differences between states to be taken into account and to factor in differences over time. State fixed effects are included to control for differences between states, like ideology. Time fixed effects are included to control for differences overtime like business cycles. Equation 2 is modeled by itself in the panel regression with fixed effect but equations 4 and 6 are modeled together in the simultaneous equation regression with fixed effects. The equations with fixed effects are expected to produce better estimates because it takes into account differences in state characteristics and differences over time.

Econometric Issues

This project uses various methods to address various econometric issues. Pantuosco (2001) noted three important econometric issues that must be addressed in order to conduct this research. These issues include heteroskedasticity, autocorrelation, and multicollinearity.[34] This project attempts to account for all three econometric issues,

Heteroskedasticity

Heteroskedasticity refers to the event where over time the error term is not constant. This leads to bias in statistics recording the variance of the regression. This paper uses the simultaneous equation regression to control for heteroskedasticity is the use of simultaneous

[34] Pantuosco, Lou, Darrell Parker, and Gary Stone, "The Effect of Unions on Labor Markets and Economic Growth: An Analysis of State Data," Journal of Labor Research XXII, no.1 (2001): 195-205

equation regressions. According to Pantuosco (2001) this represents a useful tool to account for heteroskedasticity.

Autocorrelation

Autocorrelation refers to the degree a variable is correlated with itself. Pantuosco suggest this issue may arise with respect to state unemployment rates. Pantuosco suggest in his paper that state unemployment rates may suffer from hysteresis. In order to test whether state unemployment rates change slowly over time and suffer from autocorrelation, a lagged state unemployment term is added to the model. This term will show the level of hysteresis and autocorrelation that plagues the state level unemployment rate.

Multicollinearity

Multicollinearity presented a challenging issue to this project. While trying to incorporate the suggestions by Allegretto (2011) this issue presented itself. Allegretto's research suggested the need to include state-linear trends and division specific time trends.[35] When running regression analysis with these specifications multicollinearity biased the results. Stata decided to drop random observations to correct the multicollinearity issues. Due to the econometric setback this methods will not be included in the project. Although both state specific linear trend and and division specific time division cannot be included in the same model, they can both be added separately. Including one or the other does not create the multicollinearity mentioned before.

[35] Allegretto, Sylvia A., Arindrajit Dube, Michael, "Do Minimum Wages Really Reduce Teen Employment? Accounting for Heterogeneity and Selectivity in State Panel Data," Industrial Relations 50, no. 2 (2011): 205-240

Simultaneous equation regression will be utilized instead. According to Pantuosco (2001), this method will manage the multicollinearity issues.[36]

Endogeniety

Endogeniety presents itself as a difficult issue to reconcile. Wage is endogenous to unemployment. This discourages me from including wage in the base model. In order to ascertain how wage affects unemployment, I need to account for endogeniety. In order to accomplish this, I will use simultaneous equation regression, the same method used in Pantuosco's three studies. As mentioned before, I estimated a second equation for wage (Equations 5 and 6) which will be paired together with the unemployment equation (Equations 3 and 4) in the simultaneous equation regressions.

Predictions

The hypothesis of this paper reads as follows: increases in each of the three interaction variables will lead to decreases in the unemployment rate. I also make predictions for the other variables. UNP, UNM, UNC, LQP, LQM, LQC, and MIN are expected to exhibit a positive relationship with the unemployment rate while all three interaction terms, POP, W, and lagged UR are expected to exhibit a negative relationship with the unemployment rate.

Alternate Panels

After the tests are run on Equations 1 through 4, I will decide which equation best models the effects of unionization on unemployment. This equation will still need to undergo further test

[36] Pantuosco, Lou, Darrell Parker, and Gary Stone, "The Effect of Unions on Labor Markets and Economic Growth: An Analysis of State Data," Journal of Labor Research XXII, no.1 (2001): 195-205

to make sure the results are robust. I will apply the following test to the equation which best models how unionization affects unemployment.

Clustered Standard Errors

The error term needs to be altered in order to fully test my results. The most pressing concerns regarding the error term includes the effects of having states in the panel. When states are included in the panel, the error term may cluster around each state. Unless I use clustered standard errors, the results may be biased.

Right to Work

Although the subscript *s* takes into account differences between states, there is one difference in particular that needs to be tested. Some states, mostly southern, have passed right to work laws. These laws make it harder to form and manage a union within a state. The presence of right to work laws could be skewing the results which is why I will run regressions on my best equation using two panels; first, a panel defined by having right to work laws and second, a panel defined by states not having right to work laws.

NAFTA

In 1997, The United States signed the North American Free Trade Agreement (NAFTA). NAFTA changed the U.S. economy and placed pressures on construction and manufacturing workers In order to determine how the ratification of NAFTA also affected unemployment, I will run my best regression equation on two more panels. The first panel will contain the years 1991-1997. The second panel will contain the years 1997-2011. This should help ascertain the role NAFTA played in altering state level unemployment.

Chapter 4: Results

Regression Equations

Table 1

This following section refers to the results in Table 1. This regression equation models unionization as a function of a host of independent variables. This table shows the results of Equation 1, panel regression without state or year fixed effects. As I begin to describe the data, statistical significance will be given to variables which are significant at the 95% confidence interval. The results from the regression on Equation 1 will be discussed first. Seven out of the twelve variables test significant at the 95% confidence interval. Public sector unionization and the interaction effect test positive at the 92% and 88% confidence interval respectively. The construction variables tested out to be the least significant with all 3 construction variables having p-values of .142, .571, and .462. The overall model test reasonably well with an adjusted r-squared of .7126. Of the variables which tested significant or close to significant, location quotients and unionization levels for manufacturing and public sector, minimum wage, population, and lagged unemployment correlated with an increase in the state unemployment level. The interaction effects for manufacturing and public sector are both correlated with lower unemployment.

Table 2

The second table describes the results of the regression analysis of Equation 2 which uses panel regression with state and year fixed effects. This estimation technique produces differing results as compared the estimating technique of Equation 1. The first thing I noticed is the p-values of the terms associated with the construction industry. This regression recorded much smaller p-values for the construction variables with no variable recording a high p-value than .373. Minimum wage represents another surprising result regarding p-values. Minimum Wage has a p-value of 0 and t score of 15.23 for Table 1, but only exhibits a p-value of .604 and t score of -.052 for Table 2. As compared to Table 1, Table 2 showcases seven independent variables which test significant at the 95% confidence interval. Minimum wage lost its statistical significance in Table 2 while the interaction term for manufacturing became significant in Table 2. The introduction of state and year fixed effects significantly altered the minimum wage statistics. The overall model seems to have improved in accuracy. The adjusted r-squared term of .8806 is around fifteen percentage points higher than the adjusted r-squared term for Table 1.

Table 3

This next section lists the results of Equation 3, a simultaneous equation regression with no state or year fixed effects. The most surprising result of the regression is the incredibly high p-value, .923, of the construction unionization variable. The other two construction variables also recorded high p-values, .302 and .555. This suggests that the introduction of the wage, the other endogenous variable, affects the significance of the construction variables. Wage proves to significantly affect state unemployment rates. All three public sector variables, population, minimum wage, and lagged unemployment recorded statistically significant p-values.

Incidentally, the there is no difference in the directional change of all of the exogenous variables (not including wage due to its absence from Table 1) when comparing Table 1 to Table 3. Without using fixed effects, the simultaneous equation regression resulted in no change in the signs of the coefficients of the exogenous variables. Also the adjusted-square score of Table 3 (.7189) is incredibly close to the adjusted r-squared score of Table 1 (.7161). The second equation included only one variable with a p-value of greater than zero, population.

Table 4

In this section, the results of Equation 4, the simultaneous equation regression with fixed effects, will be discussed. The results present a contradiction. The adjusted r-squared score of .8506 lies three percentage points under the adjusted r-squared score of Table 2 (.8806). With using the fixed effects model, adding in the simultaneous equation regression results in a model with a similar fit to Table 2. In other words, adding in the simultaneous equation regression should produce similar outcomes to Table 2. This notion may be challenged by viewing the p-values of the exogenous variables. For the main equation being estimated in both Table 2 and 4, there is a difference in the amount of statistically significant variables. Table 2 list seven statistically significant exogenous variables while Table 4 produces only four statistically significant exogenous variables not including wage.

Chapter 5: Conclusion

The following analysis concerns Figures 1-4 located in the appendix. These are the four main regression equations which will be estimated. The rest of the figures located in the appendix will be discussed in the conclusion. After the robustness checks section follows the discussion of Figures 1-4. The final section will discuss Equation 2, the equation I believe best explains how unionization affects unemployment.

Explanatory Variables

Unionization

There appears to be mixed results for determining the effects of unionization on state level unemployment. No unionization statistic tested significant for all four equations. UNM tested significant in Figures 1, 2 and 4 while UNP tested significant in Figure 3, and UNC tested insignificant for all four equations. This sheds light on the reliability of each statistic. On average, manufacturing unionization presents itself as a reliable predictor of unemployment. Unionization is also correlated with higher unemployment on average. The unionization variables which contradicted this statement all contained insignificant p-values with the lowest p-value being UNC on Figure 4 which displayed a p-value of .18.

Location Quotient

The location quotient variables also exhibited mixed results. Most of the location quotient variables were correlated with higher unemployment. The only exceptions occur for LQC on Figures 2 and 4. One can suspect the introduction of fixed effects may have contributed to this directional change. It is interesting to note that LQC in both Figures 2 and 4 exhibit p-values of 0. The LQM significant p-values turned insignificant when modeled in the simultaneous equation regression. In the Panel Regression LQM contained a p-value of less than .02, but in the simultaneous equation regression, the value raised to above .15. LQP contained a significant p-value for Figures 1, 2, and 3 but turned insignificant in Figure 4. Figure 4 should be the most robust model so I am not sure why LQP suddenly became insignificant.

Interaction

All of the coefficients of the interaction variables trend upward with respect to unemployment for all observations except for two. In both exceptions, the variable proved insignificant. None of the interaction variables proved to be significant at the 95% level. Only one, interaction for manufacturing on Figure 2, proved significant. Not much information can be gathered form the interaction variable.

Alternate Panels

Right to Work

In order to test the effects of right to work laws on Equation 2, I created two new panels. The first panel contained states which have passed Right to Work laws. The second panel contains states that have not passed such laws. Figure 17 reports the results of the regression equation on states that have passed right to work laws, while figure 18 reports the results of the regression equation on states that have not passed right to work laws. Population and minimum wage performed incredibly similarly in both regressions. Both variables reported similar p-values and reported the same sign change in both figures. Of the interaction variables, only manufacturing proved significant in Figure 18, while none proved significant in Figure 17. No information can be ascertained from the interaction variable from these two figures. Both figures contained two location quotient variables which proved significant. LQC and LQP proved significant in Figure 17 while LQM and LQP proved significant in figure 18. Interestingly LQP proved significant in both figures while producing differing sign changes. All three unionization variables proved insignificant for Figure 17 while two (UNM and UNP) proved significant in Figure 18. Unionization variables proved more significant in states without right to work laws.

NAFTA

In this next section, I created two new panels where the first panel encompasses the years 1991-1997 while the second covers 1998-2011. This is done to account for the passage of NAFTA and how it affected the regression equation. Regarding the interaction variable, all interactions proved insignificant in both panels. LQC proved significant in both panels while LQM proved significant in none and LQP proved significant for post 1998. UNM proved significant in both while UNP proved significant for post 1998 and UNC proved significant in neither. Overall I do not believe much information can be ascertained about the effects of NAFTA on my regression equation.

Final Thoughts

Equation 2

After review the results of each test, I come to the conclusion that Equation 2 represents the best model representing how unionization affects unemployment at the state level. This test recorded the highest adjusted r-squared score for the four main equations. LQC, LQM, LQP, POP, and UNM tested significant while LQC earned the distinction of being the only significant variable correlated with decreasing unemployment rates. The results of Equation 2 suggest to policy makers that they make sure their respective economies do not concentrate too heavily on manufacturing and public administration. Increasing concentration of construction jobs is correlated with decreased unemployment rates. Concerning unionization, all that can be stated is that increasing the unionization rate of manufacturing jobs will lead to increased unemployment. It is noticeable that the interaction variable for manufacturing tested significant at the 93% confidence interval while the rest of the interaction variables proved to be very insignificant.

Further Research Questions

I can only guess from the results of the four tables that non-linear relationships may exist between my variables. More research needs to be conducted on how the interaction between unionization and industrial concentration affects unemployment. Also, researchers should still look into using state linear trends and division specific time trends. Other researchers may be able to handle the issue of multicollinearity which arises from using these methods.

Appendix

Figure 1- Panel Regression, No Fixed Effect

Source	SS	df	MS
Model	2590.63499	12	215.886249
Residual	1027.19685	994	1.03339723
Total	3617.83184	1006	3.59625431

Number of obs	=	1007
F(12, 994)	=	208.91
Prob > F	=	0.0000
R-squared	=	0.7161
Adj R-squared	=	0.7126
Root MSE	=	1.0166

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LQC	.0048392	.003294	1.47	0.142	-.0016248	.0113032
LQM	.0046667	.0018681	2.50	0.013	.0010008	.0083325
LQP	.00881	.0038087	2.31	0.021	.0013359	.016284
UNC	-1.014152	1.790625	-0.57	0.571	-4.527992	2.499687
UNM	3.495897	1.453533	2.41	0.016	.6435511	6.348243
UNP	2.181574	1.244645	1.75	0.080	-.2608594	4.624008
I_C	.0118991	.01618	0.74	0.462	-.0198519	.04365
I_M	-.0181112	.0113638	-1.59	0.111	-.0404109	.0041885
I_P	-.0246115	.0121495	-2.03	0.043	-.0484531	-.0007698
POP_MIL	.0256153	.005743	4.46	0.000	.0143454	.0368852
MIN	.4929646	.0323639	15.23	0.000	.4294551	.5564741
lag_UR	.7363401	.0177372	41.51	0.000	.7015335	.7711468
_cons	-3.408225	.6663468	-5.11	0.000	-4.715833	-2.100617

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	-.0049077	.0064695	-0.76	0.448	-.0176032	.0077878

```
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0163142	.012302	1.33	0.185	-.0078267	.0404551

```
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0192196	.0186896	1.03	0.304	-.0174559	.0558951

Figure 2 - Panel Regression, Fixed Effect

Source	SS	df	MS
Model	3219.62971	79	40.7548065
Residual	398.202126	927	.429560006
Total	3617.83184	1006	3.59625431

Number of obs	=	1007
F(79, 927)	=	94.88
Prob > F	=	0.0000
R-squared	=	0.8899
Adj R-squared	=	0.8806
Root MSE	=	.65541

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LQC	-.0147413	.0034523	-4.27	0.000	-.0215164	-.0079662
LQM	.0063779	.0023876	2.67	0.008	.0016922	.0110636
LQP	.0145586	.006641	2.19	0.029	.0015254	.0275917
UNC	-1.707444	1.790088	-0.95	0.340	-5.220539	1.805652
UNM	7.473559	1.616635	4.62	0.000	4.300869	10.64625
UNP	2.841626	2.449851	1.16	0.246	-1.966272	7.649523
I_C	.0139877	.0156953	0.89	0.373	-.0168147	.0447902
I_M	-.055317	.0131884	-4.19	0.000	-.0811995	-.0294345
I_P	-.0332965	.0225452	-1.48	0.140	-.0775421	.0109491
POP_MIL	.1119232	.0416286	2.69	0.007	.0302261	.1936204
MIN	-.0329994	.063629	-0.52	0.604	-.1578729	.0918742
lag_UR	.5055293	.0240988	20.98	0.000	.4582348	.5528238

_nl_1: _b[LQC]*_b[UNC]

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0251699	.0306355	0.82	0.412	-.0349531	.085293

.
. nlcom _b[LQM]*_b[UNM]

_nl_1: _b[LQM]*_b[UNM]

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0476656	.0253988	1.88	0.061	-.0021802	.0975114

.
. nlcom _b[LQP]*_b[UNP]

_nl_1: _b[LQP]*_b[UNP]

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.04137	.0509718	0.81	0.417	-.0586636	.1414036

Figure 3- Simultaneous Equation Regression, No Fixed Effect

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
UR	1007	13	1.005503	0.7186	2598.99	0.0000
WAGE	1007	6	5018.73	0.5923	1450.80	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
UR						
LQC	.0031101	.0030414	1.02	0.307	-.002851	.0090713
LQM	.0024525	.0017212	1.42	0.154	-.000921	.0058261
LQP	.0095319	.003497	2.73	0.006	.0026779	.0163859
UNC	-.1614106	1.644527	-0.10	0.922	-3.384624	3.061802
UNM	1.639198	1.339251	1.22	0.221	-.985687	4.264082
UNP	4.459279	1.319453	3.38	0.001	1.873199	7.04536
I_C	.0087269	.0147437	0.59	0.554	-.0201703	.0376241
I_M	-.0134071	.0103203	-1.30	0.194	-.0336345	.0068203
I_P	-.0356907	.0119529	-2.99	0.003	-.0591179	-.0122635
POP_MIL	.0273744	.0052266	5.24	0.000	.0171303	.0376184
MIN	.5549323	.0349514	15.88	0.000	.4864289	.6234358
WAGE	-.0000649	.000012	-5.41	0.000	-.0000884	-.0000414
lag_UR	.6506446	.0240012	27.11	0.000	.6036032	.6976861
_cons	.098011	.7787904	0.13	0.900	-1.42839	1.624412
WAGE						
PCI	.6593677	.0385504	17.10	0.000	.5838102	.7349252
MIN	-2266.569	295.8986	-7.66	0.000	-2846.519	-1686.618
UNC	7186.754	2268.434	3.17	0.002	2740.705	11632.8
UNM	-13908.68	2808.98	-4.95	0.000	-19414.18	-8403.185
UNP	16583.94	1262.117	13.14	0.000	14110.24	19057.65
UR	-1057.263	122.4521	-8.63	0.000	-1297.265	-817.2617
_cons	45177.16	945.6469	47.77	0.000	43323.72	47030.59

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	-.000502	.00475	-0.11	0.916	-.0098118	.0088078

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0040202	.0056228	0.71	0.475	-.0070002	.0150407

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0425052	.0268885	1.58	0.114	-.0101953	.0952058

Figure 4 - Simultaneous Equation Regression, Fixed Effect

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
UR	1007	80	.7315454	0.8510	5116.51	0.0000
WAGE	1007	73	2216.955	0.9204	11685.36	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
UR						
LQC	-.0109208	.0024825	-4.40	0.000	-.0157864	-.0060552
LQM	.0025181	.0019261	1.31	0.191	-.0012569	.0062931
LQP	.0041608	.0058738	0.71	0.479	-.0073517	.0156732
UNC	-1.848612	1.38539	-1.33	0.182	-4.563927	.8667037
UNM	4.728923	1.398763	3.38	0.001	1.987398	7.470449
UNP	1.341765	1.858877	0.72	0.470	-2.301567	4.985098
I_C	.0171885	.0109059	1.58	0.115	-.0041866	.0385636
I_M	-.0223044	.0097337	-2.29	0.022	-.0413821	-.0032268
I_P	-.0097206	.0156929	-0.62	0.536	-.040478	.0210368
POP_MIL	.08168	.0326257	2.50	0.012	.0177348	.1456252
MIN	-.0374921	.0765208	-0.49	0.624	-.1874701	.1124858
lag_UR	.3804464	.0417192	9.12	0.000	.2986782	.4622147
WAGE	-.0002039	.0000469	-4.35	0.000	-.0002958	-.000112

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0201883	.0182143	1.11	0.268	-.015511	.0558877

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.011908	.0112185	1.06	0.288	-.0100798	.0338958

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0055828	.0134882	0.41	0.679	-.0208537	.0320192

.

Figure 5 – Panel Regression, Population Rate of Change, No Fixed Effects

Source	SS	df	MS
Model	2570.94918	12	214.245765
Residual	1046.88266	994	1.05320187
Total	3617.83184	1006	3.59625431

Number of obs	=	1007
F(12, 994)	=	203.42
Prob > F	=	0.0000
R-squared	=	0.7106
Adj R-squared	=	0.7071
Root MSE	=	1.0263

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LQC	.0061012	.0034313	1.78	0.076	-.0006322	.0128346
LQM	.0039472	.0018789	2.10	0.036	.0002602	.0076342
LQP	.0071181	.0038595	1.84	0.065	-.0004556	.0146919
UNC	1.243319	1.745837	0.71	0.477	-2.182629	4.669268
UNM	2.955603	1.463859	2.02	0.044	.0829949	5.828211
UNP	2.023683	1.258084	1.61	0.108	-.4451217	4.492488
I_C	-.0077541	.0158269	-0.49	0.624	-.038812	.0233038
I_M	-.0145984	.0114658	-1.27	0.203	-.0370984	.0079017
I_P	-.0225958	.0122635	-1.84	0.066	-.0466611	.0014695
POP_ROC	.0479386	.052679	0.91	0.363	-.0554362	.1513133
MIN	.5028436	.03471	14.49	0.000	.4347303	.5709568
lag_UR	.751677	.0175558	42.82	0.000	.7172263	.7861277
_cons	-3.356749	.6810742	-4.93	0.000	-4.693257	-2.02024

```
.
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0075857	.0140055	0.54	0.588	-.0198981	.0350695

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0116663	.0104576	1.12	0.265	-.0088552	.0321878

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0144048	.0162511	0.89	0.376	-.0174855	.0462952

Figure 6 – Panel Regression, Population Rate of Change, No Lagged Unemployment, No Fixed Effects

Source	SS	df	MS
Model	637.436416	11	57.9487651
Residual	2983.41595	996	2.99539754
Total	3620.85236	1007	3.59568258

Number of obs =	1008
F(11, 996) =	19.35
Prob > F =	0.0000
R-squared =	0.1760
Adj R-squared =	0.1669
Root MSE =	1.7307

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LQC	.012886	.0057796	2.23	0.026	.0015443	.0242276
LQM	.0135246	.0031458	4.30	0.000	.0073514	.0196978
LQP	.0175294	.0064944	2.70	0.007	.0047851	.0302737
UNC	2.715468	2.943373	0.92	0.356	-3.060455	8.491392
UNM	11.35108	2.446513	4.64	0.000	6.550172	16.152
UNP	5.607229	2.11694	2.65	0.008	1.453055	9.761404
I_C	-.0227287	.0266837	-0.85	0.395	-.0750914	.029634
I_M	-.0620255	.0192415	-3.22	0.001	-.099784	-.0242671
I_P	-.054645	.020643	-2.65	0.008	-.0951538	-.0141363
POP_ROC	.0952396	.0888012	1.07	0.284	-.0790193	.2694986
MIN	.7271841	.0578474	12.57	0.000	.6136673	.8407009
_cons	-3.787507	1.148457	-3.30	0.001	-6.041181	-1.533834

```
.
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0349914	.0502953	0.70	0.487	-.0637054	.1336883

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.153519	.0634105	2.42	0.016	.0290854	.2779525

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0982913	.0712489	1.38	0.168	-.0415238	.2381065

Figure 7 - Panel Regression, No Lagged Unemployment, No Fixed Effects

Source	SS	df	MS
Model	807.335668	11	73.3941517
Residual	2813.51669	996	2.82481596
Total	3620.85236	1007	3.59568258

Number of obs	=	1008
F(11, 996)	=	25.98
Prob > F	=	0.0000
R-squared	=	0.2230
Adj R-squared	=	0.2144
Root MSE	=	1.6807

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LQC	.0080811	.0054442	1.48	0.138	-.0026023	.0187645
LQM	.0150118	.0030608	4.90	0.000	.0090055	.021018
LQP	.0222486	.0062733	3.55	0.000	.0099383	.034559
UNC	-3.693127	2.958255	-1.25	0.212	-9.498255	2.112002
UNM	12.48203	2.376426	5.25	0.000	7.818656	17.14541
UNP	5.916205	2.052415	2.88	0.004	1.888651	9.943758
I_C	.0331133	.0267366	1.24	0.216	-.0193533	.0855798
I_M	-.0687711	.0186754	-3.68	0.000	-.1054188	-.0321234
I_P	-.0589484	.0200406	-2.94	0.003	-.0982751	-.0196217
POP_MIL	.0729077	.0093071	7.83	0.000	.054644	.0911715
MIN	.6956836	.052864	13.16	0.000	.591946	.7994211
_cons	-4.002362	1.101442	-3.63	0.000	-6.163776	-1.840948

```
.
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	-.0298446	.0154014	-1.94	0.053	-.0600676	.0003783

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.1873773	.0681526	2.75	0.006	.0536381	.3211164

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.1316274	.0802314	1.64	0.101	-.0258145	.2890693

Figure 8 - Panel Regression, Population Rate of Change, Fixed Effects

Source	SS	df	MS
Model	3234.15234	79	40.9386372
Residual	383.679496	927	.413893739
Total	3617.83184	1006	3.59625431

Number of obs =	1007
F(79, 927) =	98.91
Prob > F =	0.0000
R-squared =	0.8939
Adj R-squared =	0.8849
Root MSE =	.64335

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LQC	-.0107456	.0033635	-3.19	0.001	-.0173465	-.0041446
LQM	.0079848	.0023524	3.39	0.001	.0033681	.0126014
LQP	.0114795	.0065237	1.76	0.079	-.0013234	.0242823
UNC	-1.70604	1.751138	-0.97	0.330	-5.142695	1.730615
UNM	8.61228	1.582415	5.44	0.000	5.506748	11.71781
UNP	2.77262	2.399844	1.16	0.248	-1.937138	7.482377
I_C	.0132562	.015339	0.86	0.388	-.0168469	.0433594
I_M	-.0679958	.013074	-5.20	0.000	-.093654	-.0423377
I_P	-.0311699	.0221208	-1.41	0.159	-.0745826	.0122427
POP_ROC	-.3281168	.0502776	-6.53	0.000	-.4267879	-.2294458
MIN	-.0757514	.0628444	-1.21	0.228	-.1990853	.0475824

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0183324	.0229868	0.80	0.425	-.0267797	.0634445

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.068767	.0296317	2.32	0.021	.0106139	.12692

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0318283	.0425435	0.75	0.455	-.0516646	.1153211

Figure 9 - Panel Regression, Population Rate of Change, No Lagged Unemployment, Fixed Effects

Source	SS	df	MS
Model	3096.42933	78	39.6978119
Residual	524.423031	929	.564502725
Total	3620.85236	1007	3.59568258

Number of obs =	1008
F(78, 929) =	70.32
Prob > F =	0.0000
R-squared =	0.8552
Adj R-squared =	0.8430
Root MSE =	.75133

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LQC	-.0225444	.0038555	-5.85	0.000	-.0301108	-.014978
LQM	.0143735	.0027148	5.29	0.000	.0090456	.0197013
LQP	.0245872	.0075687	3.25	0.001	.0097334	.0394411
UNC	-4.710769	2.036202	-2.31	0.021	-8.706857	-.7146809
UNM	13.84777	1.817668	7.62	0.000	10.28056	17.41498
UNP	4.387066	2.800422	1.57	0.118	-1.108821	9.882953
I_C	.0365441	.0178528	2.05	0.041	.0015076	.0715807
I_M	-.1185566	.0149106	-7.95	0.000	-.147819	-.0892943
I_P	-.0572438	.0257651	-2.22	0.027	-.1078083	-.0066794
POP_ROC	-.6370344	.0553072	-11.52	0.000	-.7455759	-.528493
MIN	-.1734056	.0731047	-2.37	0.018	-.316875	-.0299361

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.1062014	.0593636	1.79	0.074	-.0103009	.2227037

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.1990405	.0570648	3.49	0.001	.0870495	.3110314

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.1078659	.0957514	1.13	0.260	-.0800482	.2957799

Figure 10 - Panel Regression, No Lagged Unemployment, Fixed Effects

Source	SS	df	MS
Model	3033.51715	78	38.8912455
Residual	587.335217	929	.632223054
Total	3620.85236	1007	3.59568258

Number of obs	=	1008
F(78, 929)	=	61.52
Prob > F	=	0.0000
R-squared	=	0.8378
Adj R-squared	=	0.8242
Root MSE	=	.79512

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LQC	-.0333892	.004046	-8.25	0.000	-.0413295	-.0254488
LQM	.0124271	.0028733	4.33	0.000	.0067882	.018066
LQP	.0338128	.0079745	4.24	0.000	.0181626	.0494629
UNC	-5.286974	2.16179	-2.45	0.015	-9.529532	-1.044415
UNM	12.65951	1.937949	6.53	0.000	8.856245	16.46278
UNP	4.963446	2.969242	1.67	0.095	-.8637539	10.79065
I_C	.0423674	.0189699	2.23	0.026	.0051385	.0795963
I_M	-.1029443	.0157474	-6.54	0.000	-.133849	-.0720397
I_P	-.0676097	.0272631	-2.48	0.013	-.1211141	-.0141052
POP_MIL	.2181762	.050123	4.35	0.000	.1198088	.3165436
MIN	-.1009498	.0770779	-1.31	0.191	-.2522167	.0503172

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.1765276	.0879201	2.01	0.045	.0039826	.3490726

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.1573212	.0542182	2.90	0.004	.0509168	.2637256

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.1678278	.1318621	1.27	0.203	-.0909543	.42661

Figure 11 - Simultaneous Equation Regression, Population Rate of Change, No Fixed Effect

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
UR	1007	13	1.009764	0.7162	2571.77	0.0000
WAGE	1007	6	5017.601	0.5925	1448.12	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
UR						
LQC	.0054339	.0031737	1.71	0.087	-.0007865	.0116543
LQM	.0019249	.0017587	1.09	0.274	-.0015221	.0053719
LQP	.0073914	.0036255	2.04	0.041	.0002856	.0144972
UNC	2.077452	1.632247	1.27	0.203	-1.121693	5.276598
UNM	1.247763	1.362788	0.92	0.360	-1.423252	3.918778
UNP	4.085162	1.357731	3.01	0.003	1.424059	6.746265
I_C	-.0112882	.014701	-0.77	0.443	-.0401017	.0175252
I_M	-.0107887	.0105689	-1.02	0.307	-.0315034	.0099259
I_P	-.0328422	.0122782	-2.67	0.007	-.0569069	-.0087775
POP_ROC	.0177467	.0511339	0.35	0.729	-.0824738	.1179672
MIN	.5524718	.0381578	14.48	0.000	.4776839	.6272597
WAGE	-.0000585	.0000119	-4.91	0.000	-.0000818	-.0000351
lag_UR	.6761011	.0238721	28.32	0.000	.6293126	.7228896
_cons	-.1641524	.7740138	-0.21	0.832	-1.681192	1.352887
WAGE						
PCI	.6615375	.0385993	17.14	0.000	.5858842	.7371908
MIN	-2288.966	296.6307	-7.72	0.000	-2870.351	-1707.58
UNC	7159.708	2268.076	3.16	0.002	2714.361	11605.06
UNM	-13918.76	2808.365	-4.96	0.000	-19423.06	-8414.471
UNP	16572.54	1261.882	13.13	0.000	14099.3	19045.79
UR	-1041.44	123.3853	-8.44	0.000	-1283.27	-799.6089
_cons	45154.82	945.6829	47.75	0.000	43301.32	47008.33

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0112886	.014319	0.79	0.430	-.0167762	.0393533

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0024018	.0044323	0.54	0.588	-.0062854	.0110891

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.030195	.0238455	1.27	0.205	-.0165413	.0769313

Figure 12 - Simultaneous Equation Regression, Population Rate of Change, No Lagged Unemployment, and No Fixed Effect

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
UR	1008	12	1.584453	0.3011	417.46	0.0000
WAGE	1008	6	6000.261	0.4180	970.00	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
UR						
LQC	.014902	.0052933	2.82	0.005	.0045272	.0252767
LQM	.0049961	.0029562	1.69	0.091	-.000798	.0107901
LQP	.0254218	.0059773	4.25	0.000	.0137066	.0371371
UNC	5.933397	2.706226	2.19	0.028	.6292927	11.2375
UNM	7.723091	2.257516	3.42	0.001	3.29844	12.14774
UNP	15.8453	2.096789	7.56	0.000	11.73567	19.95493
I_C	-.0482329	.0245089	-1.97	0.049	-.0962694	-.0001964
I_M	-.0487762	.0176453	-2.76	0.006	-.0833603	-.0141921
I_P	-.1231437	.0196417	-6.27	0.000	-.1616408	-.0846466
POP_ROC	.32951	.0833584	3.95	0.000	.1661306	.4928894
MIN	.9344225	.0553902	16.87	0.000	.8258596	1.042985
WAGE	-.0001897	.0000148	-12.79	0.000	-.0002187	-.0001606
_cons	3.482884	1.194986	2.91	0.004	1.140754	5.825014
WAGE						
PCI	.9567636	.0899994	10.63	0.000	.7803679	1.133159
MIN	-5328.384	871.3882	-6.11	0.000	-7036.274	-3620.495
UNC	3574.076	2870.836	1.24	0.213	-2052.658	9200.81
UNM	-15453.17	3377.822	-4.57	0.000	-22073.58	-8832.758
UNP	15022.89	1562.583	9.61	0.000	11960.28	18085.49
UR	1107.74	581.712	1.90	0.057	-32.39422	2247.875
_cons	42095.24	1384.7	30.40	0.000	39381.28	44809.2

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0884193	.0663981	1.33	0.183	-.0417185	.2185571

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.038585	.0317931	1.21	0.225	-.0237283	.1008983

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.4028165	.1426911	2.82	0.005	.1231471	.6824859

.

Figure 13 - Simultaneous Equation Regression, No Lagged Unemployment, and No Fixed Effect

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
UR	1008	12	1.575856	0.3087	511.96	0.0000
WAGE	1008	6	5064.172	0.5854	1359.21	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
UR						
LQC	.0077826	.0045439	1.71	0.087	-.0011232	.0166884
LQM	.0059097	.0026112	2.26	0.024	.0007919	.0110275
LQP	.0245903	.0053051	4.64	0.000	.0141924	.0349882
UNC	-.3765612	2.483149	-0.15	0.879	-5.243444	4.490321
UNM	6.231421	2.060169	3.02	0.002	2.193563	10.26928
UNP	14.04382	1.904125	7.38	0.000	10.31181	17.77584
I_C	.0123999	.0221689	0.56	0.576	-.0310502	.0558501
I_M	-.0493243	.01559	-3.16	0.002	-.0798801	-.0187686
I_P	-.1068894	.0178114	-6.00	0.000	-.1417991	-.0719798
POP_MIL	.0671958	.008394	8.01	0.000	.050744	.0836477
MIN	.8320254	.0506274	16.43	0.000	.7327975	.9312533
WAGE	-.0001942	.0000146	-13.31	0.000	-.0002228	-.0001656
_cons	5.245863	1.104689	4.75	0.000	3.080712	7.411013
WAGE						
PCI	.7403103	.0533606	13.87	0.000	.6357253	.8448952
MIN	-3098.297	480.2827	-6.45	0.000	-4039.633	-2156.96
UNC	6222.759	2330.913	2.67	0.008	1654.254	10791.26
UNM	-14362.36	2837.808	-5.06	0.000	-19924.36	-8800.36
UNP	16159.38	1287.901	12.55	0.000	13635.14	18683.62
UR	-468.7849	293.2814	-1.60	0.110	-1043.606	106.0362
_cons	44334.04	1026.238	43.20	0.000	42322.65	46345.43

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	-.0029306	.0180635	-0.16	0.871	-.0383345	.0324732

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0368259	.0262591	1.40	0.161	-.014641	.0882929

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.3453419	.1164598	2.97	0.003	.1170848	.573599

Figure 14 - Simultaneous Equation Regression, Population Rate of Change, Fixed Effect

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
UR	1007	80	.6892658	0.8678	6352.75	0.0000
WAGE	1007	73	2210.029	0.9209	11754.78	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
UR						
LQC	-.0092978	.0025986	-3.58	0.000	-.0143911	-.0042045
LQM	.0039411	.002106	1.87	0.061	-.0001866	.0080687
LQP	.0029955	.0061288	0.49	0.625	-.0090169	.0150078
UNC	-1.819986	1.42603	-1.28	0.202	-4.614954	.9749814
UNM	5.958127	1.40838	4.23	0.000	3.197752	8.718502
UNP	1.674159	1.927203	0.87	0.385	-2.103089	5.451408
I_C	.0162466	.0117727	1.38	0.168	-.0068276	.0393207
I_M	-.0355502	.0108296	-3.28	0.001	-.0567759	-.0143246
I_P	-.0128275	.0170334	-0.75	0.451	-.0462124	.0205574
POP_ROC	-.1930272	.040843	-4.73	0.000	-.2730781	-.1129763
MIN	-.0592235	.0690183	-0.86	0.391	-.1944968	.0760498
lag_UR	.3795215	.0377029	10.07	0.000	.3056252	.4534177
WAGE	-.0001723	.0000429	-4.01	0.000	-.0002564	-.0000882
WAGE						
PCI	.4073612	.060005	6.79	0.000	.2897535	.5249689
MIN	-376.2594	215.4392	-1.75	0.081	-798.5124	45.99366
UNC	1675.287	2088.217	0.80	0.422	-2417.543	5768.117
UNM	4501.751	2697.167	1.67	0.095	-784.5998	9788.101
UNP	3990.026	2554.33	1.56	0.118	-1016.369	8996.421
UR	-961.7079	145.0256	-6.63	0.000	-1245.953	-677.4628

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0169219	.016595	1.02	0.308	-.0156037	.0494475

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0234815	.0163006	1.44	0.150	-.0084672	.0554301

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0050149	.0143464	0.35	0.727	-.0231036	.0331333

Figure 15 - Simultaneous Equation Regression, Population Rate of Change, No Lagged Unemployment, Fixed Effect

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
UR	1008	79	.7798632	0.8307	4606.69	0.0000
WAGE	1008	73	2187.546	0.9226	11990.83	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
UR						
LQC	-.0207852	.0034739	-5.98	0.000	-.0275939	-.0139766
LQM	.0080321	.0027391	2.93	0.003	.0026635	.0134007
LQP	.0092459	.0076655	1.21	0.228	-.0057783	.02427
UNC	-4.804331	1.747303	-2.75	0.006	-8.228981	-1.37968
UNM	10.03822	1.802022	5.57	0.000	6.506325	13.57012
UNP	2.934555	2.342468	1.25	0.210	-1.656598	7.525708
I_C	.0408604	.0146024	2.80	0.005	.0122403	.0694805
I_M	-.0735814	.0148375	-4.96	0.000	-.1026624	-.0445003
I_P	-.0309876	.0211471	-1.47	0.143	-.0724352	.01046
POP_ROC	-.4484441	.0620837	-7.22	0.000	-.570126	-.3267622
MIN	-.1419411	.0797462	-1.78	0.075	-.2982407	.0143586
WAGE	-.0002127	.0000456	-4.67	0.000	-.0003021	-.0001234
WAGE						
PCI	.4889562	.0705787	6.93	0.000	.3506245	.6272879
MIN	-425.0687	214.4288	-1.98	0.047	-845.3414	-4.795933
UNC	2129.914	2077.863	1.03	0.305	-1942.623	6202.451
UNM	3845.467	2684.932	1.43	0.152	-1416.903	9107.837
UNP	4428.66	2532.229	1.75	0.080	-534.417	9391.737
UR	-613.2112	216.8808	-2.83	0.005	-1038.29	-188.1327

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0998591	.0485888	2.06	0.040	.0046268	.1950914

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0806276	.0383968	2.10	0.036	.0053712	.155884

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0271326	.0393726	0.69	0.491	-.0500362	.1043014

Figure 16 - Simultaneous Equation Regression, No Lagged Unemployment, Fixed Effect

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
UR	1008	79	.8935248	0.7777	3264.81	0.0000
WAGE	1008	73	2193.29	0.9222	11928.24	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
UR						
LQC	-.024838	.0045915	-5.41	0.000	-.0338372	-.0158388
LQM	.0044214	.0023815	1.86	0.063	-.0002462	.009089
LQP	.0095969	.0071074	1.35	0.177	-.0043332	.0235271
UNC	-4.880805	1.790603	-2.73	0.006	-8.390322	-1.371288
UNM	7.484139	1.8189	4.11	0.000	3.919161	11.04912
UNP	2.474703	2.241614	1.10	0.270	-1.91878	6.868187
I_C	.0431411	.0143001	3.02	0.003	.0151135	.0711688
I_M	-.0441129	.0133817	-3.30	0.001	-.0703406	-.0178852
I_P	-.0250446	.0191479	-1.31	0.191	-.0625738	.0124845
POP_MIL	.1410569	.0438089	3.22	0.001	.0551929	.2269208
MIN	-.0869909	.0937178	-0.93	0.353	-.2706744	.0966926
WAGE	-.000294	.0000473	-6.21	0.000	-.0003868	-.0002013
WAGE						
PCI	.4512791	.0805142	5.60	0.000	.2934743	.609084
MIN	-402.9113	216.175	-1.86	0.062	-826.6065	20.78393
UNC	1919.557	2094.325	0.92	0.359	-2185.245	6024.359
UNM	4136.833	2708.316	1.53	0.127	-1171.37	9445.035
UNP	4242.007	2545.997	1.67	0.096	-748.0555	9232.07
UR	-773.3721	271.9147	-2.84	0.004	-1306.315	-240.4292

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.1212295	.0611585	1.98	0.047	.001361	.2410979

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0330906	.0232349	1.42	0.154	-.012449	.0786302

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0237496	.034152	0.70	0.487	-.043187	.0906862

Figure 17 – Equation 2 for States with Right to Work laws

Source	SS	df	MS
Model	1446.56931	53	27.2937606
Residual	161.049814	395	.407721049
Total	1607.61912	448	3.58843555

Number of obs	=	449
F(53, 395)	=	66.94
Prob > F	=	0.0000
R-squared	=	0.8998
Adj R-squared	=	0.8864
Root MSE	=	.63853

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LQC	-.0284627	.0041252	-6.90	0.000	-.0365728	-.0203526
LQM	-.0061714	.0043867	-1.41	0.160	-.0147956	.0024528
LQP	.0254131	.0115355	2.20	0.028	.0027345	.0480917
UNC	-4.24402	2.506714	-1.69	0.091	-9.172189	.6841491
UNM	2.807198	2.833649	0.99	0.322	-2.763721	8.378118
UNP	-.5166661	6.356521	-0.08	0.935	-13.01351	11.98018
I_C	.0398078	.0185243	2.15	0.032	.0033893	.0762264
I_M	.0130872	.0250353	0.52	0.601	-.0361319	.0623062
I_P	.010151	.0561773	0.18	0.857	-.1002929	.1205949
POP_MIL	.1169633	.0561115	2.08	0.038	.0066488	.2272777
MIN	.2824601	.189289	1.49	0.136	-.0896798	.6546001
lag_UR	.4266962	.0377046	11.32	0.000	.3525694	.5008231

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.1207963	.0831796	1.45	0.147	-.0427337	.2843263

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	-.0173244	.013041	-1.33	0.185	-.0429628	.008314

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	-.0131301	.1564879	-0.08	0.933	-.3207833	.2945231

Figure 18 – Equation 2 for States without Right to Work laws

Source	SS	df	MS
Model	1764.0752	59	29.8995797
Residual	180.628606	498	.362708044
Total	1944.70381	557	3.49138924

```
Number of obs =     558
F( 59,   498) =   82.43
Prob > F      =  0.0000
R-squared     =  0.9071
Adj R-squared =  0.8961
Root MSE      =  .60225
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LQC	.0028906	.0068216	0.42	0.672	-.010512	.0162933
LQM	.011831	.0029843	3.96	0.000	.0059675	.0176944
LQP	-.0344386	.010406	-3.31	0.001	-.0548837	-.0139935
UNC	2.853845	3.349088	0.85	0.395	-3.726239	9.433929
UNM	8.778448	1.8688	4.70	0.000	5.106745	12.45015
UNP	-7.828399	2.988304	-2.62	0.009	-13.69964	-1.957161
I_C	-.0415082	.0321632	-1.29	0.197	-.1047005	.0216842
I_M	-.0872728	.0153655	-5.68	0.000	-.1174621	-.0570835
I_P	.0689422	.0277037	2.49	0.013	.0145116	.1233727
POP_MIL	.1210083	.0668001	1.81	0.071	-.0102365	.2522531
MIN	-.1092843	.0751885	-1.45	0.147	-.2570101	.0384416
lag_UR	.473078	.0310976	15.21	0.000	.4119793	.5341767

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0082494	.027586	0.30	0.765	-.0459499	.0624488

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.1038576	.042836	2.42	0.016	.019696	.1880191

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.2695992	.1730293	1.56	0.120	-.0703581	.6095566

.

Figure 19 – Equation 2 for States after 1998

Source	SS	df	MS
Model	2713.23887	72	37.6838732
Residual	154.990409	599	.258748597
Total	2868.22928	671	4.27455929

```
Number of obs =     672
F( 72,   599) =  145.64
Prob > F      =  0.0000
R-squared     =  0.9460
Adj R-squared =  0.9395
Root MSE      =  .50867
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LQC	-.0156703	.0036999	-4.24	0.000	-.0229367	-.008404
LQM	.003487	.0027698	1.26	0.209	-.0019527	.0089268
LQP	.0228529	.0075755	3.02	0.003	.0079751	.0377308
UNC	-3.760505	2.14279	-1.75	0.080	-7.968799	.4477894
UNM	3.554744	1.829494	1.94	0.052	-.0382589	7.147747
UNP	-.6392015	2.529728	-0.25	0.801	-5.607416	4.329013
I_C	.040797	.0188015	2.17	0.030	.0038722	.0777219
I_M	-.0252229	.0158159	-1.59	0.111	-.0562842	.0058384
I_P	.0043483	.0228551	0.19	0.849	-.0405376	.0492342
POP_MIL	.204864	.0591951	3.46	0.001	.0886089	.3211191
MIN	.1124458	.0607568	1.85	0.065	-.0068764	.2317679

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0589283	.0438251	1.34	0.179	-.0271411	.1449978

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0123955	.0145513	0.85	0.395	-.0161822	.0409733

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	-.0146076	.0547178	-0.27	0.790	-.1220697	.0928545

Figure 20 - Equation 2 for States before 1998

Source	SS	df	MS
Model	1033.23745	47	21.9837756
Residual	99.6923808	286	.348574758
Total	1132.92984	333	3.4021917

Number of obs =	334
F(47, 286) =	63.07
Prob > F =	0.0000
R-squared =	0.9120
Adj R-squared =	0.8975
Root MSE =	.5904

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LQC	-.0154845	.0059951	-2.58	0.010	-.0272846	-.0036845
LQM	.0033228	.0042831	0.78	0.439	-.0051077	.0117533
LQP	.0066633	.0138884	0.48	0.632	-.0206731	.0339997
UNC	-.5053676	4.571621	-0.11	0.912	-9.503658	8.492923
UNM	8.43614	3.668598	2.30	0.022	1.215264	15.65702
UNP	-1.28458	5.089505	-0.25	0.801	-11.30222	8.733058
I_C	-.0003167	.0437469	-0.01	0.994	-.0864234	.0857899
I_M	-.0533947	.0261834	-2.04	0.042	-.1049313	-.0018582
I_P	.023608	.0505402	0.47	0.641	-.0758699	.1230859
POP_MIL	.1538907	.061286	2.51	0.013	.033262	.2745195
MIN	-.1682282	.1074788	-1.57	0.119	-.379778	.0433215
lag_UR	.4410083	.0486653	9.06	0.000	.3452208	.5367959

```
. nlcom _b[LQC]*_b[UNC]

       _nl_1:  _b[LQC]*_b[UNC]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0078254	.0727811	0.11	0.914	-.1354292	.1510799

```
.
. nlcom _b[LQM]*_b[UNM]

       _nl_1:  _b[LQM]*_b[UNM]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	.0280316	.0461147	0.61	0.544	-.0627357	.1187988

```
.
. nlcom _b[LQP]*_b[UNP]

       _nl_1:  _b[LQP]*_b[UNP]
```

UR	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_nl_1	-.0085595	.0232642	-0.37	0.713	-.0543504	.0372313

Reference Page

Allegretto, Sylvia A., Arindrajit Dube, Michael, “Do Minimum Wages Really Reduce Teen Employment? Accounting for Heterogeneity and Selectivity in State Panel Data,” Industrial Relations 50, no. 2 (2011): 205-240

Izraeli, Oded, Kevin J. Murphy, “The effect of industrial diversity on state unemployment rate and per capita income,” Annuls of Regional Science 37, no. 1 (2003): 1-14

Mizuno, Keizo, Fumitoshi Mizutani. Noriyoshi Nakayama, “Industrial diversity and metropolitan unemployment rate,” Annuls of Regional Science 40, no. 1 (2006): 157-172

Mollick, André Varella, “What explains unemployment in US–Mexican border cities?” Annuls of Regional Science 42, no.1 (2008): 169-192

Pantuosco, Lou, Darrell Parker, and Gary Stone, “The Effect of Unions on Labor Markets and Economic Growth: An Analysis of State Data,” Journal of Labor Research XXII, no.1 (2001): 195-205

Pantuosco, Lou, “Macroeconomic Differences in Public and Private Union Density: An Analysis of US State Economies, Review of Regional Studies 32, no. 2 (2002): 171-186

Pantuosco, Lou, William Seyfried, “The Effect Of Public And Private Unions On State Economic Activity: Evaluating The Benefits To Organized Workers, Policymakers, And Companies,” Journal of Business & Economics Research 6, no. 2 (2008): 27-39

“Union Membership and Coverage Database from the CPS,” *unionstats.com*, February 4, 2012, http://unionstats.com/

http://archive.sba.gov/advo/research/data.html

http://www.bea.gov/iTable/index_regional.cfm

http://www.bls.gov/schedule/archives/all_nr.htm#SRGUNE

http://www.census.gov/hhes/www/income/data/statemedian/

http://www.dol.gov/whd/state/stateMinWageHis.htm