



2017

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Recommended Citation

Rippin, Brianna J. (2016) "Local Union Strength's Effects on Individual Employment Outcomes," *Undergraduate Economic Review*: Vol. 13 : Iss. 1 , Article 16.

Available at: <http://digitalcommons.iwu.edu/uer/vol13/iss1/16>

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Local Union Strength's Effects on Individual Employment Outcomes

Abstract

This cross-sectional analysis of employment in the 50 U.S. States during the years 2003-2012 provides evidence that increased local union strength does significantly diminish an individual's hours worked. The multivariate OLS regression estimation reveals that the negative effect of union strength is dwarfed by the effects of proxies for worker quality such as one's age, sex, and education level. However, union strength effects are found to be stronger than local economic trends. This research indicates that individual factors are the most important determinant of one's employment outcomes as they are most indicative of productivity.

Keywords

Local Labor Market, Unionization, Employment Determinants

Cover Page Footnote

The researcher is grateful to Christian Nsiah for his advice in refining the regression methodology and for his assistance with STATA. Thanks are also due to Jonathan Spilker, Austin Nagy, Vanessa Adu Gyamfi, Karleigh Pluta, and Tyler Lee for their quality peer reviews. Lastly, the researcher is appreciative for the assistance of Bartosz Soltys when he exerted incredible effort to retrieve data after the researcher's computer hard drive failed.

I. Introduction

The effect of unions on wages has been one of the most intensely studied topics within the realm of labor economics. Previous researchers have largely concluded that unions raise the wages of their workers when compared to non-union workers. Though the scholarly community has come to conclusions about the effect of unions on wages, they have been unable to reach any considerable conclusions about how unions, and union wages, affect employment. Numerous studies have arrived at conclusions which support the neoclassical perspective that unions do cause unemployment. Conversely, many researchers have lent support to the heterodox views when their studies failed to find a correlation between unions and unemployment.

Many past researchers either examine the economy on a firm level or divide the economy into two sectors: a union sector and a non-union sector. Though the two-sector approach allows for a clear analysis of union versus non-union employment outcomes, it may lead to an overstatement of unemployment levels. It is possible that workers unemployed in the union sector or at a unionized firm simply look for jobs in the non-union sector or at a non-unionized firm. This research examines aggregate employment effects and therefore captures union effects in the aggregate economy. By examining union strength at a relatively local level, this research acknowledges that workers are most subject to the conditions of their local job market as that is where they conduct their search for employment. As wages are determined on a micro basis, this research recognizes that local conditions and individual worker quality are the best way to investigate employment outcomes for an individual. Repetitions of a seminal study have yielded different conclusions based on the time period analyzed. This research analyzes the years from 2003-2012, thus lending a modern perspective on an issue which seems sensitive to the time period of examination.

The employment effects of labor unions have been so ardently investigated in large part because the implications of the findings permeate the lives of the public extensively. The Bureau of Labor Statistics reports that in 2013, 11.3% of the workforce, which is over 14 million individuals, were part of a private union. Therefore, it is likely that every individual knows someone in a union. As such, nearly everyone has a personal interest in ensuring that working environments provide fair wages and decent working conditions. In addition to private unions, over 35% of public employees are members of a union (Bureau of Labor Statistics). The economic wellbeing of a portion of any community's firefighters, teachers, and police officers is directly impacted by union activity. Not only are these public servants likely friends and neighbors, but their services impact the quality of community life.

A community will want to encourage productive public servants now and into the future. Poor working conditions would dissuade young people from becoming public servants.

Independent of concern for the wellbeing of others, union bargaining affects the prices the public pays at stores. If unions increase wage levels they may also perpetuate inflation. It is possible that an employee cannot work more to try and compensate for inflation because unions may cause unemployment and/or a reduction in working hours. As a result, firms, and consequently the macro economy, would not be able to grow. The effects are not only limited to touching this generation, but extend to shaping the job market for the next generation. It is necessary to evaluate if the money being supplied to unions is more effective at perpetuating wellbeing for workers or for causing negative economic externalities.

II. Literature Survey

A myriad of researchers have sought to understand the validity of neoclassical theory off the blackboard. The seminal study to address the relationship between unions and employment was conducted by H. G. Lewis and was entitled “Unionism and Relative Wages in the United States: An Empirical Inquiry.” In this study Lewis aimed to estimate the magnitude of the impact of unionism on wage differentials and employment among groups of labor over time. Lewis was the first researcher to determine that there was a significant correlation between union presence and a wage premium for union workers when compared to non-union workers. He determined that during the time period of his examination (1920-1958) the wage differential between union and non-union workers caused significant discrepancies between industries, but actually worked to reduce wage inequality within an industry (Somers 1964). Therefore, the change in the macroeconomic wage inequality caused by unions was found to be less than 6% (Somers 1964). Lewis found that the hours worked of an unionized employee also decreases with increased unionization (Somers 1964). Though the overall effect of a wage premium was found to be small in a macro sense, the determination of a wage premium at all and a negative effect on hours worked was expected by neoclassical theorists. What they did not expect was the significant “time period effect” found by Lewis. When he examined data from the years during the Great Depression, he found the wage premium to be upwards of 25%. However, during the time period right after WWII, Lewis found that the wage premium had shrunk to almost 0% (Somers 1964).

As such, Lewis concluded that unions are more effective at maintaining wages during times of depression than raising wages in times of economic expansion. Therefore, the union wage premium's effect on determining unemployment on a macro level becomes questionable.

It must be considered that during the expansionary period when Lewis found a low wage premium employers would need to incentivize workers to work for them (to fund their expansion). As such, perhaps non-union employers simply increased wages to union levels (Somers 1964). In his review of Lewis' work, Gerald G. Somers terms this possibility the "threat effect" (1964). The threat effect would make it appear that unions are not raising wages when they are in fact doing a lot to increase wages. With this possibility, it again becomes viable that unions increase wages enough to cause unemployment.

To ascertain the true wage premium for union workers in light of the possibility of a "time effect" or a "threat effect" it is necessary to examine wage differentials using different time periods. In their 1984 study entitled "A Reconsideration of the Effects of Unionism on Relative Wages and Employment in the United States" John Pencavel and Catherine Hartsog apply this lens of scrutiny to Lewis' conventionally unquestioned conclusions. They expand Lewis' original inquiry to include the years 1958-1980 (for a cumulative period of study from 1920-1980). Though Pencavel and Hartsog's findings regarding the relative wage effect are similar to Lewis', they do not find the same negative correlation between unionization and hours worked (1984). This calls into question the idea that higher union wages always mean a smaller labor force. As Pencavel & Hartsog and Lewis all find the "time effect" to be significant when determining the wage premium, it is important to continually gauge the wage premium.

The wage premium was studied extensively before Pencavel and Harsog's 1984 study. In his research on the effect of unions on employment, particularly of young black individuals, Holzer (1982) found that unions significantly increased the wages of unionized blacks, and significantly depressed the wages of non-unionized blacks. When analyzing the effects of union wage inflation on non-union sectors, Kahn (1978) found that the wage inflation, and its subsequent spill over into other sectors, was significant.

Studies conducted in the early 20th century using data which extends after the time periods examined by Pencavel and Hartsog still found the wage premium to be significant. In 2007 Ozkan Eren determined a wage premium of about 21.5% during the years 1973-2001. In a similar study, Barry Hirsch concluded that the wage premium was consistently over the common estimate of 15%, and as high as 24% (2004). Verma and Fang utilized cross sectional data from 1999 to estimate the union wage premium at 7.7% (2002).

With the confirmation of a wage premium from numerous researchers which aligns with the predictions of neoclassical theory, it thus becomes necessary to address the question: Does this wage premium decrease the labor force by decreasing employment or hours worked? When addressing this question, Lewis (1964), Pencavel and Hartsog (1984), Eren (2007), and Hirsch (2004) all utilize a two-sector model: dividing the economy into unionized and non-unionized parts. Leonard (1992), Wooden and Hawke (2000), Long (1993), and Walsworth (2010) utilize this same two sector approach and arrive at the conclusion that the employment in the unionized sector experiences slower growth than the employment in non-unionized sectors. Leonard's study concludes that in the United States (California specifically) employment will grow 3.9% slower in unionized sectors than in non-unionized sectors (1992). Wooden and Hawke determine that in Australia the negative effect of unions on employment in unionized sectors is about 2.5%. Long's case study analyzed Canadian firms and concluded that employment growth was between 3.7% and 3.9% slower in unionized firms as opposed to non-unionized firms (1993). The suppressed employment growth which was attributed to unions was present across industries (Long 1993). Walsworth sought to update Long's study and examined employment in Canada the period from 1999-2005. Walsworth concluded that when union hold a majority presence in an industry the employment growth of that industry diminished by 2.2% (2010). These findings are consistent with the neoclassical theory, even if the theory did not account for a two sector model. Lewis' original conclusions are supported by the work of these researchers.

However, the debate is not closed as numerous studies conducted by researchers like Chang and Hung (2016) support Pencavel and Hartsog's (1984) conclusions that a union wage premium does not decrease hours worked. According to Chang and Hung, an increased wage rate bargained for by unions decreases employment in the unionized sector. It is theorized however, that the remaining employed will be incentivized by the higher wages to work harder and longer, especially in paid-by-the-hour positions (Chang and Hung 2016). This would result in an overall increase in the labor force (if it was measured by hours worked) and an absence of many of the externalities of unions which are criticized by the neoclassical theory. Though Chang and Hung (2016) believe unions positively affect overall hours worked, they introduce the possibility that the elastic substitution between capital and labor diminish this effect. Other researchers have conducted theoretical studies which, like Chang and Hung, support the idea that a wage premium is not detrimental to employment.

One of these such studies is the research conducted by McDonald and Solow (1981) as outlined by Oswald (1985) which developed the efficient bargaining theory. The efficient bargaining theory dictates that equilibrium employment with unions present is higher than in the equivalent employment rate which would result from a competitive labor market.

In response to the large amount of theoretical work conducted which suggests that unions do not cause unemployment, many researchers have applied a lens of scrutiny to previous empirical studies which suggest unions cause unemployment. For example, Thomas Reed asserts that the arguments of Freeman and Medoff, which suggest that unemployment in highly unionized areas is 1% higher than in non-unionized areas, does not support the relationship between unionization and unemployment because Freeman and Medoff failed to find any significant correlation (Reed 1987).

As is evidenced by the above studies, previous researchers saw the best way to gauge the effects of unions to be to divide up the economy into union and non-union sectors. It was assumed by previous researchers that employment and unemployment effects needed to be equal when they need not be. This two sector approach cannot accurately measure the displacement effect of unions because it does not account for the fact that workers can move between sectors. Therefore, these studies may have overestimated the disemployment effect of unions. If unionized sectors experience diminished employment growth as is suggested by Eren (2007), Hirsch (2004), Leonard (1992), and Long (1993) it is possible that displaced workers in the unionized sector will seek employment in the non-unionized sector. Workers will continue to search for employment within their local job market regardless of the sector.

Another weakness of the previously mentioned studies is that it is difficult to determine what it means to be unionized and non-unionized, especially across countries. This difficulty was acknowledged by Hirsch (2004) as he outlines the consequences and significance of misclassification of union workers. As such, it is necessary to analyze union strength within the local job market in order to clearly ascertain the disemployment effects of unions on the macro economy.

Montgomery (1989) considers these holes in the previous research and utilizes models developed by Welch (1974), Mincer (1976), and Gamich (1976) to estimate the probability of being employed and probability of being employed part time within a local labor market with regards to union strength levels. This study seeks to update Montgomery's study with new data and refined independent variables. The importance of updating findings is supported by the "time effect" found by Lewis (1964) and supported by numerous researchers including Pencavel and Harsog (1984). In an effort to reconcile the conclusions of Chang and Hsiao-Wen's (2016) and Pencavel & Hartsog (1984) and the conclusions of researchers like Lewis (Somers 1964) and Walsworth (2010) this

study will not only consider the unemployment effects of unions but do so by examining the effects on working hours. If workers maintain employment but their hours are cut to part time, then the economy cannot possibly produce on the production possibilities curve: therefore, inefficiency is present. To consider the two sector model's inability to gauge macro level disemployment effects this study will utilize the strategy pioneered by Montgomery (1989) to analyze aggregate employment within local markets (without regard to unionized versus non-unionized sectors). By analyzing union strength without regard to firm or industry, this study accounts for the substantial public union membership, which is often ignored when analysis is conducted at the firm or sector level.

The importance of examining local job markets, as Montgomery (1989) suggested, becomes more apparent when one considers that union strength likely varies by location. As workers search within their local job market, as was suggested by Montgomery (1989) one can surmise local employment conditions are a very important determinant of employment outcomes. Therefore, it is important to address union strengths at a more micro level than simply with an aggregation. Studies like those of Holzer (1982) attempted to address this condition when they utilized the percentage of workers in unions in an area as the measure of union strength. However, much of the previous research fails to adjust for the wage premium which changes constantly. Montgomery (1989) adjusts for this phenomenon by calculating union strength with consideration to percent unionized in an area and the wage premium. This research will apply this expanded definition of union strength with analysis conducted at the state level. The union strength calculations in this study do not account for wage premium variations between localities, only nominal wage premium variations over time. The state level of analysis is more macro than Montgomery's (1989) study which examined standard metropolitan statistical areas (SMSA). Inasmuch, this research considers the possibility that workers search for employment within their state not simply within their SMSA. As Long (1993) finds that union employment suppression is present without significant variance across industries, aggregate analysis will be conducted without controls for an individual's industry.

This research attempts to contribute insight to the contentious debate over union's effect on employment by eliminating the biases introduced with a two-sector model. Through testing the possible redefinition of a local labor market and adjusting for the importance of local labor conditions through a redefining of union strength as utilized by Montgomery (1989), this research attempts to reduce error when aggregating union-employment effects. Unlike the literature cited within this review, this research study introduces marginal measures which gauge the local economic trends during the year of data collection. These trends (such as percentage change in population and percentage change in real GDP) may prove to be stronger influencers of business hiring decisions than population or GDP

levels (as was used in previous research to control for economic effects). Lastly, this research addresses a new time- period (2003-2012) which encompasses a major recession. Therefore, this study will be helpful in analyzing the effect of time and economic conditions on employment: an effect which the literature has considered a significant determinant of employment effects.

III. Theory and Theoretical Predictions

Not long after the rise of unions, the foundations laid by classical economists were adopted by the newly forming neoclassical school of thought. The famous classical economist David Ricardo developed the theory of diminishing returns, which was adopted by the neoclassical economic school when examining the labor market. Neoclassical economists asserted that a worker's salary was only worth his/her marginal product (as that was what the company gained by his/her employment). The marginal product of labor is regarded as exhibiting diminished returns with each additional unit of labor added. Eventually, there comes a point where the marginal product of an additional labor unit is lowered below the wage level and no more hiring will be done. Firms will only hire until the marginal cost of workers is equal to the marginal revenue brought about by that worker's efforts, because after that point, the firm incurs a loss on each additional worker.

Under equilibrium resulting from these conditions, neoclassical economics dictates that the economy is producing at an efficient rate. The presence of unions violates this equilibrium employment rate, as unions bargain for higher than equilibrium level wages. The high wage rates insisted upon by unions act as a binding price floor. The higher wage increases the number of workers willing to work for that wage by incentivizing them with a higher payoff to trade leisure for work. Conversely, the higher wage level decreases the number of employers willing to hire workers. Employers are discouraged from hiring the previous number of workers because the higher wage increases the marginal cost of workers. The marginal cost of worker is also increased by the costly severance, work stoppages with striking¹ and decreased management autonomy which are brought about by unions. With diminishing marginal products, at least some of the previously hired workers will have value added less than the increased marginal cost.

Therefore, a surplus of workers is added to the labor force. Those in the surplus quantity are thus unemployed. Increased unemployment prevents an economy from producing at its potential (on the production possibilities frontier).

¹ More information on labor strikes can be found at <https://www.bls.gov/wsp/>.

Neoclassical theory suggests that systems (like the free labor market) are efficient because the equilibrium employment level represents Pareto Optimality. A market is Pareto Optimal when no one market player's position can be bettered without negatively affecting another market player's position (Ingham 2016). As unions may better the wages of their workers while detracting from the overall employment level, union activity is deemed by neoclassical theorists to defy Pareto Optimality. On these grounds, the neoclassical economic school criticizes unions for causing economic inefficiency.

This Neoclassical position rests on a vast number of assumptions which, should they be violated in the real world, would invalidate the relationships laid out in the theory. The first flaw of neoclassical theory is that the marginal product of a worker is not as easily defined in the real economy as it is with theory (Komlos 2014). In a factory, it is easy to measure how many widgets a worker produces and what they are paid per hour. However, it is less easy to measure the marginal cost or marginal product of workers who are teachers or firemen. This is especially important because the largest unions are public unions made up of individuals in these professions (Bureau of Labor Statistics). The immeasurability of these marginal products leads to fuzziness about exactly when to cease hiring. This is a violation of the "perfect information" assumption which acts as a foundation of neoclassical theory. Economic agents simply do not have the capacity to discern all the information necessary to make the rational decisions laid out in neoclassical theory.

The neoclassical school of economic thought forms the aforementioned theory assuming that the supply and demand of labor exists within a perfectly competitive market. In reality, employers have become increasingly oligopolistic in nature. As such, they may have enjoyed buyer power which has allowed them to suppress wages in a binding price ceiling. In this case, the supplier power provided by unions may allow for unions to match the buying power of firms and move wage back to an equilibrium rate. Should this be true, then unions are not causing inefficiency, and should not be diminishing the aggregate labor force. The neoclassical view assumes that unions have the bargaining power to raise wages. Neoclassical theory does not consider that unions might not set higher than equilibrium wages at all phases of the business cycle. Finally, neoclassical theory does not consider that there are nonunion workers in the economy. Simply because some workers demand a wage premium does not mean that most or all workers demand a wage premium because not all workers are union members. It is an assumption of the neoclassical theory that union wages permeate the entire economy.

Also, if union wages increase and there is a consequent excess supply of labor in the unionized market place (due to wage increases) it is possible that those workers will look for employment in the non-unionized sector. This will shift up the supply curve in the non-unionized sector thus affecting wage and employment in that sector.

It is understood that unions hold influence in two main ways: firstly, union strength is determined by the sheer number of the workforce who are members. However, the membership is not important if unions have not proved effective at increasing the wage level on behalf of its members. Therefore, the best measure of union strength is a combination of the percent of the workforce which is unionized and the wage premium that unions have been able to obtain for their members.

Neoclassical economic theory proposes that the most important determinate of employment in the labor market is a wage. The ability of unions to increase wages above the equilibrium level (through union strength) will therefore be an appropriate independent variable to gauge the effects of unions on employment. Though wage is considered the most powerful factor in determining employment of an individual, neoclassical theory also recognizes that the productivity of the individual is important in determining his/her appeal in the job market. As was previously mentioned, firms are supposed to pay workers their marginal revenue product. The more productive the worker, the more likely that firms can pay more and will want to hire that worker to take advantage of his/her productivity.

Neoclassical labor market theory operates on the assumption that workers are rather fungible. However, one must account for the reality that all workers have different skill levels, backgrounds, and abilities. Therefore, when investigating one's ability to gain employment, it is important to control for worker quality. When economists traditionally analyze one's human capital the first thing that they look for is education level.² One's education level is deemed to be indicative of the fact that the individual has acquired skills which can presumably be translated into workplace productivity. As such, this research will control for the individual's education level when investigating his/her ability to gain employment. The researcher acknowledges that education is not a sure-fire way to gauge a worker's skill set. It is possible that the education received instilled skills which are wholly unrelated to the worker's profession and therefore will not contribute to productivity. It must also be considered that the knowledge gained from education can either be forgotten or obsolesced by new discoveries: as was suggested by Joseph Schumpeter's theory of creative destruction (Caballero 2008) In an effort to consider the value of education in

² Education often acts as a sign of productivity. The nature of such indicators can be found in further detail Michael Spence's seminal work on job signaling.

determining worker productivity and yet also to acknowledge the imperfections of education the researcher will control for workplace experience as an additional measure of worker quality. A worker's workplace experience will likely translate to his/her ability to accomplishing tasks quickly and with quality as a result of exposure to the industry. The researcher was unable to find concurrent data which included a worker's job tenure. As such, the researcher utilizes age as a proxy for experience.

Researchers like Gary Becker (1985) have suggested that gender also has an effect on worker quality. Becker considers that the additional hours women exert when fulfilling their duties at home may diminish the effort which they put into their market jobs. Work by Hersch and Stratton (1997) confirms Becker's assertion. Though not all researchers have arrived at this conclusion (Bielby and Bielby 1988) this research will attempt to control for the possibility that gender affects productivity: which would affect an individual's employment outcomes. Another reason to control for gender is the possibility of workplace discrimination. This research considers the possibility that employers diminish the employment opportunities for certain genders or races by controlling for the individuals' race and gender.

Macro-economic factors must also be controlled for when considering an individual's ability to gain employment. An individual can be extraordinarily qualified, but if the economy is in a condition where demand is falling then employers do not have incentive to hire him. Neoclassical theory outlines this phenomenon as it identifies unemployment as a symptom of an economic contraction. Therefore, the researcher utilizes year-over-year percent change in real GDP within the individual's state of residence as a control for his/her ability to gain employment. The researcher also utilizes the percent change in population of the individual's state as a control for the growth of the job market in which the individual will be searching for employment. Intuitively it can be assumed that the larger the job market the higher the probability that the individual will find employment. Montgomery (1989) utilized SMSA population levels as an explanatory variable in recognition of the possibility.

Neoclassical labor theory does not provide restraints on the job market in which individuals search for jobs. It is assumed in this school of economics that workers can and will move to where there is a demand for work. The researcher considers the conclusion of Montgomery (1989) that workers will search for employment within their local job market. As such, it is presupposed that only the macroeconomic factors and union strength within the individual's state will have a significant effect on their search for employment. By concentrating analysis at the local level the research attempts to minimize error by not assuming union and macroeconomic effects are powerful enough to reach everywhere in the country.

The researcher attempts to identify the effect of union strength on an individual's ability to gain employment (independent of worker quality, macroeconomic factors, and discrimination). If neoclassical labor theory is correct, union strength will be found to have a significant effect on an individual's ability to gain employment. Neoclassical theory also dictates that a worker's quality (proxied by their education, sex, and age) will be strong determinants of employment outcomes. Traditional theory also stresses the importance of the macroeconomy in determining employment. However, it is known that decisions are made on the margin not the aggregate. Therefore, this research takes an original approach by utilizing year over year percentage real GDP change and year over year percentage population change as proxies for economic impacts as opposed to GDP levels and population levels which are found in the current body of scholarly literature. This study's economic proxies are an effort to consider that businesses change hiring habits based off of future expectations (which are indicated by trends) as opposed to the current economic state.

Both neoclassical theory and Montgomery (1989) conclude (using economic levels) that economic effects are much larger than that of unions. The research hypothesis is drawn from heterodox theory suggesting that union strength is not exerting a significant effect on an individual's ability to gain employment.

IV. Methodology

Individual level data for 1,328,629 respondents across years 2003-2012 was collected from the US Census Bureau March Supplement Survey within the annual Current Population Survey. As all observations recorded at the individual level were done so in March, seasonality effects are removed. Using the Data Ferret tool, the researcher extracted age, gender, race, education attainment, and hours worked per individual. The total number of individuals in the analysis per year is shown in the table below³:

³ This sample does not include respondents younger than 16 or older than 65 as they are not in the labor force. The respondents represent all 50 states excluding DC.

Year	Number of Records
2003	136939
2004	135500
2005	133120
2006	132697
2007	131588
2008	131791
2009	132960
2010	134104
2011	131163
2012	128767

The race variable was a nominal level variable coded by the Census Bureau into 21 different categories, including details about different combinations of mixed races. The researcher recoded the race variable to be a binary dummy variable where white is represented by a 0 and minorities (any non-white) were represented by a 1.

The sex variable was also a nominal level variable coded by the Census Bureau where males were represented by a 1 and females were represented by a two. The researcher recoded the sex variable to be binary dummy variable where males were represented by a 0 and females were represented as a 1.

Education attainment was coded into 16 categories by the US Census Bureau. The researcher did not change the categories, but did reassign numbers in the coding so that the categories were coded as ranging from 1-16 as opposed to 0, and 31-46.

In order to control for macro-economic factors when considering an individual's ability to gain employment the researcher utilizes year-over-year percent population change and year-over-year percent real GDP growth in the respondent's state during the respondent's year of survey. The researcher theorizes that the percent year-over-year population change will drive hours worked as it is indicative of increased job opportunities. It is expected that this effect will outweigh the possibility that population increase will make jobs scarce and labor more available therefore decreasing hours worked. The data for year over year percent real GDP change and year over year percent population change was collected from FRED during the time period 2003-2012.

In contrast to traditional theory which assumes that workers can and will move to where there is a demand for work, the researcher in this study considers the conclusion of Montgomery (1989) that workers will search for employment within their local job market. As such, it is presupposed that only the macroeconomic factors and union strength within the individual's state will have a significant effect on their search for employment. By concentrating analysis at the local level the research attempts to minimize error by not assuming union and macroeconomic effects are powerful enough to reach everywhere in the country.

As the researcher combined respondent data over ten years (2003-2012) the researcher controls for time by including the year as an explanatory variable.

The means, standard deviations, minimum and maximum observations for the variables are summarized in the table below:

	N	Minimum	Maximum	Mean	Std. Deviation
Union Strength	1328629	.6618971061	7.601809955	3.439239032	1.684487283
Sex Recode	1328629	0	1	.52	.500
Race1	1328629	0	1	.20	.399
HRSWK	1328629	0	99	29.65	19.650
Age	1328629	16	65	39.10	13.655
Educ Recode	1328629	1	16	9.94	2.771
% YOY GDP Growth	1328629	-8.41557	22.23841	1.7057317	2.88489100
% YOY Pop Change	1328629	-5.98613000	4.329860000	.9318293971	.7345870635
Valid N (listwise)	1328629				

The method of statistical processing is the development of an OLS regression model. The model is as follows:

$$\text{Hours worked} = \alpha + \beta_1 \text{Union Strength} + \beta_2 \text{Age} + \beta_3 \text{Race} + \beta_4 \text{Sex} + \beta_5 \text{Education} + \beta_6 \text{Percent YOY GDP change} + \beta_7 \text{Percent YOY Population Change} + \beta_8 \text{Year} + \varepsilon$$

Upon inclusion of these control variables for worker quality, economic conditions, time, and discrimination the nature of the OLS regression estimation ensured that only proper explanatory power is contributed to measures of union strength. These statistical methods can adequately test the research hypothesis as the betas will indicate the strength and direction of the relationship. As the data is cross sectional the researcher will focus on the global F-test results and variable significance as opposed to R^2 and standard error values.

V. Model Estimation

The researcher estimated the model by performing OLS regression. The OLS regression yielded the following results:

```
. regress hrswk year sexrcode race1 age yoypopchange educrcode
      unionstrength
```

Source	SS	df	MS	Number of obs = 1328629		
Model	75048402.4	8	9381050.3	F(8, 1328620) = 28460.17		
Residual	437940112	1328620	329.620292	Prob > F = 0.0000		
				R-squared = 0.1463		
				Adj R-squared = 0.1463		
Total	512988514	1328628	386.103947	Root MSE = 18.155		

hrswnk	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
year	-.3484522	.005776	-60.33	0.000	-.359773	-.3371314
sexrcode	-8.930741	.031547	-283.09	0.000	-8.992572	-8.86891
race1	-2.438292	.0396335	-61.52	0.000	-2.515972	-2.360611
age	.1321962	.001182	111.84	0.000	.1298796	.1345128
yoypopchange	-.0229718	.0059827	-3.84	0.000	-.0346977	-.0112459
unionstrength	-.2475993	.0097275	-25.45	0.000	-.2666649	-.2285337
yoypopchange	.1415717	.0233604	6.06	0.000	.095786	.1873574
educrcode	1.931461	.0058324	331.16	0.000	1.92003	1.942892
_cons	710.6374	11.59942	61.26	0.000	687.9029	733.3719

The model is significant at the 0.01 level with an F score of 28460.17. As such the researcher finds that at least one of the independent variables has a significant effect on hours worked.

The OLS regression model indicates that the union strength index is significant at the 0.01 level. Therefore, the researcher finds with 95% confidence (as the confidence interval contains only negative values) that local union strength exhibits a negative effect on an individual's working hours. This finding is consistent with the conclusions of the body of research covered in the introduction; including the studies of Montgomery (1989), Leonard (1992), Hawke (2000), and Walsworth (2010). The negative correlation found in this study directly contradicts the empirical findings of Pencaval and Hartsog (1984) and the theoretical work done by McDonald and Solow (1981) and Chang and Hung (2016). This research also finds the negative correlation which Freeman and

Medoff failed to find (which was the source of Reed's (1987) criticism). The negative relationship between union strength and hours worked was expected by the neoclassical perspective that wages set by unions are above worker marginal product, thereby causing decreased employment effects.

At the significance level of 0.01, the researcher rejects the null that union strength does not decrease hours worked. The researcher concludes that there is sufficient statistical evidence to infer that one increase in union strength decreases hours worked between .229 and .267 hours.

The beta estimators from this study also reveal that minorities work 2.438 hours less than whites and that females work 8.931 hours less than males. As was found by Holzer (1982) and Montgomery (1989), the effect of one's race and sex have very powerful effects, more so than union strength. The researcher concludes with 95% confidence that race and sex exhibit negative effects on hours worked which are both significant at the 0.01 level (as the confidence interval contains only negative values).

The study reveals that one degree level increase in education leads to a 1.931 increase in an individual's hours worked. This finding is consistent with the traditional economic principle that an increase in worker quality (which is often brought about by education) should increase that individual's employment prospects as the worker can produce more marginal product to the employer. The positive relationship is significant at the 0.01 level and the researcher finds the direction of the relationship with 95% confidence (as all the values in the confidence interval are positive). The effect of education on individual employment outcomes is stronger than the effect of union strength.

Another proxy for worker quality was age. Neoclassical perspectives, as were utilized by Montgomery (1989) dictate that as age advances (experience increases) hours worked should increase in recognition of the increased worker quality. This researcher's study results confirm this understanding. The model estimated that as age increases by one year, hours worked increases by 0.132 hours. The researcher is 95% confident the relationship between age and hours worked is positive (as all the values in the confidence interval are positive). The relationship between age and hours worked is significant at the 0.01 level. Unlike the education proxy for worker quality, age as a proxy for worker experience demonstrates weaker effects on employment outcomes than does union strength.

The researcher's findings about the relationship between percent year-over-year real GDP growth and hours worked is averse to what traditional economic theory supposes. The researcher is 95% percent confident that the correlation between local percent year-over-year real GDP change and hours worked is negative, and significant at the 0.01 level (as the confidence interval contains only negative values). This suggests that a local economic contraction (as expressed by percent year-over-year real GDP growth) increases, hours

worked for individuals increases. However, the magnitude of the relationship between percent year-over-year real GDP growth and hours worked is small: nearly 11 times smaller than union strength's effects.

Unlike the coefficient of percent year-over-year real GDP growth, the direction of the relationship between percent year-over-year population change and hours worked was as expected by the theoretical analysis. As the percent year-over-year population change increases an individual's hours worked increases. The researcher is 95% confident that the relationship between percent year-over-year population change and hours worked is positive (as all the values in the confidence interval are positive). The relationship is significant at the 0.01 level.

The analysis reveals that time has a negative effect on employment outcomes. This is likely reflective of the great recession which occurred during the time-period analyzed. It must also be considered that increasing automation of jobs must also be considered an explanation of decreasing employment outlooks over time. The effect of time is stronger than economic effects and the effects of unions.

In an effort to ensure that the coefficients found through the OLS regression were not the product of a faulty sample, the researcher conducted two tail hypothesis tests on each beta estimator. The results are as follows:

Null Hypothesis	F Score	P-Value	Decision	Sig.
b ₁ UnionSt = 0	F (1,1328620) = 647.88	Prob > F = 0.0000	Reject	0.01
b ₂ Population=0	F (1,1328620) = 36.73	Prob > F = 0.0000	Reject	0.01
b ₃ GPD =0	F (1,1328620) = 14.74	Prob > F = 0.0001	Reject	0.01
b ₄ Education =0	F (1,1328620) = 1.1e+05	Prob > F = 0.0000	Reject	0.01
b ₅ Race =0	F (1,1328620) = 3784.83	Prob > F = 0.0000	Reject	0.01
b ₆ Sex =0	F (1,1328620) =80141.68	Prob > F = 0.0000	Reject	0.01
b ₇ Age =0	F (1,1328620) =12509.14	Prob > F = 0.0000	Reject	0.01

As the beta estimators for all the explanatory variables are found to be significantly different from 0 at the 0.01 level, the researcher is confident in the relationships which are stated above.

The magnitudes of the beta estimators are both support and contrast for findings of the model study done by Montgomery (1989). Montgomery determined that union strength had a significant negative effect on employment, however, those effects were dwarfed by the effects of macroeconomic and personal factors. This research study finds that personal factors (race, sex, and education) are stronger determinants of hours worked than union strength, but macroeconomic factors (percent year-over-year real GDP growth and percent

year-over-year population change) are weaker determinants of hours worked than union strength. This discrepancy may be due to the fact that Montgomery defined local labor market conditions at the standard metropolitan statistical area level whereas this research utilized state level economic conditions. The direction of the relationship between age (proxy for experience) and hours worked is in line with Montgomery's (1989) study. However, this research determined age (experience) to be a less powerful determinant of employment outcomes than union strength whereas Montgomery concluded that all personal factors (including experience) demonstrated more powerful influence over employment outcomes than union strength. In this way, this research contradicts that overarching conclusion made by Montgomery (1989).

VI. Assumptions Assessment

Though these results look interesting, the usefulness of the model is limited until the assumptions of OLS multivariate regression are proven true. As OLS regression models are least robust to departures from independence and most robust to departures from normality the first assumption to address is the independence of the variables from each other.

A1. Multicollinearity

Multicollinearity occurs when independent variables correlate with each other such that explanatory variance cannot be assigned accurately within the model. Multicollinearity may also cause the signs on the beta estimators to change incorrectly. To test for multicollinearity the researcher produced a correlation matrix of Pearson rs. Pearson rs were used as they are parametric and the data utilized for OLS regression is presumed to be normally distributed.

	Union Strength	Year	SexRecode	Race1	Age	% YOY GDP	%YOY Pop	Educ Recode
Union Strength	1.000	-0.048	0.000	0.061	0.002	-0.029	-0.251	0.026
Year	-0.048	1.000	-0.001	0.022	0.028	-0.305	-0.122	0.038
SexRecode	0.000	-0.001	1.000	0.026	0.031	-0.002	-0.001	0.012
Race1	0.061	0.022	0.026	1.000	-0.025	-0.004	0.038	-0.027
Age	0.002	0.028	0.031	-0.025	1.000	-0.014	-0.013	0.067
% YOY GDP	-0.029	-0.305	-0.002	-0.004	-0.014	1.000	0.306	-0.024
%YOY Pop	-0.251	-0.122	-0.001	0.038	-0.013	0.306	1.000	-0.032
Educ Recode	0.026	0.038	0.012	-0.027	0.067	-0.024	-0.032	1.000

Using the definition of a strong correlation being above .5 (Tabachnick and Fidell 2007) the researcher concludes that none of the independent variables have strong correlations with each other. As such, none of the explanatory variables linearly predict other explanatory variables.

In order to affirm the interpretation of the correlation matrix the researcher

obtained the variance inflation factors.

	VIF	1/VIF
Year	1.11	0.899895
UnionStrength	1.08	0.923998
Race1	1.01	0.991380
EducRecode	1.05	0.950038
Age	1.05	0.952426
SexRecode	1.00	0.998238
GDP Growth	1.20	0.832828
POP Change	1.19	0.842484
-----+-----		
Mean VIF	1.09	

VIFs with a value near or above 10 are indicators of serious multicollinearity, and VIFs with values about 4 often warrant investigation (Pennsylvania State 2005). The VIFs produced in this assumptions test all have values near 1, indicating that there is no correlation between predictor variables. As all the VIFs are substantially lower than 10, the researcher concludes that the independent variables do not have a multicollinearity problem. As such, the direction of the beta estimators is not unduly influenced. As there is an absence of multicollinearity the model has the power to predict changes in the dependent variable based off changes in the independent variable.

A2. Independence of Residuals

The next assumption to be evaluated is the possibility of autocorrelation which would result from the residuals not being independent. Within the context of this study an autocorrelation problem could mean that an individual's employment outcomes yesterday affect his/her employment outcomes today, therefore the researcher would not be able to accurately attribute fluctuations in hours worked to the independent variables. As every individual respondent in this study is recorded only once, there is not a possibility of autocorrelation.

A3. Normality

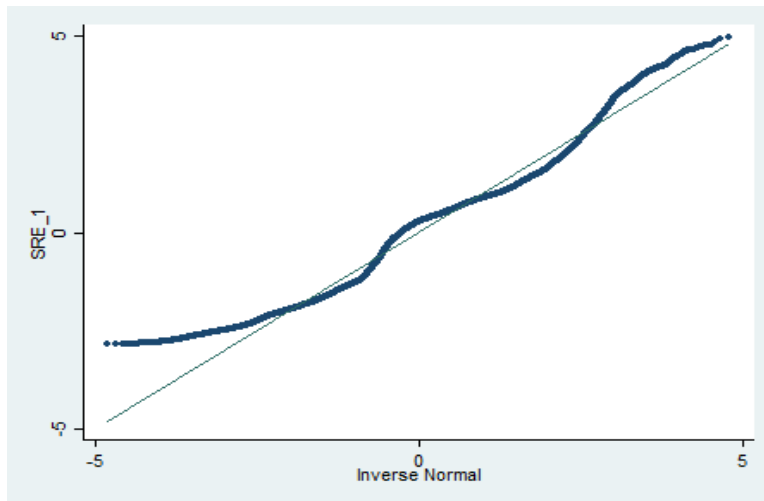
OLS regression models are built on the assumption that residuals are normally distributed. A normal distribution would have a skewness of 0 and an excess kurtosis of 0

The following table displays the results for a test of normality of the residuals:

Descriptive Statistics							
	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Standardized Residual	1328629	.0000000	.99999699	-.330	.002	-.294	.004

Though the kurtosis is indicative of a slight platykurtic (thin tailed) distribution, the large sample (200 or more) should diminish the underestimation effects (Tabachnick and Fidell 2007). The skewness and kurtosis values are conventionally deemed to be within a normal range (Tabachnick and Fidell 2007).

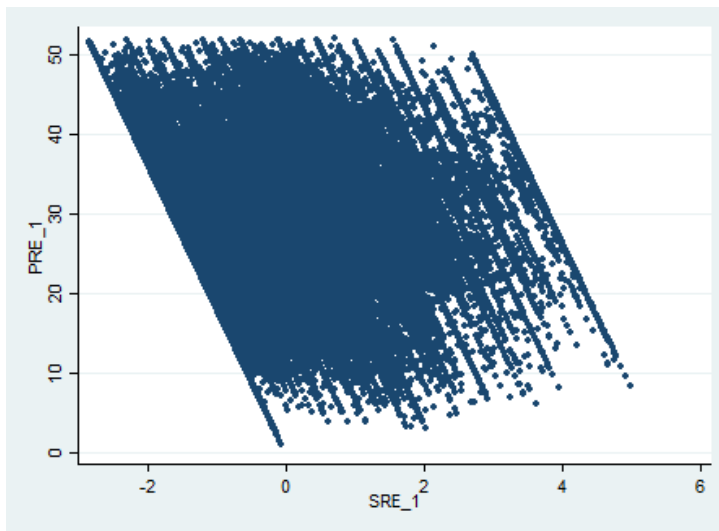
To visualize the normal distribution the researcher produced a graph plotting the quantiles of the residuals against the quantiles of a normal distribution. This graphic, which was produced using the `qnorm` function in STATA is indicative of a normal distribution as the residuals fall in a linear pattern.



As the residuals are scattered closely around the line, the researcher affirms that the residuals are normally distributed.

A4. Homoskedasticity

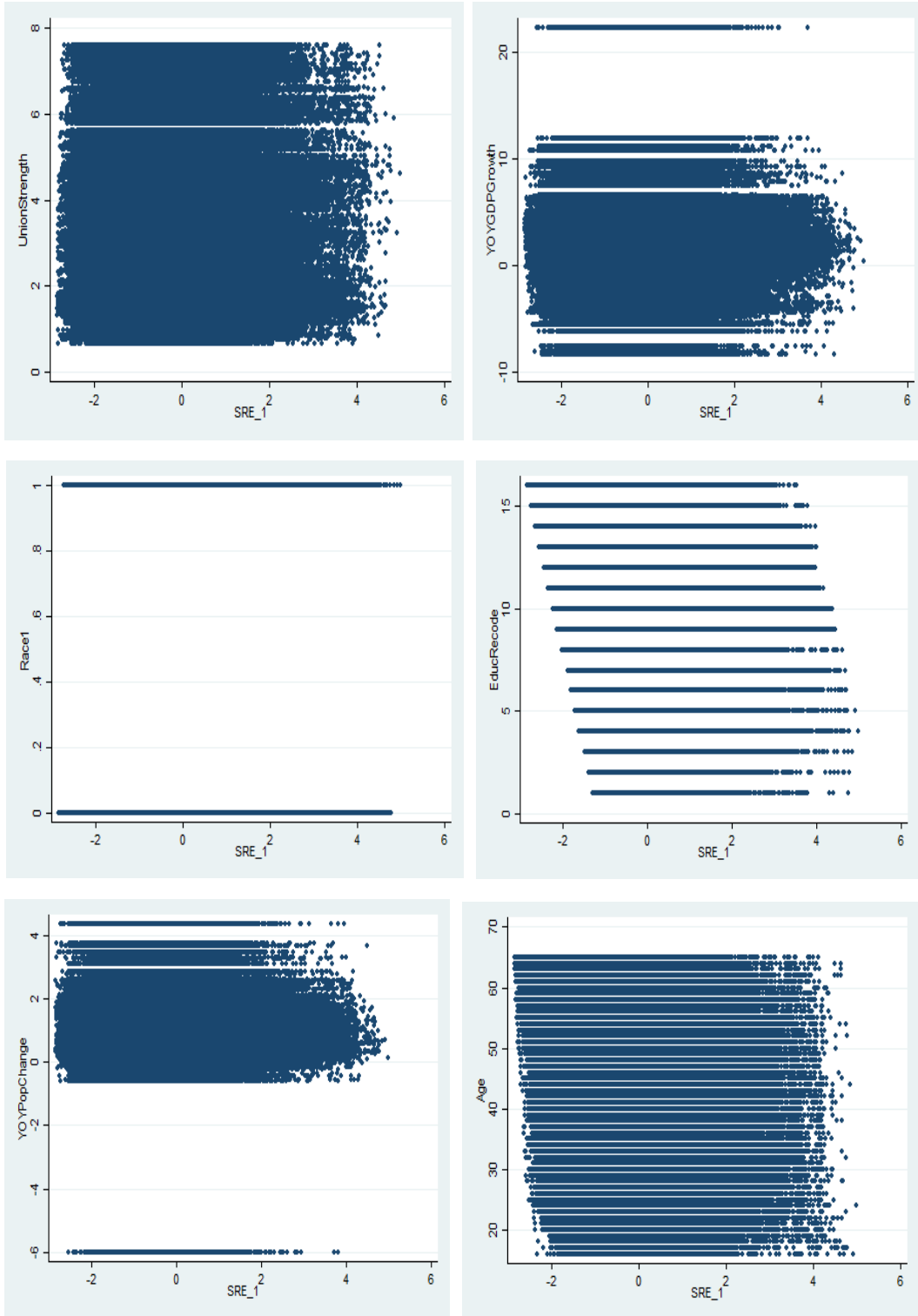
Linear Multivariate regression models assume that error terms exhibit non-zero constant variance (Tabachnick and Fidell 2007). The variability in hours worked should be the same for all levels of the independent variables. This constant variance assumption is termed homoskedasticity. In an effort to test for homoskedasticity the researcher produced the following graph plotting predicted values (PRE_1) against studentized residuals (SRE_1).

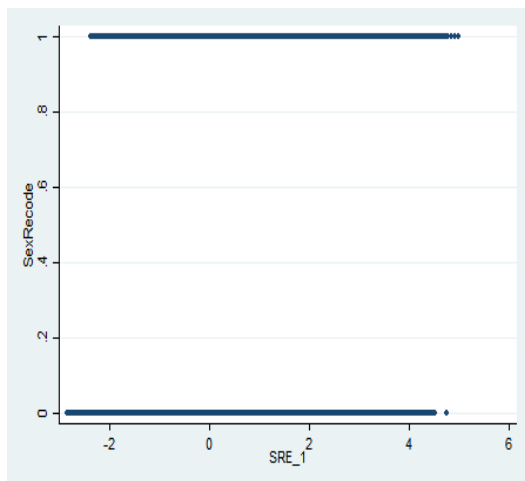


As no particular level of predicted values are accompanied by especially high or low error values, the graph is deemed to be indicative of a model that does exhibit homoskedasticity.

A5. Linearity

The linearity assumption requires that independent variables and the dependent variable exhibit a straight-line relationship. As Tabachnick and Fidell (2007) note, the linearity assumption is important because significant non-linear relationships are ignored during model estimation. In order to diagnosis linearity, the researcher produced residual plots of the predicting variables.





Linearity appears to be present as residuals are both negative and non-negative in equal proportion throughout different levels of the independent variable. It is therefore evident that there is not a significant curvilinear relationship which led to an inappropriate estimated value (which would be demonstrated by especially high residuals for specific values of the independent variable).

A6. Non-Stochastic Independent Variables

The last assumption of normal linear regression that has to be considered is that the independent variables are non-stochastic. This assumption is violated if independent variables are correlated with error terms, thus exhibiting endogeneity. An endogeneity problem exists when there is a confounding variable impacting both the explanatory variables and the dependent variable.

As the researcher considers this problem, the problem of reverse causality or loop causality must also be examined. This phenomenon exists when the independent variable impacts the dependent variable, but the dependent variable also impacts the independent variable. Should reverse causality exist in this study it would mean that union strength causes employment outcomes to shift, but as employment outcomes shift unions feel the need to either strengthen or weaken in response to how well they believe the economy is treating their members.

Though the researcher acknowledges that endogeneity and reverse causality may be a problem, time and data constraints prevented testing of this assumption. For the purpose of this study, the researcher supposes that non-stochastic effects are minimal if they exist. This assumption by the researcher is important to consider as one reviews the model.

VII. Conclusions

The results of the analysis show local union strength negatively impacts individual hours worked. Though the impact of union strength is negative and significant it is important to note that worker quality (or perceived worker quality) proxies, like education, gender, race and sex, dwarf the effect of union strength. The relative importance of union strength and worker quality found in this study mimics both the theories of the neoclassical tradition and the findings of Montgomery (1989). What firms care about is marginal product of their workers. Though union strength may set the threshold higher for workers to produce marginal revenue which warrants higher wages, this research indicates that personal factors are larger determinants of whether firms feel that workers can satisfy this increased threshold.

The results of this study contradict the finding of Montgomery (1989) and the neoclassical tradition which both suggest that economic factors should be powerful determinants of individual employment outcomes. This researcher finds that year over year percentage population changes exhibit the expected direction of the relationship to hours worked, but the magnitude of the effect is small. The study also finds that local year over year percentage real GDP change has an inverse relationship to hours worked.

One possibility for this discrepancy between theoretical predictions and the empirical results regarding percent year over year real GDP change is that as GDP decreases and businesses are strained, employers try to squeeze more working hours out of every existing employee and thus working hours increase. Another possible explanation for the contrasting findings of this study and Montgomery's study regarding the strength of economic factors upon hours worked is the fact that this study defined the local environment by state whereas Montgomery's analysis defined locality at the standard metropolitan statistical area level. As this study determines that year over year percent population change and year over year percent real GDP change effects are minimal the researcher considers that perhaps levels, or change measured in levels (as opposed to percentage change), of population or real GDP are better measures of economic impacts than trends.

Though economic effects were weak, the effect of time was relatively strong. This finding supports the time effect which has proved a significant determinant of employment outcomes by previous researchers. The researcher hypothesizes that time has such a significant effect because business expectations are significantly altered during times of recession and expansion.

As time had a significant negative effect on hours worked even in the presence of union strength controls this research refutes Lewis' seminal conclusion that unions are more active during times of recession than times of expansion (Somers 1964). If Lewis was correct, then this study would have found union strength to have stronger effects than time.

Future research should consider investigation of the possibility that only very local GDP or far reaching national GDP affects employment as opposed to state level GDP. Future researchers may also find benefit in incorporating business expectations and confidence as an explanatory variable in the model to proxy for local labor market conditions. As GDP only is released quarterly businesses react to more timely information like the PMI confidence index or sales projections. This researcher was not able to incorporate business confidence or expectations because data could not be located at the local level.

Quartile regression would also be a useful tool to analyze the relationship between union strength and hours worked to determine if the effects are significant for unions with certain strengths. The relatively small effect age had upon hours worked may indicate that age is not a proper proxy for experience. This would explain why the researcher found that experience (age) was less important than union strength in determining hours worked whereas Montgomery (1989) found that experience's effect dwarfed that of union strength. Future researchers who could locate individual workplace experience or tenure would improve this study by utilizing it as an explanatory variable.

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