Examine the change of the unemployment rates during Covid-19 pandemic in Illinois (August 2020 – October 2021)

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Abstract:

Since the outbreak, various parts of the world have experienced shutdowns and production stoppages. This has dealt a huge blow to the industrial chain in a globalized economy. Higher operating costs for businesses due to shortages of goods and rising prices, which in turn have caused waves of unemployment, have occurred in most countries. As countries have started vaccine development, clinical trials, mass production and distribution of vaccinations, a long recovery process has begun. This paper uses spatial autocorrelation and regression analysis to examine the factors that may affect the rate of decline in unemployment in Illinois counties under Covid-19, covering age, race, education level, and complete vaccination rates. The results show that among a number of factors, the ethnic diversity of a region has the greatest impact on the unemployment rate, and the greater the diversity, the faster the unemployment rate declines in that region. At the same time, the higher the level of education, the lower the level of aging, and the higher the rate of complete vaccination, the better the region recovered from the epidemic and the faster the unemployment rate declined.

Keywords:

Covid-19, unemployment rate, Illinois, aging, education, ethnic diversity, vaccination completion, economy, labor force, recover

Background:

Back in 2020, Covid-19 pushes the U.S. unemployment rate to new heights at once - the last time it peaked was in October 2009, when it peaked at 10%. While in April 2020, the unemployment rate jumps straight up to 14.8%, only to fall back below 10% in August 2020. An article published by the National Academy of Sciences in July 2020 notes that the new crown epidemic has made that 43% of small businesses were temporarily closed and that employment had fallen by 40% while small businesses employ almost 50% of American workers. In addition to small businesses, Covid-19 has impacted the tourism, retail, and global supply chain & logistics industries. It also re-emphasizes the urgency of getting back to normal. So, the goal for this research is to figure out the potential factors which may affect the change of unemployment rate from August 2020 to October 2021.

Study Area and Data Source:

Study Area: Illinois State on County Level

Data From CDC:

1. Covid-19 Vaccination Completion Rates (monthly, 08/2020-10/2021)

Data From US Census:

2. Unemployment Rate (monthly, 08/2020-10/2021)
3. Population Percentage over 60 (ACS 2019 5-year-estimate)
4. Education Attainment (over 25, bachelor or higher) (ACS 2019 5-year-estimate)
5. Work Force by Race (over 18, black) (ACS 2019 5-year-estimate)

Methodology:

Global assumptions:

1. $y = Dependent\ variable: Unemployment\ Rate$

2. $x = Independent\ variable: Vaccination\ Completion\ Rates, White\ Work\ Force\ Population\ Percentage\ over\ 60, Education\ Attainment, Black\ Work\ Force$

Spatial Autocorrelation:

1. Moran's I:

$$I = \frac{n\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\left(\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}\right)\sum_{i=1}^{n}(x_i - \bar{x})}$$

$I\ =\ index$

$n =\ the\ amount\ of\ counties$

$x =\ the\ value\ of\ a\ specific\ independent\ variable, \bar{x}\ is\ the\ mean\ of\ x$

$w =\ the\ weight\ setting\ between\ county\ i\ and\ j$

In Bivariate Moran's I, x_i and x_j are different variables.

2. Local Moran's I (LISA):

$$I_i = z_i \sum_j w_{ij} z_j$$

$j\ is\ the\ neighbor\ county\ of\ i$

$z\ is\ z\ value\ of\ a\ county$

Regression Analysis:

3. Ordinary Least Squares Regression (OLS):

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_p x_{ip} + \varepsilon_i$$

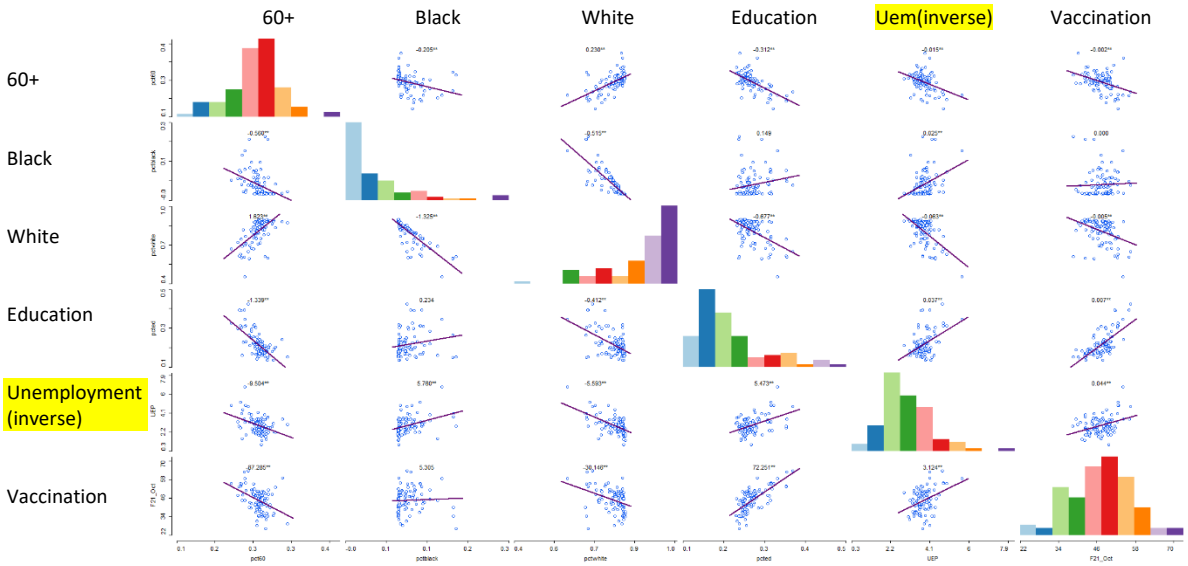
$\beta\ is\ the\ coefficient\ of\ a\ specific\ independent\ variable$

$\varepsilon\ is\ the\ error\ coefficient$

Results:

Overview:

In this part we use scatter plot map to show the correlation between the variables.



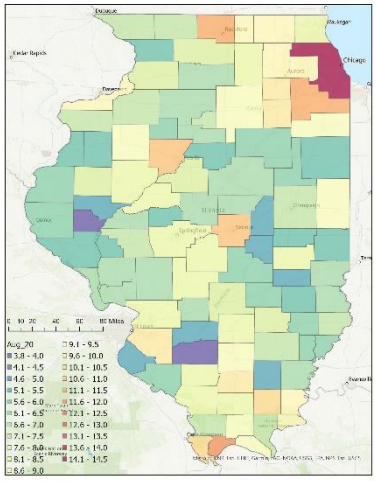
Because the data in this matrix are symmetric, we focus only on the triangular area in the lower left corner.

The data in the first column indicate that a county with more people over the age of 60 has a larger share of the white labor force, a smaller share of the black labor force, and a smaller share of the highly educated and vaccinated population.

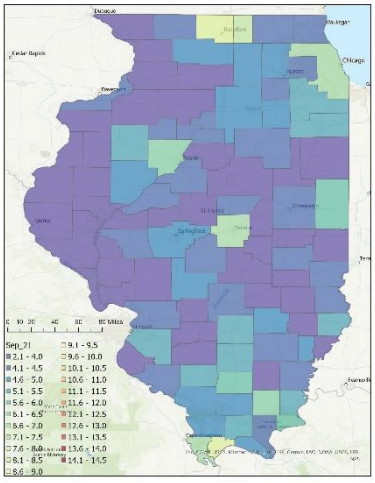
Although the correlation between the white labor force and the black labor force and the other variables is reversed, the slope of the data in these two columns is different, and the slope between the black labor force and the other variables is smaller than the slope between the white labor force and the other variables. So, what is reflected here is the correlation between the degree of ethnic diversity and the other variables, i.e., in ethnically diverse areas, people have higher levels of education, higher rates of complete vaccination, and younger age of the group, and the faster the unemployment rate falls.

If a county has a higher percentage of people with higher education, then that county has a higher rate of complete vaccination and a faster drop in unemployment.

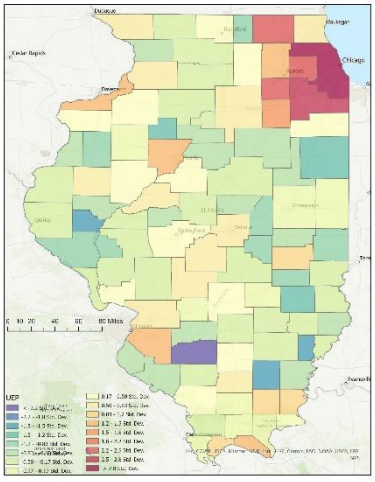
Unemployment Rate in Aug 2020



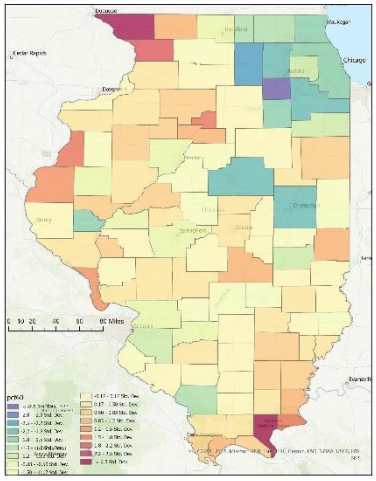
Unemployment Rate in Sep 2021



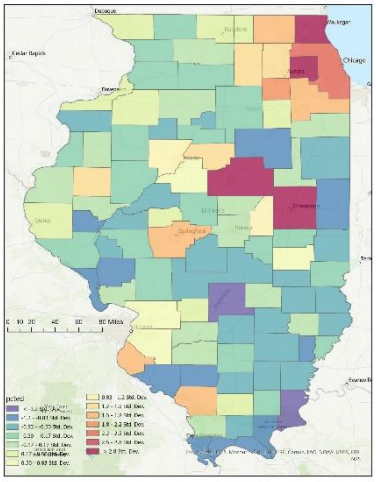
Unemployment Rate Change



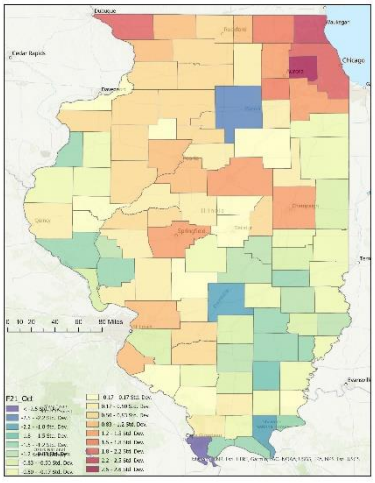
60+ Population Rate



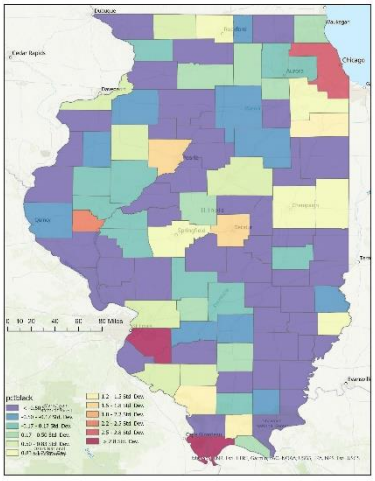
Higher Education Rate



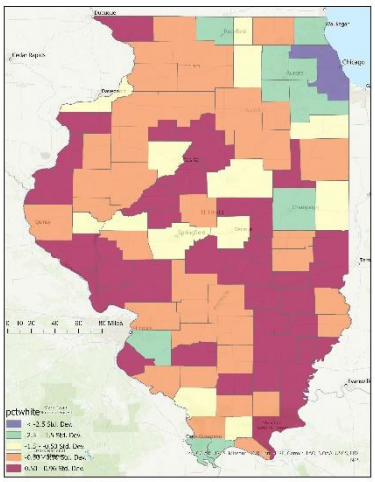
Vac—Completion Rate in Oct2021



Black Work Force Rate

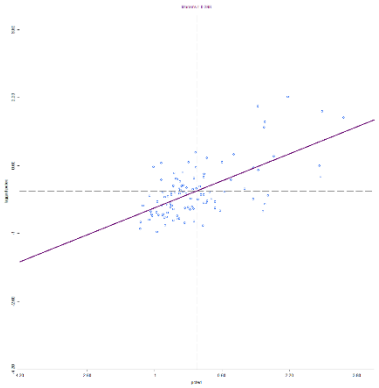


White Work Force Rate

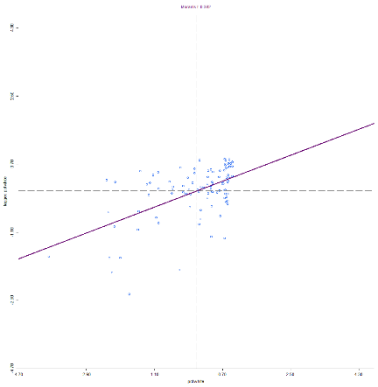


If we plot all the variables in the map, we can see that the most significant drop in unemployment, i.e., the best recovery, is concentrated around Chicago. After looking at the independent variables that may have contributed to this phenomenon, we find that this part of the city is more ethnically diverse, has a higher rate of higher education, fewer elderly people, and higher vaccination rates.

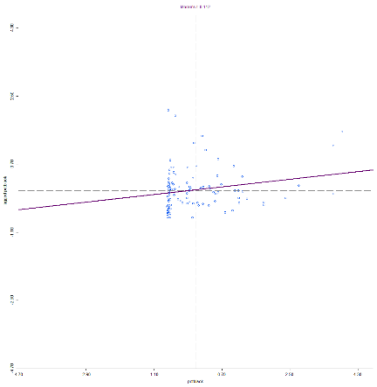
Global Moran's I:



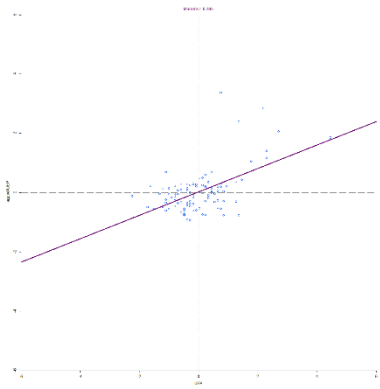
Unemployment Rate Decline:0.395



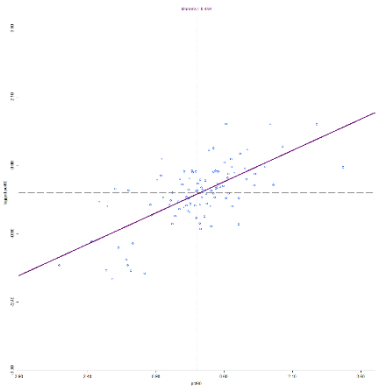
White Labor Force:0.382



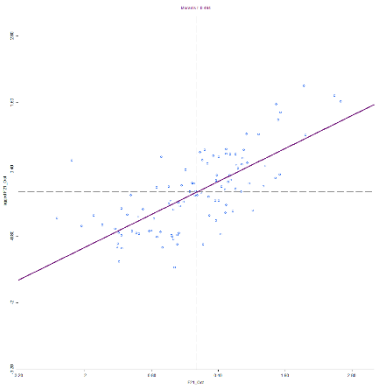
Black Labor Force:0.112



Education Attainment:0.398



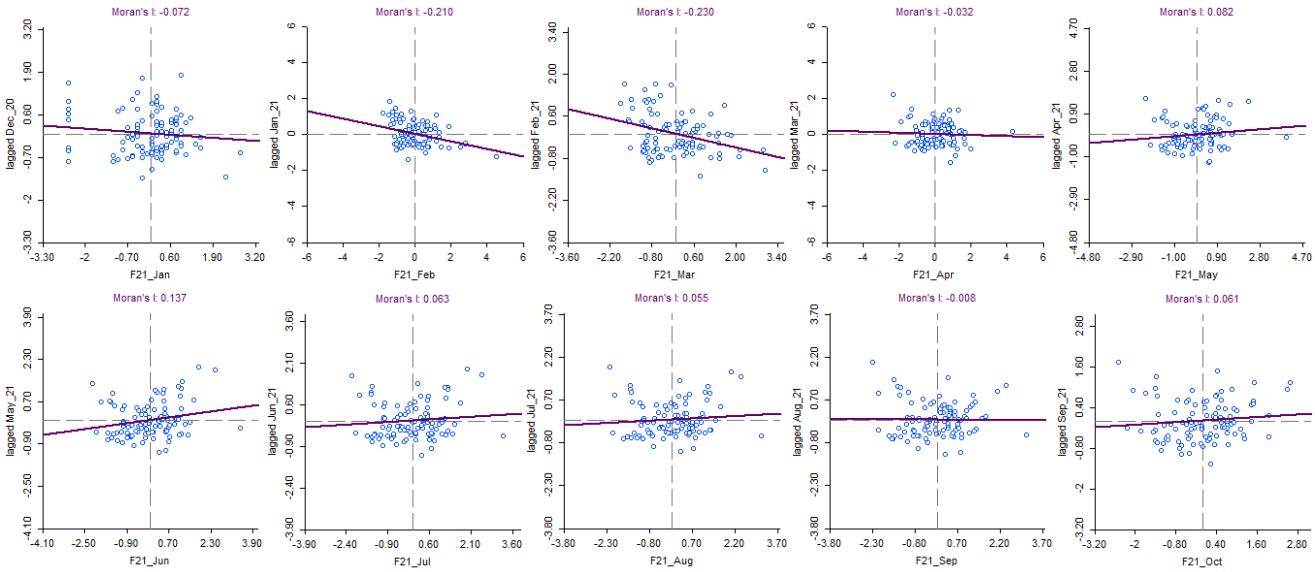
People Over Sixty:0.459



Vaccination Complement:0.494

Through the Global Moran's I test, we found that all of the independent and dependent variables in our study have different degrees of clustering pattern except for the spatial distribution of the black labor force, which is more randomly distributed.

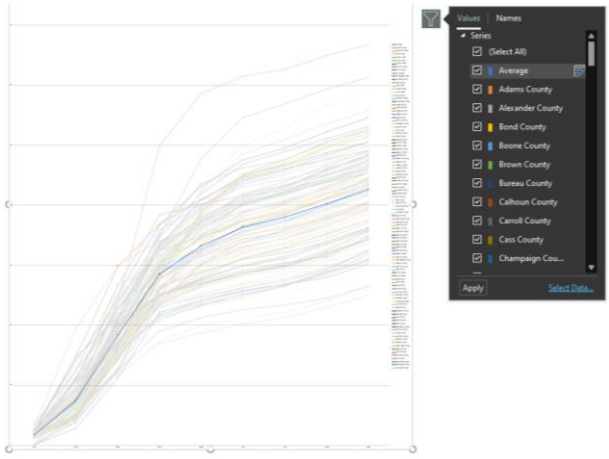
Bivariate Moran's I: (F stands for finished vaccination)



The Bivariate Moran's I test was selected using unemployment data from December 2020 to September 2021 and cumulative vaccination rate data from January 1, 2021 to October 1, 2021. The data were chosen this way because too few people are vaccinated before 2021, and their share is not yet ready for study precision. In this study we use the cumulative vaccination rate on the first day of each month to express the cumulative vaccination rate as of the previous month, which is why we use the cumulative vaccination rate on January 1, 2021 as the horizontal coordinate and the unemployment rate data for December 2020 as the vertical coordinate, and so on.

The results of Bivariate Moran's I show that, overall, unemployment is not strongly associated with vaccination status. An interesting phenomenon is that in this ten-month plot, the slope is initially negative, reaches a peak of negative slope in March, then shows a positive slope (i.e., the cumulative vaccination rate and unemployment rate are positively correlated), and then returns to a level close to the rate of zero. The reason for this may be that the

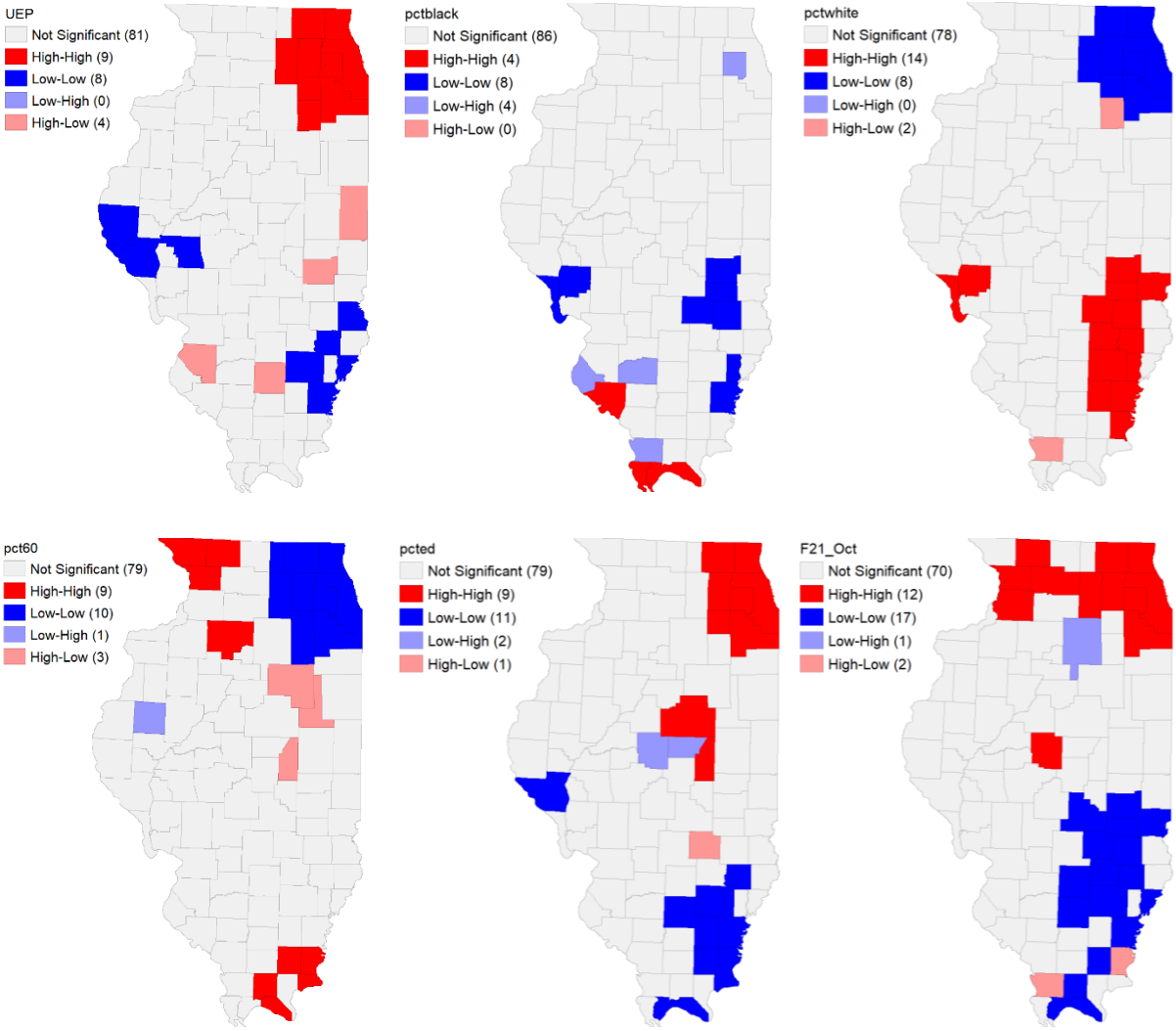
rate of vaccination was high in the early period and peaked in March, when the unemployment rate also continued to decline, and then the unemployment rate stalled or even rebounded once, while the vaccination rate was still growing but at a slower rate.



2021 Illinois Unemployment Rate from U.S. BUREAU OF LABOR STATISTICS

Illinois Average Cumulative Vaccination Rates (Unweighted)

Local Moran's I (LISA): (F21_Oct stands for finished vaccination in 10/2021)



The results of LISA show that the spatial distribution of cold hotspots is not consistent across the variables in all regions except Chicago and its surrounding areas and the Southeast. When only unemployment rate decline is analyzed as a dependent variable with other independent variables, only Chicago and its surrounding area leads to the more specific conclusion, that, the area is a cold spot for the white labor force as well as for elder over 60, and a hot spot for higher education attainment and vaccinations completion.

It is worth noting that LISA analyzes the correlation between the county and its neighbors. The results are still consistent with the findings of the previous experiments, namely that Chicago and the surrounding area are less aged, have higher vaccination rates, have higher unemployment rate reductions, are more ethnically diverse and have a larger share of people with higher education.

If there was any confusion about the previous tests that summarized and analyzed the percentage of blacks and whites in the labor market as ethnically diverse, LISA is more directly illustrative. In this test, Chicago and the surrounding area is a cold spot for the white labor force, but not a cold spot or hot spot for the black labor force. This indicates that the white workforce is significantly less represented in the region than the rest of the region but the black workforce does not show this phenomenon, again succinctly illustrating that other races are more represented in the region, i.e. the region is more ethnically diverse.

Ordinary Least Squares Regression (OLS):

Variable	Coefficient	Std.Error	t-Statistic	Probability
CONSTANT	8.78383	2.0861	4.21065	0.00006
Education	1.57256	1.66095	0.946786	0.34612
BlackLabor	-4.227	2.64275	-1.59947	0.113
WhiteLabor	-7.71992	1.9962	-3.86731	0.0002
60+Elder	3.08861	2.92448	1.05612	0.29356
Vaccination	0.003719	0.013846	0.268556	0.78885

The OLS regression test reflects 4 issues,

1. Among the many independent variables, the white labor force and unemployment decline are significantly negatively correlated.
2. The black labor force and the white labor force and unemployment decline are negatively correlated again indicating the positive correlation between ethnic diversity and unemployment decline.
3. The change in unemployment rate is not related to vaccination rate.
4. The percentage of people with higher education and the percentage of people over 60 years old and unemployment decline are only weakly correlated.

Conclusion:

When comparing the recovery from the epidemic, Chicago and its surrounding areas did the best, i.e., the largest decrease in unemployment over the same time period. If we take a closer look at the independent variables in the case of Chicago and its surroundings, we find that the reasons for this phenomenon are:

1. The ethnographic composition of the region is significantly diverse from other regions
2. The region is much younger, with a much lower percentage of the population over 60 than the other regions

3. The region has a much higher level of education, especially in higher education, than other regions

4. the vaccination rate is higher in the region, higher than the other regions

In addition, through spatial autocorrelation as well as regression analysis, we found that the decrease in unemployment was most associated with ethnic diversity and almost not with complete vaccination rates.

Literature Review:

A study by Mongey, Pilossoph, and Weinberg (2020) point out that workers most likely to be affected by job losses due to COVID-19 had lower levels of education, fewer economic resources, and lower levels of liquid assets. In short, they are the most laid-off and ungainly members of the American population. By contrast, many of the jobs that allow working from home tend to be white-collar professional jobs that include health benefits, paid sick leave and decent pay.

A study by Berube & Bateman, (2020) point out that, in many ways, nearly a quarter of U.S. workers are employed in immediate risk industries. Statistics show that of the 37.2 million vulnerable workers, nearly 10 million (more than a quarter) are employed in what the Census Bureau calls "food service and drinking establishments," often referred to as restaurants and bars. General merchandise stores (mainly department stores) are the second largest immediate risk industry in terms of employment, at 2.8 million.

A study by Neeta Kantamneni,(2020) point out that the industries most affected by COVID-19 have a disproportionate share of workers from low-income and racial/minority backgrounds, and a lack of decent jobs for low-income workers, many of whom are from Latino backgrounds.

A study by N Dragano, CJ Rupprecht, O Dortmann, M Scheider (2020) point out that in separate analyses for men and women show consistent results for both genders, especially in the case of

long-term unemployment (see Table 3). There are slight differences in short-term unemployment for men (stronger correlation for women) and for special benefit recipients (stronger correlation).

A study by T Chin, R Kahn, R Li, JT Chen, N Krieger, CO Buckee (2020) point out that, low-income communities and people of color are more vulnerable than others. Reports from Detroit, Milwaukee, New Orleans, and Chicago suggest a disproportionate share of deaths relative to the percentage of blacks in the population (2019 coronavirus disease).

Discussion and Further Studies:

1. The temporal factors were not studied in detail in this study, and only the differences between the beginning and end data were used. In further studies, more analytical studies including spatial autocorrelation will be conducted on the time scale.
2. Only a limited number of variables were discussed in this study. After reading the literature, I will include more potential factors in further studies. For example, sex, population density and GDP per capita, etc.
3. There were fluctuations in epidemics during the time period studied, and these several epidemic rebound (due to weather and mutation) could be potential subjects for study.
4. In the current study, we found that ethnic diversity contributed the most to the decline in unemployment. The conclusion that economic recovery is good in areas where racial minorities are concentrated is neither in line with public perception, nor is it reliable after reading the relevant literature. More research could be done on race in future studies.

5. After reading the literature, I believe that the racial representation of the unemployed population could be included in my subsequent study, as well as the types of unemployed jobs that could be included in the study.
6. Government relief payments have been mentioned in more than one literature, and when combined with the news during the epidemic, it can be found that relief policies, as well as mandatory employee vaccination policies, can also have an impact on the decrease in unemployment rates. These factors could be part of a follow-up study.

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