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Abstract

By July 2009, the U.S. unemployment rate had increased to levels not seen in 26 years, leaving millions of Americans out of work. By looking at factors associated with unemployment in the past, we can gain greater insight into the causes of unemployment today. This paper explores factors associated with unemployment rates across metropolitan areas in the United States in 2007. I investigated how the rate of unemployment is affected by various economic components such as economic diversity, housing prices, population, salary, and region. I found that population has a positive relationship on the rate of unemployment, that there is an interval in which increasing the number of manufacturing jobs will decrease the unemployment rate, and that wage and housing prices have an inverse relationship with unemployment rates.

Introduction

This unemployment rate has increased significantly from 4.5% in April 2007 to 5.0% in April 2008 to 8.9% in April 2009 (U.S. Bureau of Labor Statistics). The number of available jobs has fallen dramatically because companies were forced to cut positions as a response to the recession. If there were a way to predict how unemployment rates respond to different economic factors, it would be possible that the economic repercussions of unemployment could be made less severe or even preventable in the future. In this paper, I explored the variables affecting the unemployment rate in U.S. metropolitan areas in 2007 in order to gain a better understanding of the economic downturn of 2009.

In particular, the focus of this paper is on the relationship between economic diversity and unemployment rates. This is an important issue to be addressed, especially in the midst of the largest economic downturn since 1980. Many people are faced with unemployment as companies close their doors. If an area is more economically diverse, one would expect the change in unemployment rates to be

less dramatic, as individuals could find employment in other sectors of the economy. In addition, I examined the relationship between unemployment rates and housing prices, as much of the 2009 recession has been blamed on the infamous bursting of the "housing bubble."

Literature Review

Each of the following three articles addressed to some extent the effects of a diversified economy. Despite the range of time periods studied, all three sets of authors concluded that the industrial composition plays a role in an area's stability.

Cutler and Hansz (1971) summarized their assessment of the relative degrees of response that various Metropolitan Statistical Areas (MSAs) had to economic activity during a period of general economic expansion. The dependent variable for their analysis was sensitivity of cities to fluctuations in the economy. They defined sensitivity to be the relative showings of change with respect to bank debits and non-agricultural employment. The primary independent variable used was industrial composition. During their tests for the relationship between sensitivity and industrial composition, they employed the following variants of composition: employment in the manufacturing of durable goods as a percentage of all manufacturing employment and as a percentage of total employment, and manufacturing employment as a percentage of total employment. Their research summarized that the hypothesis, which stated that a genuine connection between industrial composition and sensitivity to economic fluctuations, was corroborated when attention is paid solely to the most industrialized part of the country.

Gittell and Sohl (2005) concentrated on the technology sector. Their objective was to gain insight into regional high-technology areas during times of economic contraction. The regions they focused on were 25 of the 287 U.S. MSAs. The 25 MSAs chosen for this study were those "top ranked" by the Milken Institute in 1999. In the model by Gittell and Sohl the dependent variable was the percentage change in MSA total employment from March 2001 to February 2003. They used five explanatory variables: venture capital per worker, average wages across all industries, employment in the high-tech sector, diversity in high-tech employment, and information industry concentration. They found that, even though high-tech centers perform at or near the national average, some fared poorly during the downturn. Gittell and Sohl speculated that this was due to a poorly diversified base, high wages, and high levels of venture capital funding. They concluded that high-tech centers are just as vulnerable as other industries to pronounced economic cycles of growth and decline because they are no more resilient during periods of economic decline than other industries.

Izraeli and Murphy (2003) examined the effect of industrial diversification on the unemployment rate and per capita income of states. They tested to see if more industrially diverse states were less prone to the spells of high unemployment and if more specialization within a state would lead to higher incomes. The dependent variable used for this model was the state unemployment rate. The model took into account the following independent variables: (a) the measure of the degree of industrial diversity, (b) state per capita income, (c) population density, (d) working age of population, (e) percent of total population that was non-White, (f) percent of total population ages 16–19, (g) percent of total population over 65, and (h) the national

unemployment rate. Both Gittel and Sohl and Izraeli and Murphy took their data from the Bureau of Labor Statistics. Similar to the findings of Gittell and Sohl, there was evidence to suggest that diversity leads to decreased unemployment. Izraeli and Murphy's research led them to recommend that diversification policies be implemented because the policies seemed to have little downside.

Economic Model

I explored the changes in the unemployment rate in various U.S. metropolitan areas, using the rate of unemployment (*unemploy*) as my dependent variable. The data in my regression came from the U.S. Bureau of Labor Statistics Web site. I focused on 317 of the 350 MSAs. The subset of metropolitan areas chosen was determined by including only the areas that had information available for each variable in my model at the time of study. The independent variables included population (*popul*), wage and salary disbursements (*wage*), the median housing prices (*house*), and the number of manufacturing jobs in a given location (*manuf*). My proposed model is represented in the equation below:

$$Unemployment = \alpha + \beta_1(popul) + \beta_2(wage) + \beta_3(manuf) + \beta_4(house) + \beta_5(north) + \beta_6(south) + \beta_7(west) + \varepsilon$$

The coefficient for population was expected to be positive. That is, as population increases so will the rate of unemployment. As more people live in an area, more people may be unemployed at any one time, which will cause a higher rate of unemployment. To test this prediction, I used the population numbers provided by the Population Division of the U.S. Census Bureau. I anticipated that the coefficient on salary would be negative. The data for this variable was actually the value of wage and salary disbursements, in the given MSA, which I found on the U.S. Bureau of Labor Statistics Web site. Areas with higher salaries may be more stable and thus less susceptible to higher instances of unemployment.

Based on the National Association of Home Builders (NAHB) data, I expected the coefficient on median house price to be negative. As the median price of a house in the housing market increases, one would expect to see less unemployment because people will have steady employment in order to make their housing payments. This was a variable of particular interest as the instability of housing prices was a primary focus during the analysis of the 2009 economic downturn.

To measure economic diversity, I used the total number of manufacturing jobs in the state in which the metropolitan area is located. Because the effect of the downturn varied by industry, I anticipated that if an area is more economically diverse, that is, not reliant on solely one industry, then the amount of unemployment would be less affected by an economic downturn. Historically, the more industrial cities of the rust belt were harder hit than areas with greater economic diversity. This led me to believe that more industrial MSAs would have higher unemployment; therefore, this coefficient would be positive.

I also included dummy variables to control for region of the country; this provides insight into whether the geographic position of the MSA plays a role in determining the rate of unemployment. Based on divisions set forth by the U.S. Census

Bureau, I divided the MSAs into four main regions: Northeast (*north*), South (*south*), Midwest (*midwest*), and West (*west*). Table 1 summarizes the data:

Table 1
Summary of Variables

Variable	Summary statistics				Sign	Explanation/definition	Source
	Count	%					
north	44	13.88			+	Assumes the value of 1 for states located in the Northeast Census Region.	U.S. Census Bureau
midwest	75	23.66			N/A	Assumes the value of 1 for states located in the Midwest Census Region.	U.S. Census Bureau
south	125	39.43			-	Assumes the value of 1 for states located in the South Census Region.	U.S. Census Bureau
west	73	23.03			-	Assumes the value of 1 for states located in the West Census Region.	U.S. Census Bureau
	Mean	Standard deviation	Min	Max			
wage	16.2	44.1	1.1	580.0	-	Wage and salary disbursements (billions of dollars) – This variable helps to indicate how the disbursement of wages within a given metropolitan area affects unemployment.	U.S. Department of Commerce – Bureau of Economic Analysis
popul	0.7	1.6	0.0007	19.0	+	Population (2007 estimate in millions) – This variable shows how population affects unemployment in a given metropolitan area.	U.S. Census Bureau, Population Division
house	252,849	105,446	85,804	849,020	-	Median housing prices (2007 in dollars) – This variable is included to explain the relationship that may exist between housing prices and unemployment.	NAHB/Housing Economics
unemploy	4.7	1.6	2.0	18.0	N/A	Unemployment rate (2007) – This is our dependent variable; I tried to find a model to predict unemployment rate in given metropolitan areas based on the other variables.	U.S. Bureau of Labor Statistics
manuf	4,863	4,052	284	15,136	+	Number of manufacturing jobs (by state, in thousands for Jan. 2007) – This variable helps to explain how the number of manufacturing jobs affects the rate of unemployment.	www.cnn.com/SPECIALS/2009/map.economy/index.html
Note: Sample size = 317							

The metropolitan area with the largest population was New York City, with 19 million residents; it was also the metropolitan area with the highest incomes, totaling more than $577 million. The metropolitan area with the smallest population was Casper, WY, with 71,784 inhabitants. However, the smallest population did not coincide with the metropolitan with the smallest wage and salary distribution. Instead, Danville, IL, had the smallest wage and salary distribution at $1.1 million. The metropolitan area of San Jose-Sunnyvale-Santa Clara, CA, had the highest median home price at $849,022. Charleston, WV, had the lowest reported median home price at $85,804. California had the largest total number of manufacturing jobs, and Wyoming had the smallest. Of the 317 MSAs in the study, 39% were located in the South, 24% in the Midwest, 23% in the West, and 14% in the Northeast.

Data Analysis

All of the models that were tested were generated using Ordinary Least Squares multiple regression analysis, which provided estimated coefficients, standard errors, *t*-ratios, and *p*-values for each of the variables in the regression (see Table 2). The natural log was taken of total wage and salary disbursements (*lnwage*), of median home price (*lnhouse*), and of population (*lnpopul*) to allow interpretation as a percentage value. I also included nonlinear terms for manufacturing (*manuf*, *manufsq*, *manufcb*) and an interaction between the Northeast region of the United States and manufacturing (*normanuf*). The interaction term was used because the two variables were suspected of having different effects together than separately. This new variable allowed me to ask whether manufacturing in the Northeastern region had a different effect on unemployment than manufacturing in other regions.

As indicated in Table 2, almost all of the variables in the regression are statistically significant at the 1% level or better. The final regression had an R^2 value of 0.4178 and an adjusted R^2 value of 0.3987. From this information, I concluded that the model explained approximately 40% of the variation in the rate of unemployment.

Table 2
Coefficients and Standard Errors of Variables in Final Regression

Variable	Estimated coefficient	Standard error	*t*-ratio	*p*-value
constant	16.94	3.02	5.61	0.00
lnwage	-2.36	0.33	-7.06	0.00
lnhouse	-0.69	0.24	-2.86	0.01
lnpopul	2.51	0.37	6.82	0.00
manuf	0.00009	0.0002	6.06	0.00
manufsq	-0.000002	0.0000002	-6.63	0.00
manufcb	0.72 E-11	0.10 E-11	7.05	0.00
south	-0.87	0.15	-5.76	0.00
west	-0.48	0.30	-1.59	0.11
north	0.43	0.30	1.45	0.15
normanuf	-0.0001	0.0004	-3.43	0.00

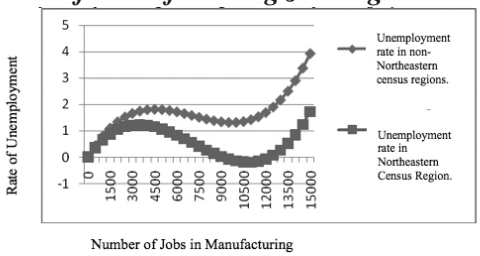
Table 3 summarizes the interpretations of the coefficients corresponding to each variable in Table 2. While examining the interpretations of the coefficients in the table below, it is important to keep in mind the scale in which unemployment is measured. The data used for the regression has a range of unemployment rates of 2–18, a median value of 4.4, an average value of 5, and a standard deviation of 1.55.

Table 3
Coefficient Interpretations

Variable	Estimated coefficient	Interpretation of coefficient
constant	16.94	This number indicates that the unemployment rate would be 16.94%, assuming all other variables took the value 0.
lnwage	-2.36	Holding all else equal, a 1% increase in wage and salary distributions in a given metropolitan area is associated with a drop in the unemployment rate of 0.024%.
lnpopul	2.5	Holding all else equal, a 1% increase in the population of a given metropolitan area is associated with an increase of 0.03% in the unemployment rate.
lnhouse	-0.69	Holding all else equal, a 1% increase in the median housing price in a given metropolitan area is associated with a 0.07% drop in the unemployment rate.
manuf	0.94798*10^-3	*See Figure 1.
manufsq	-0.15338*10^-6	*See Figure 1.
manufcb	0.71753*10^-11	*See Figure 1.
south	-0.87	Holding all else equal, metropolitan areas located in the Southern Census Region on average have an unemployment rate 0.87% lower than the Midwest.
west	-0.48	Holding all else equal, being located in the West Census Region is associated with an unemployment rate that is 0.48% lower than in the Midwest.
north	0.43	*See Figure 1.
normanuf	-0.14664*10^-03	*See Figure 1.

By plotting manufacturing against the unemployment rate, the complicated relationship that exists between the two variables became visible in Figure 1. The lower curve represents the effect seen in the Northeast Census Region, and the upper curve shows manufacturing's effect in the other regions. Changes in the number of manufacturing jobs in the Northeast cause greater variability in the unemployment rate than is seen in other regions. However, the unemployment rates in regions outside the Northeast are always higher. In the Northeast Census Region, the unemployment rate increases until the number of manufacturing jobs reaches 3,445, then it decreases until there are 10,805 manufacturing jobs, after which it increases again. All other regions follow a similar trend, but the number of manufacturing jobs at which the unemployment rate changes direction is different. The rate of unemployment for non-Northeastern census regions increases until the number of manufacturing jobs equals 4,530, after which it falls until there are 9,719 manufacturing jobs, before rising again. This suggests that in all regions there is an optimal number of jobs that should exist in the manufacturing sector.

Figure 1
Plot of Manufacturing Jobs Against Rate of Unemployment



Conclusion

The purpose of this study was to determine the factors associated with the unemployment rate in cities in 2007 in order to better understand possible causes for the increase in unemployment in 2009. With my model, I was able to offer an explanation for 40% of the variations in unemployment rates across the country. I found that median housing price, population, salary, and region were all associated with fluctuations in the rate of unemployment in a given metropolitan area. In particular, population has a positive relationship with the rate of unemployment, there is an interval in which increasing the number of manufacturing jobs will decrease the unemployment rate, and wage and housing prices have an inverse relationship with unemployment rates in metropolitan areas.

These results imply that metropolitan areas seeking to reduce unemployment rates should pay close attention to the number of manufacturing jobs in their region, ideally existing in the interval where additional manufacturing jobs coincide with decreasing unemployment rates. This suggests that local governments should work to promote economic diversity to not be underreliant or overreliant on manufacturing.

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