Case Western Reserve University Journal Of Economics

Volume 2
Issue 1 *Spring 2024*

Article 1

May 2024

SPRING 2024 Full Print

Editorial Board
Case Western Reserve University, joeeditors@case.edu

Recommended Citation

Board, Editorial (2024) "SPRING 2024 Full Print," *Case Western Reserve University Journal Of Economics*: Vol. 2: Iss. 1, Article 1.
DOI: https://doi.org/10.28953/APPL00011120.1013
Available at: https://commons.case.edu/joe/vol2/iss1/1

Board: SPRING 2024 Full Print

CWRU Journal of Economics

Spring 2024 Issue, Volume II

IN THE EDITION

CASE WESTERN RESERVE UNIVERSITY

journalofeconomics@case.edu

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CWRU Economics Department

Weatherhead School of Management at
Case Western Reserve University

Peter B. Lewis Building
11119 Bellflower Road
Cleveland, OH 44106

https://commons.case.edu/joe/vol2/iss1/1
DOI: 10.28953/APPL00011120.1013

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Letter from the Editors

The CWRU Journal of Economics is an award-winning, student-led initiative that offers experiential learning and career development opportunities for economics students. Each semester, we publish economic analysis of the Ohio region and beyond. The Journal serves as a platform for students to explore economic research, build data analysis skills, and connect with peers interested in economics.

Our students are split into teams to write their articles for the semester. Our editors collaborate with each group to refine research ideas and foster academic and career mentorship. Teams also meet with faculty mentors to receive project feedback and guidance. We would like to send a special thanks to Dr. Sining Wang, Dr. Mark Schweitzer, Dr. Susan Helper, Dr. David Clingingsmith, and Dr. Jenny Hawkins for advising our teams this semester.

As you flip through the Journal, you will read twelve articles that explore a variety of topics in economics research, including inequality, education, and labor markets, highlighting the diversity of the field and our students' interests. We hope you gain a better understanding of our local economy and the socioeconomic and political issues facing our community.

The Spring 2024 Edition is the Journal's second ever publication. Between semesters, our cohort doubled in size to expand our mission to as many students as possible, and we pushed students to dig deeper into their topics of interest. We held our first Project Pitch event for students to practice communicating a large idea in a short, succinct presentation to senior leaders. In addition, three of our student teams had the unique opportunity to present their findings at the Federal Reserve Bank of Cleveland's Economic Scholars Program, an undergraduate research symposium that teaches students what it is like to participate in a research conference. Our student presenters went above and beyond to prepare a research proposal, conduct econometric analyses, and deliver a ten-minute presentation in front of economists. Some of our students also participated in the program's Peer Review Board or served as discussants or session chairs at the conference. Thank you to the students, professors, and Federal Reserve economists and research analysts that provided feedback and encouragement for our teams.

Next semester, we are excited to implement a new organizational structure to the Journal. Our students will work across three divisions—Research and Editorial, Regional Analysis, and Outreach—with our talented rising seniors serving on a revamped editorial board. Our incoming first years will participate in quantitative training to develop their data, coding, and critical thinking skills and better prepare them for economic analysis. Sophomores and juniors will continue to explore their areas of interest under the mentorship of our editors through Investigative Discussion and Economic Analysis (IDEA) Papers. Building upon the creation of our Economic Resilience Index, select students will work to develop new indexes focused on creating new economic gauges for Ohio and its constituent regions. The remainder of our students will work on the Outreach Division to maintain and forge new partnerships with local news organizations, nonprofits, and research institutions in the Cleveland area.

This edition is the last publication led by the founding senior editors. Although we will be graduating and moving onto predoctoral programs out-of-state, we plan to remain actively engaged in the implementation and continuous improvement of our organizational structure and development of new initiatives and partnerships. Reflecting on the past year, we would like to express our highest appreciation for our faculty advisor, Dr. Sining Wang. His dedication and passion for not only the Journal but for expanding opportunities for CWRU Economics undergraduates has shaped us into better mentors and leaders. He has inspired us to do our best work in the Journal and in our other academic and professional endeavors.

We thank you for your readership!

Brooke Hathhorn	*Katie Merritt*	*Henry Blyth*	*Beck Pierce*
Brooke Hathhorn	Katie Merritt	Henry Blyth	Beck Pierce
Editor-in-Chief	Editor-in-Chief	Senior Editor	Senior Editor

Education: Regional Trends and Policy Analysis

***Article*: Examining Trends of Higher Education in Ohio Institutions**

Noam Greenberg and Alex Giordano

***Paper*: EdChoice - A Reason to Rejoice? An Analysis of Competitive Effects of School Voucher Programs in Ohio**

Jakob Danninger, Laura Harris, Sidharth Jindal, and Nathan Page

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DOI: 10.28953/APPL00011120.1013

Examining Trends of Higher Education in Ohio Institutions

By: Alex Giordano & Noam Greenberg

Different types of post-secondary education institutions offer unique job opportunities and attract different demographics, depending on the nature of the institution. Research into post-secondary education in Ohio, including two-year and four-year degrees, is crucial for several reasons. First, it provides data-driven insights into the effectiveness, outcomes, and challenges of different higher education pathways, empowering policymakers, educators, students, and families to make informed decisions about educational investments and career choices. Moreover, research can uncover disparities in access to higher education opportunities based on factors such as income, race, and gender. Research also helps evaluate the relevance and value of educational programs. Studies into higher education in Ohio help to assess the alignment between educational offerings and workforce needs, thereby informing curriculum development and training initiatives to better prepare students for employment opportunities.

Higher education in Ohio is essential for driving economic prosperity, promoting social mobility, and fostering innovation. As industries evolve and new technologies emerge, the demand for skilled workers continues to grow, highlighting the importance of aligning educational programs with workforce needs. However, disparities in access and outcomes persist, highlighting the need for research and policy interventions to address equity issues and enhance educational opportunities for all Ohioans.

To research this topic, examining enrollment is key to understanding the evolution of higher education in Ohio. It's also crucial to consider economic shocks like the 2008 recession and the COVID-19 pandemic when examining how the economy impacts education. According to a report by the National Student Clearinghouse Research Center, as cited by Conley and Massa (2022), the COVID-19 pandemic was associated with a significant decrease in higher education enrollment: from Fall 2019 to Fall 2021, enrollment fell 6.6% nationally. Similarly, during the 2008 recession, university enrollment fell, but 2-year colleges saw enrollment increase by 33% ("Postsecondary Enrollment…," 2018). Many people believe that a degree from a 4-year university is simply "not worth it". Rising tuition costs, coupled with concerns about the actual return on investment, have made families more cautious about sending their children to college after high school.

The visualizations below are based on data dating back to 2005 and look at Ohio universities rather than countrywide enrollment. For the most accurate determination, we chose Ohio's largest universities and community colleges and analyzed their enrollment trends, graphing them over time. We also observed the percent change in enrollment over time, allowing for a comparison between universities and community colleges. All data was collected from the Integrated Postsecondary Education Data System (IPEDS).

Figure 1. (left) Enrollment at Ohio universities; **Figure 2.** (right) Enrollment at Ohio community colleges

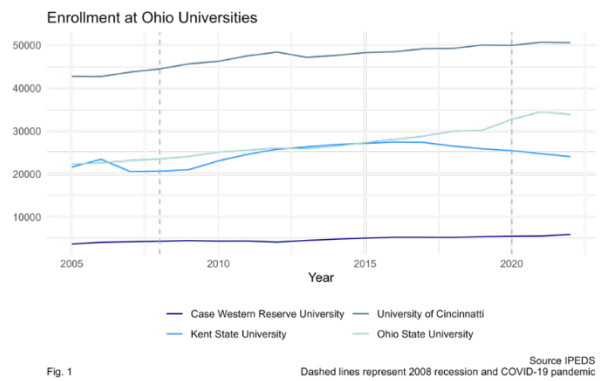

Fig. 1

Source IPEDS
Dashed lines represent 2008 recession and COVID-19 pandemic

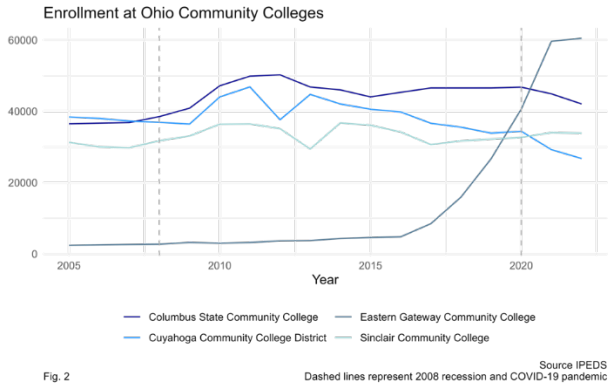

Fig. 2

Source IPEDS
Dashed lines represent 2008 recession and COVID-19 pandemic

The university enrollment graph above (Figure 1) shows consistent growth over time, with the four selected universities growing at similar rates from the mid-2000s to the 2020s. The community college enrollment graph (Figure 2) above shows less consistent growth, with most institutions remaining at or below 2005 levels through to the 2020s.

Figure 3. Percent change in enrollment at Ohio universities and community colleges

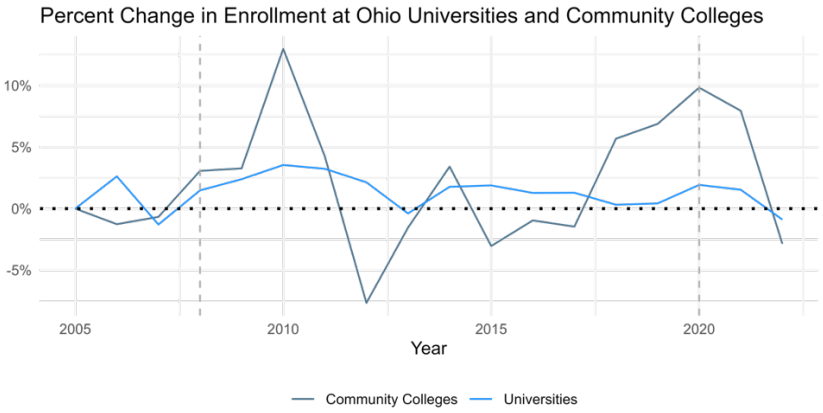

Fig. 3 Source IPEDS
Dashed lines represent 2008 recession and COVID-19 pandemic

Looking at Figure 3, university enrollment shows a relatively steady and consistent growth pattern, contrasting with the more erratic fluctuations seen in community college enrollment. This may be because community college enrollment numbers are more vulnerable to external economic conditions, as community colleges tend to attract students who are more sensitive to economic fluctuations, job market trends, and changes in government funding or financial aid policies. Additionally, the volatility in community college enrollment may be attributed to the fact that bachelor's degree programs require a greater time commitment. This may indicate a higher level of commitment from prospective college students to attend an institution with longer degree programs.

In conclusion, the steady growth of university enrollment in Ohio over the last two decades contrasts with the more erratic fluctuations seen in community college enrollment. This disparity is most pronounced when examining the percent change graph, where the highs and lows for community colleges appear much more irregular. One possible explanation for this difference is the relative affordability of community colleges compared to universities, making them more sensitive to economic conditions. Additionally, the volatility in community college enrollment may be attributed to the fact that bachelor's degree programs require a greater time commitment, suggesting that prospective students are more committed to attending institutions offering longer degree programs.

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https://commons.case.edu/joe/vol2/iss1/1
DOI: 10.28953/APPL00011120.1013

EdChoice — A Reason to Rejoice? An Analysis of Competitive Effects of School Voucher Programs in Ohio

Jakob Danninger[1]
Laura Harris
Sidharth Jindal
Nathaniel Page

Abstract

Ohio's school choice voucher program, known as the EdChoice Scholarship, has been highly controversial since its inception and the recent 2023 expansion has reignited debates. The economic rationale for this policy is that increased competitive pressure creates higher performing public schools. Previous research has found that Florida public schools performed slightly better due to the competitive effects of school choice vouchers. We use data from the Ohio Department of Education and Google Maps API over the years 2009-2018 to estimate the competitive effects of eligible private schools on public school performance after the 2013 income-based EdChoice expansion. This is achieved using a two-way fixed effects model that predicts state exam performance using the number of voucher eligible competitors in a 5 miles radius. Contrary to popular assumptions, we find that increased competitive pressure spurred by the expansion predicts a decrease in school performance. Our findings suggest that the negative effects of losing high-performing students and having diminished spending capabilities due to total lower enrollment overpower the positive effects that increased competition has on school performance.

Introduction

The Education Choice Scholarship (EdChoice) is a program that provides students in Ohio with up to $8408 dollars that can be used to pay for non-public school tuition. This program has been highly controversial with proponents arguing that EdChoice gives power back to families, levels the educational playing fields, and provides much-needed competition for public schools that will benefit all groups involved. Opponents counter that this program is just another way to defund already struggling public schools and an already struggling public school system, and that EdChoice will lower educational outcomes for all parties involved.

Ohio's EdChoice started with the 1996 Cleveland Scholars Program and allowed all students in the Cleveland Metropolitan School District to attend eligible private schools. The program was expanded statewide in 2006, broadening eligibility to include any student in Ohio who attends a "failing" school district. The Ohio Department of Education defines a "failing" district as a chronically underperforming district who "needs significant support to meet state standards". After seven years, in 2013, the program was expanded to include all students whose families fell below 200% of the federal poverty level ($62,400 for a family of four), regardless of the status of their school district. Recently, in 2023, the program was expanded so all students qualify; however, to receive the full scholarship participants must fall within 450% of the federal poverty level ($140,400 for a family of four).

Due to lack of 2023 data, we empirically analyzed the 2013 expansion of EdChoice, assessing the change in competitive effects after the implementation of the statewide policy change. Our findings provide insight into whether

[1] Thank you to our editor Brooke Hathhorn for all her help and guidance!

the competitive effects that EdChoice catalyzes positively or negatively affect public school performance, as well as giving us evidence to predict the long-term competitive effects of the larger 2023 EdChoice expansion.

Literature Review

The Education Choice Scholarship (EdChoice) is a program that provides students in Ohio with up to $8408 dollars that can be used to pay for non-public school tuition. This program has been highly controversial with proponents arguing that EdChoice gives power back to families, levels the educational playing fields, and provides much-needed competition for public.

Belfield (2006) looked at Cleveland public school students who moved to private schools using the Cleveland Scholarship. Out of those who moved to private schools he found that they did not perform academically better and, in some cases, performed academically worse. Belfield speculates that students who move to private schools do not do better academically, and this can be attributed to the fact that these private schools are dealing with the same financial constraints that public schools face.

Figlio and Hart (2010) analyzed whether the introduction of private school vouchers in Florida led to public schools performing better due to competition. This was done using a regression of public-school test scores on a competition index which is based of the number and type of private school competitors within five miles of each public school. Figlio found that for every mile closer a private school was, public schools performed about 0.015 standard deviations better. Overall, Figlio speculates that the three reasons these effects could be observed are firstly the competition provided by vouchers leads public schools to change to more effective policies/practices, secondly private schools are shows to attract underperforming students from public schools leading to public schools having a greater positive peer effect, and lastly if only a few students leave public schools the per student resources may go up due to the indivisibility of teachers.

Data

The data we use is sourced from the Ohio Department of Education and the Google Maps API. The ODE has school building specific data regarding performance index scores, which is a scoring system to measure a school's overall academic performance and is determined by state exam results. The ODE also releases a list of voucher eligible private schools. The Google Maps API is then used to cross reference the location of public schools to their private school competitors, and this is used to build a map of how many private schools directly compete with each public school. The number of voucher eligible private school competitors within 5 miles of a public school is used to measure how much competition each public-school faces.

Table 1. Key Variable Summary Statistics (2013)

Variable	n	Mean	SD	Min	Max
Performance Index	3319	92.29	14.26	33.33	118.2
Competition Score	3319	2.86	3.53	0	22

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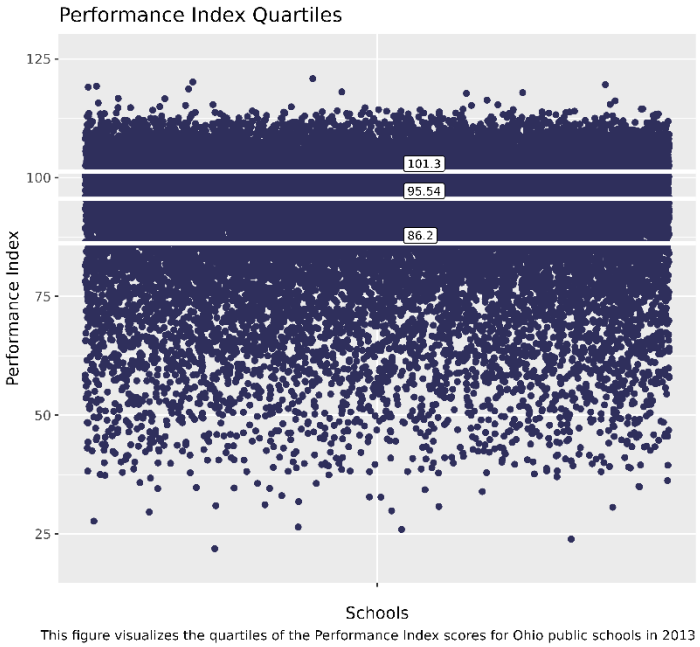
Figure 1. Quartiles for School Performance Index (2013)



Hypothesis

We hypothesize that the 2013 EdChoice expansion will have a positive competitive effect on public school performance in line with the findings of Figlio & Hart (2010). However, the size of the impact is likely to be small due to reductions in district spending (which is determined by enrollment size) offsetting much of the benefits of the increased level of competition.

Methodology

To measure the competitive effects of the 2013 EdChoice income-based expansion, we employ a two-way fixed effects model. This model novelly uses location data to construct a competition score faced by Ohio public schools. We estimate the effects using a model of the following form:

$$Perf_{it} = \beta_0 + \beta_1 EdChoice_t + \beta_2 Competition_i + \beta_3 EdChoice_{it} * Competition_i + \delta_i + \gamma_t + \nu_{it} + \varepsilon_{it}$$

where $Perf_{it}$ is Performance index, $\beta 3$ is the treatment effect, δi are school fixed effects, γ_t are time fixed effects (year), ν_{it} are controls for enrollment and typology, $EdChoice_t$ is a dummy variable indicating whether or not the EdChoice expansion has been implemented in the given year t, Competitioni is the number of voucher eligible private schools within a five-mile radius of a given school i.

Our outcome variable $Perf_{it}$ is school performance, measured by the student performance index reported by the Ohio Department of Education. $\beta_2 Competition_i$, gives us the relationship between a school's competition and their predicted school performance. Our variable of interest is β_3, the interaction between EdChoiceit & Competitioni. This coefficient gives us the change in competitive effect after the 2013 EdChoice expansion. If the EdChoice expansion had positive competitive effects on public school performances, we would expect a positive β_3 value.

Results

We find evidence that public schools see substantially lower performance with higher levels of competition. Crucially, we also find evidence that after the EdChoice expansion, which spurred higher levels of competition

between public and non-public schools, higher levels of competition predict a further reduction in public school performance. Our results suggest that per each additional eligible private school within a five-mile radius of a public school, the public school's performance is predicted to decrease by .2475 points ($\beta_2 Competition_i$). This is statistically significant at the 1% significance level. For a public school with five competitors, their predicted performance would decrease by 1.2375 points. Our coefficient on β_3, the interaction between EdChoice and Competition, suggest that after the 2013 EdChoice expansion, the performance of public schools is predicted to decrease by an additional .0765 points per each additional competitor. For a public school with five competitors, their predicted performance would decrease by an additional .3825 points after the EdChoice expansion. This result is statistically significant at the 5% significance level.

Table 2. Fixed effects regression results

	School Performance
Constant	101.1***
	(.6963)
EdChoice	-5.367***
	(.1307)
Competition	-.2475***
	(.0558)
EdChoice*Competition	-.0765**
	(.0379)
n = 331 9; * p<0.10, ** p<0.05, *** p<0.001	

To make these results more concrete, let us imagine that we are the public school with the median performance score (50th percentile). If this school were to have five competitors, it's predicted school performance would descend to the 47.9th percentile. If this school were to have ten competitors, it would descend to the 45.9th percentile. Our sample consisted of 3319 public schools. If this median school had five competitors, it would fall 43 spots in absolute performance score rankings. If this median school had ten competitors, it would fall 78 spots in absolute performance score rankings. We feel that these interpretations should help readers in understanding the magnitude of our coefficients of interest.

Conclusion and Policy Implications

A contentious point of debate in the discussions around EdChoice surround whether the program increases the performance of public schools through spurring competition, or whether the program decreases the performance of public schools by siphoning away their top students and lowering their total spending capabilities. Proponents argue this competition stimulus will put strong pressure on administrators, teachers, and schools to elevate their game and increase school performance to avoid losing students to private schools. Conversely, opponents argue that losing a number of high performing students will get rid of the beneficial peer effects that these students provide as well as lowering the total funds that the school will have access to. The state allocates funds to public schools based on the number of enrolled students, so losing students to non-public schools lowers the total expenditures public schools can make. This inhibits their ability to make large capital investments like upgrading or replacing school infrastructure, constructing, or renovating athletic facilities, and specialized educational programs.

Our results provide evidence to support the latter explanation, leading us to conjecture that the competitive effects of EdChoice negatively impact public school performance. It is important to note these findings do not constitute a rebuke of the EdChoice program or school choice programs more broadly. More narrowly, we find that the elevated competition resulting from the 2013 EdChoice expansion negatively impacted public school performance. There are many other considerations in this policy decision, including parental choice, equity and access in education, school diversity, and long-term non-academic student outcomes. Finally, our results allow us to make predictions about the 2023 EdChoice expansion. Because the expansion is much broader than previous iterations, we expect more potent competitive effects, leading us to predict a more substantial negative impact on public school performance.

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DOI: 10.28953/APPL00011120.1013

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Ohio's Metros: Analyses of the "Three C's"

https://commons.case.edu/joe/vol2/iss1/1
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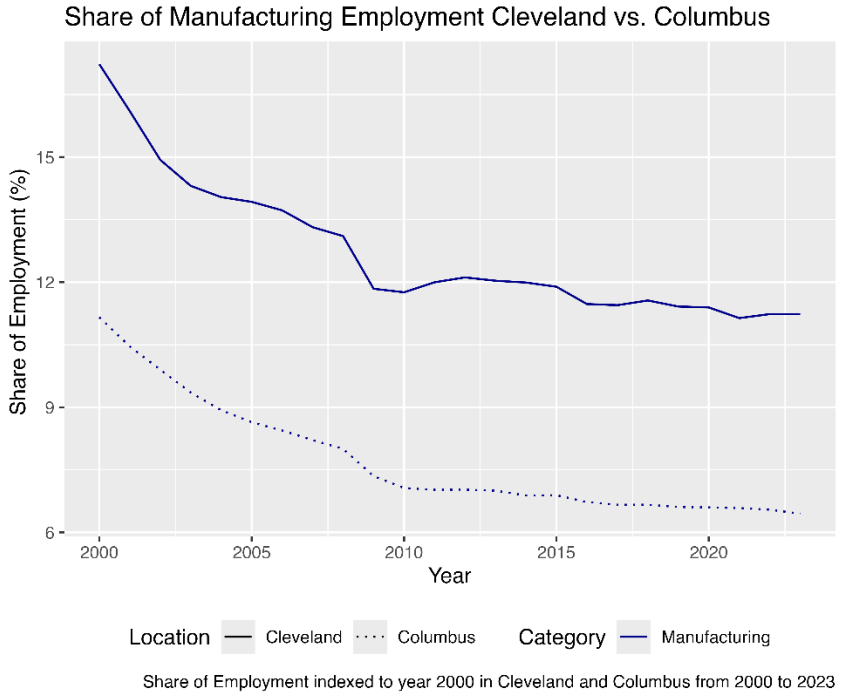
Rust to Riches: Cleveland's Stall vs. Columbus's Success

By: Ian Cameron & Quynh Nguyen[1]

Cleveland and Columbus reside as Ohio's two biggest cities by population within their respective Metropolitan Statistical Areas (MSAs). During the 19th and early 20th centuries, Cleveland thrived due to its location, industrialization, and steep population growth, fueled by manufacturing. Meanwhile, Columbus lacked the geographical advantages that drove Cleveland's economy, hindering its ability to match Cleveland's prior economic success. Columbus, still maintaining a large manufacturing presence, diversified its economy to encompass governmental and educational industries as well. Nonetheless, both cities relied heavily on manufacturing, accounting for 44% of all jobs at its peak in Ohio. However, globalization, which has increased competition from nations with lower labor costs, automation, which has boosted productivity and reduced the need for human labor, and outsourcing, have all contributed to declines in manufacturing's share of employment. Cleveland's manufacturing share dropped to 11.2%, while Columbus's dropped to 6.4%. While these declining trends have ignited Cleveland's fall from prominence, Columbus has flourished by seizing new opportunities (Shkurti & Stewart, 2017).

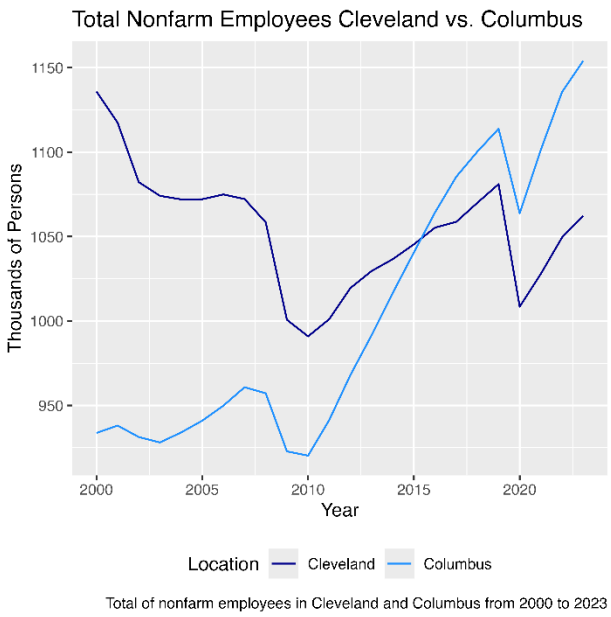
Figure 1. Share of manufacturing employment in Cleveland versus Columbus

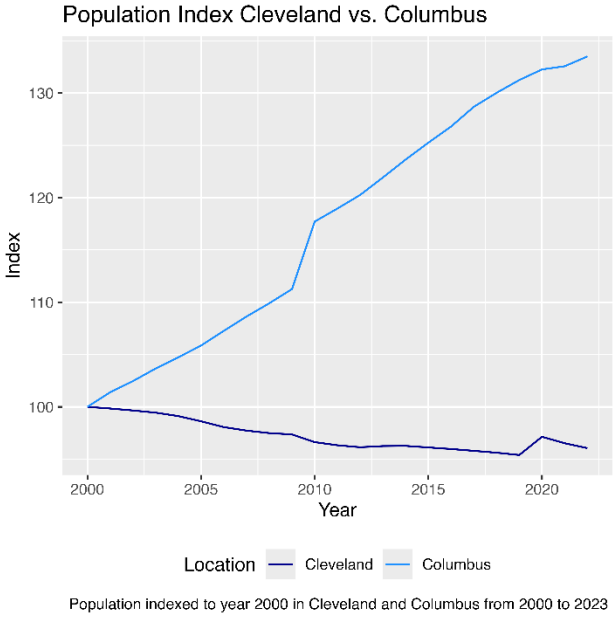


Since 2000, Columbus, mentioned as being "the fastest growing city in the U.S." (Chang, 2024), has experienced remarkable growth in total population and employment: 33.5% in population (1,619,514 to 2,162,066 persons) and 22.6% in all employees (933,700 to 1,154,000 persons). Conversely, Cleveland has experienced a steady decline in total population and employment: -3.9% in population (2,147,948 to 2,063,132 persons) and -7.5% (1,135,900 to 1,062,300 persons).

[1] Thank you to Professor Mark Schweitzer and Yanett Chimeless

Figure 2. (left) Total non-farm employees in Cleveland versus Columbus; **Figure 3.** (right) Population index for Cleveland versus Columbus





Two leading drivers behind Columbus's recent booming economy and growth are the Columbus Partnership and the Columbus-Franklin County Finance Authority. The Columbus Partnership, a nonprofit, member-based organization of CEOs from Columbus' leading businesses and institutions, launched "Columbus 2020" aiming for 150,000 net new jobs, securing $8 million in new capital investment, and increasing per-capita income by 30%. By 2014, the region added 85,000 net jobs, increased its per-capita income by 11%, and attracted $4.5 billion in capital investment. In 2019, "Columbus 2020" evolved into "One Columbus," targeting 60,000 new jobs, $3.3 billion in annual payroll, and $10 billion in investments. Furthermore, the Columbus-Franklin County Finance Authority (CFFA), established in 2006, provides financing solutions for economic development projects in Columbus for all sectors. Through over $4.5 billion in bond financing and over $5.7 billion in investments, the CFFA has successfully fostered business creation and expansion, new jobs, and contributed to the fastest-growing city in the U.S. (CFAA, 2024).

Cleveland's fall from prominence can be attributed to its lack of shovel-ready land and the disconnect between job access and employment. Companies have continuously approached Cleveland's City Hall regarding the availability of shovel-ready land for relocating their operations. However, the answer is always no, according to Councilman Anthony Hairston (Rascon, 2023). The lack of green fields and space in the area causes companies to set their eyes on developing cities like Columbus where business is easy. Furthermore, inverse relationships between job access and employment rates in Cleveland metro areas have worsened the city's challenges. In a national study done across 96 metro areas, a positive relationship of 0.05 existed between job access and employment rates. However, Cleveland's metro area presents a negative relationship of -0.27, emphasizing neighborhoods with higher rates of job access experience lower employment rates and vice versa. Mismatches between job opportunities and the workforce, limited impact of transportation initiatives, and underrepresentation of black workers are to blame (Fee, 2021).

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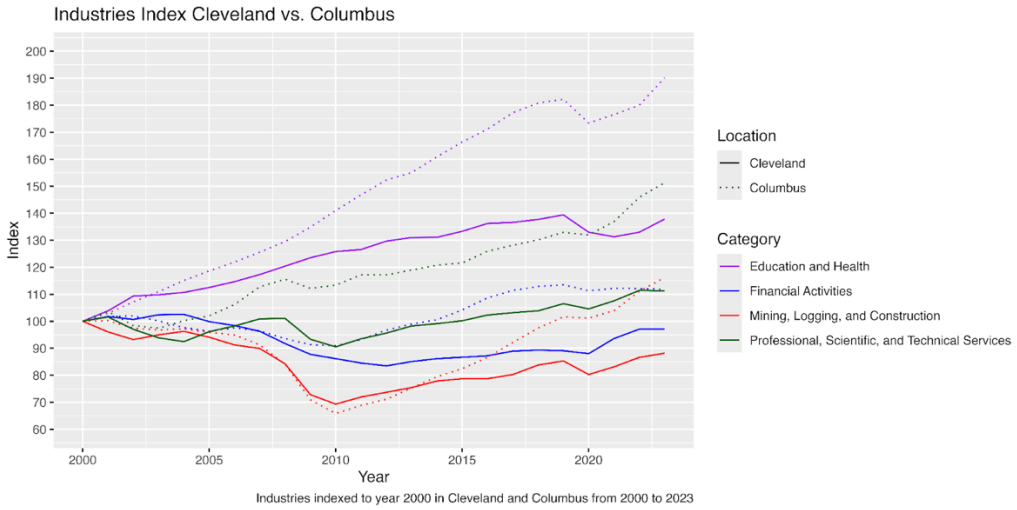
DOI: 10.28953/APPL00011120.1013

Figure 4. Industries Index for Cleveland versus Columbus



Comparing the industry-specific "all employees" growth between the two cities, Columbus stands out with impressive positive markers across key industries: 90.2% in health and education, 51.32% in professional, scientific, and tech, 11.8% in finance, and 16.2% in mining, logging, and construction. Conversely, Cleveland's trends have fluctuated, recording modest growth and decline across the same industries: 37.8% in health and education, 11.2% in professional, scientific, and tech, -2.9% in finance, and -11.8% in mining, logging, and construction.

Since the fall of manufacturing, economic challenges display the divergent trajectories between both cities, with Columbus flourishing through effective initiatives and adequate investing while Cleveland struggles with issues of land availability and employment disconnects.

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Creating an Economic Resilience Index and an Economic Vulnerability Index for Ohio

By: Puja Gowda, Magie Zheng[1]

Analyzing the resilience and vulnerability of regional economies helps us understand how a community endures and adapts to economic adversity. Economic resilience can be defined as the capability of an economy to rebound from economic shocks while vulnerability signifies how susceptible an economy is to these adverse events. In this article, we discuss the economic resilience and vulnerability of the three major Metropolitan Statistical Areas (MSAs) in Ohio, Cleveland, Columbus, and Cincinnati, examining the factors that contribute to their capacity to weather economic shocks. In order to understand their reactions to specific economic events, we observe the economy during the 2008 Recession and the 2020 COVID-19 Recession.

As the global economy becomes more interconnected, quantifying and comparing these factors is important for policymakers and government entities (Rose 2013). Building these metrics deepens the understanding of economic dynamics and their implications for long-term sustainable developments. In this article, we enter an exploration of economic resilience and vulnerability, and their significance in the context of regional economies.

To assess economic resilience and vulnerability, we employ two metrics: the Resilience Index and the Vulnerability Index (Wu 2020). The Resilience Index quantifies a region's ability to bounce back from economic setbacks, taking into account various economic factors. The Vulnerability Index measures the susceptibility of an economy to external shocks, considering variables such as dependency on specific industries and location quotients. Measuring resilience and vulnerability together provides a more comprehensive understanding of the dynamics and characteristics of an economy.

In our previous research in the Fall 2023 semester, we created an Economic Resilience Index for the major MSAs using the Ohio real GDP, education level, house price index, and unemployment. Now, we aim to include more indicators to further enhance the calculation. The list of indicators can be grouped into three categories.

Economic Indicators	Engineering Indicators	Social Indicators
Ohio Real GDP	Density of Highway Network	Higher Education Rate
Ohio Real GDP Growth Rate	Internet Penetration Rate	Unemployment Rate
House Price Index		
GDP Per Capita		
GDP Per Square Mile		

Resilience Index = $\frac{1}{n}\sum_{i=1}^{n}\omega_i \times \left(\frac{\chi_i - \underline{\chi_i}}{\sigma_i}\right)$

Where:

n = represents the number of indicators
$\omega_i *$ = denotes the weight assigned to each indicator based on its perceived importance
χ_i = the observed value of the respective indicator
$\underline{\chi_i}$ = the mean of the indicator across the 2005-2021 period
σ_i = the standard deviation of the indicator across the 2005-2021 period

**For this calculation, we will be considering all indicators to be at the same weight (~14.286%), however, for future calculations, a regression analysis will be used to determine the relative weights of indicators.*

[1] Thank you, Professor Bogart, and Professor Clingingsmith, for their insights. Additionally, thank you Katie Merritt for her guidance.

https://commons.case.edu/joe/vol2/iss1/1
DOI: 10.28953/APPL00011120.1013

Interpretation: A higher resilience index suggests that the MSA's economy was doing better than the Ohio average that year and a lower resilience index implies that the MSA is doing worse.

Additionally, we are including a calculation for the vulnerability index, which is quantified by using location quotients and traded industries (Tuysuz 2022). Location quotients (LQ) are a statistical tool that is used to assess the concentration of a particular industry. It is measured as the proportion of the industry in the MSA, to the proportion of that industry in the entire nation. A LQ greater than 1 indicates that the industry is more concentrated in that MSA than the United States, whereas a LQ less than 1 suggests the opposite. Tradable industries are sectors of the economy that produce goods and generate revenue from outside the local market. Non-tradable industries primarily serve local markets and do not contribute to external sales.

The measurement for the vulnerability index is stated below:

$$\text{Vulnerability Index} = \sum_{i=1}^{n_t} es_i \times \left(\frac{TLQ_i - 1}{Total\ TLQ}\right) - \sum_{j=1}^{n_{nt}} es_j \times \left(\frac{NTLQ_j - 1}{Total\ NTLQ}\right)$$

Where:

n_t = represents the number of tradable industries
n_{nt} = represents the number of non-tradable industries
es_i *= denotes the employment share for the *i*th tradable industry, measured as employment per 1000 jobs
es_j *= denotes the employment share for the *j*th non-tradable industry, measured as employment per 1000 jobs
TLQ_i = the LQ for the *i*th tradable industry in the MSA
Total TLQ = the total number of LQs for all tradable industries in the MSA
NTLQ_i = the LQ for the *j*th non-tradable industry in the MSA
Total NTLQ = the total number of LQs for all non-tradable industries in the MSA

Interpretation:

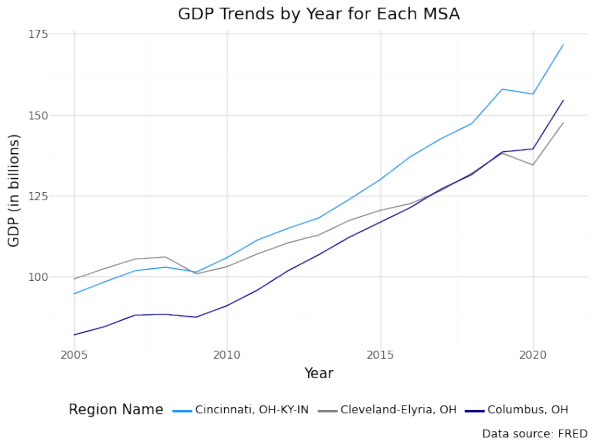
- A higher vulnerability index suggests a greater dependence on tradable industries, making the MSA more susceptible to economic shocks.
- A lower vulnerability index indicates a greater dependence on non-tradable industries, making the MSA less susceptible to economic shocks.

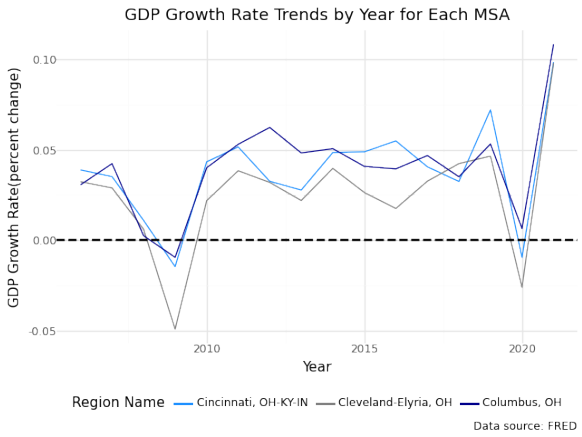
All the data for these indicators are pulled from the Federal Reserve of Economic Data (FRED), the US Bureau of Labor Statistics, and the US International Trade Administration. We include data from 2005 to 2021 for the MSAs of Ohio to observe how these areas responded to the 2008 Recession. By creating these indexes, we hope to create a complete understanding of Ohio's economy, as well as support further research that can be expanded to other states or regions. Below we have listed the indicators we will be using:

Economic Resilience Index

Economic Indicators

Figure 1. (left) GDP trends by year for Ohio MSAs; **Figure 2.** (right) Ohio real GDP growth rate

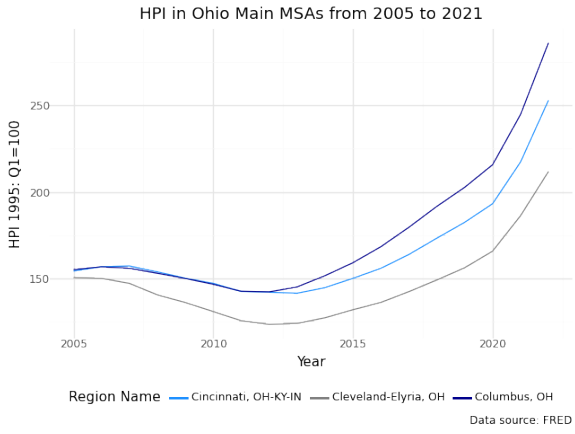


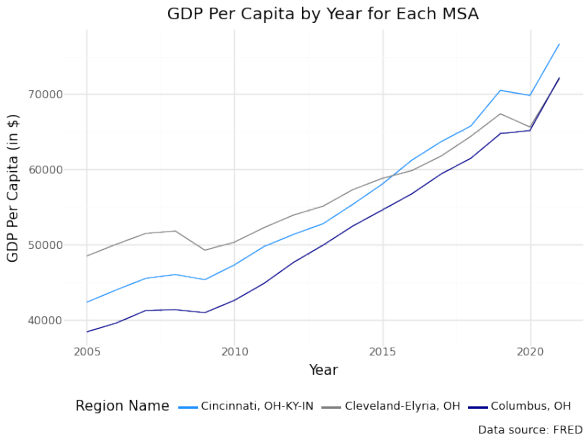


The first graph depicts the GDP over time in millions of dollars for the three biggest metropolitan areas in Ohio, Cincinnati, Cleveland, and Columbus, ranging from 2005 to 2021. The GDP steadily increases until 2008, where it then dips in Cleveland until 2009. On the other hand, in Columbus in Cincinnati, it seems to remain more stagnant. This is most likely in response to the Great Recession, which primarily took place between 2008 and 2009. After 2009, all three metros increased steadily until 2019, when they began to dip again, presumably due to the spread of the COVID-19 virus and subsequent lockdown. Also worth noting is that Cleveland had the highest GDP prior to the 2008 Recession, however has gradually fallen behind Cincinnati and Columbus over time.

The second graph shows the growth rate of real GDP for the three MSAs from 2006 to 2021. The fluctuations in growth rate oscillate around a level of 4%. The two exceptions are seen in 2009 and 2020, where in 2009 it reached a change of -5% and in 2020, around -2%. The recovery is also much more pronounced in 2020 as seen in the extreme high following the extreme low, whereas the outlier in 2009-2010 lacks such an obvious rise following the drop. In 2021, the change reached about 11%. The contracting patterns observed in the two recessions highlight differences in their nature and impact on GDP. The slow recovery from the 2008 recession likely reflects the effects of the global financial crisis and its prolonged aftermath. Conversely, the 2020 recession rebound can be explained by fiscal stimulus measures and pent-up demand.

Figure 3. (left) House Price Index (HPI); **Figure 4.** (right) GDP per capita





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DOI: 10.28953/APPL00011120.1013

Figure 3 measures the house price index for Cleveland, Columbus, and Cincinnati from 2005 to 2021. The house price index for two of the cities was the lowest in 2012 with Cleveland being at about 125 and Columbus being at around 158, and highest in 2021 at 212 for Cleveland and 285 for Columbus. For Cincinnati, the city saw its lowest HPI at 139 in 2013, and its highest at 252 in 2021. The index has seen an upward trend since 2012. The years between 2007 to 2012 saw a decline in the house price index, and the index only returned to the level it was in 2007 again around 2016 - 2017 and continued to surpass it.

Figure 4 depicts the GDP per capita for the big three metropolitan areas in Ohio. Here we see a decrease after 2008 that continues until 2009, where it then begins increasing at a steady rate. Initially, Cleveland had the highest GDP per capita, however, it was surpassed by Cincinnati in 2015. All three MSAs were no longer increasing in 2019 and began increasing again in 2021. The initial decrease is correlated with the 2008 Recession, and the second change coincides with the COVID-19 pandemic. Compared to the graph depicting GDP over time, we see similar trends, however, we see that Cleveland does not dip far below Cincinnati and Columbus.

Figure 5. GDP per square mile

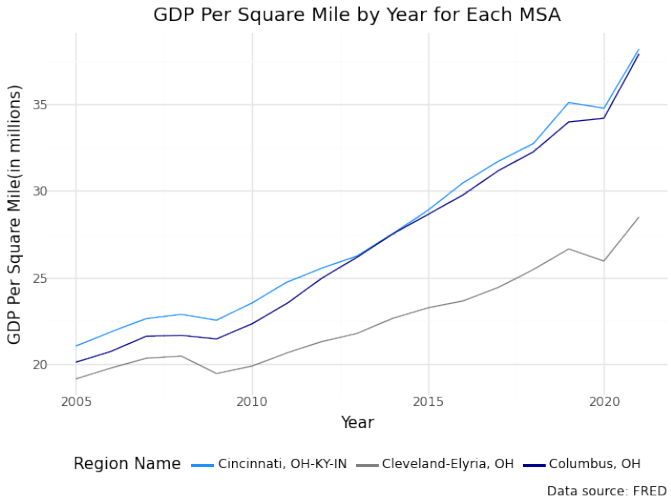


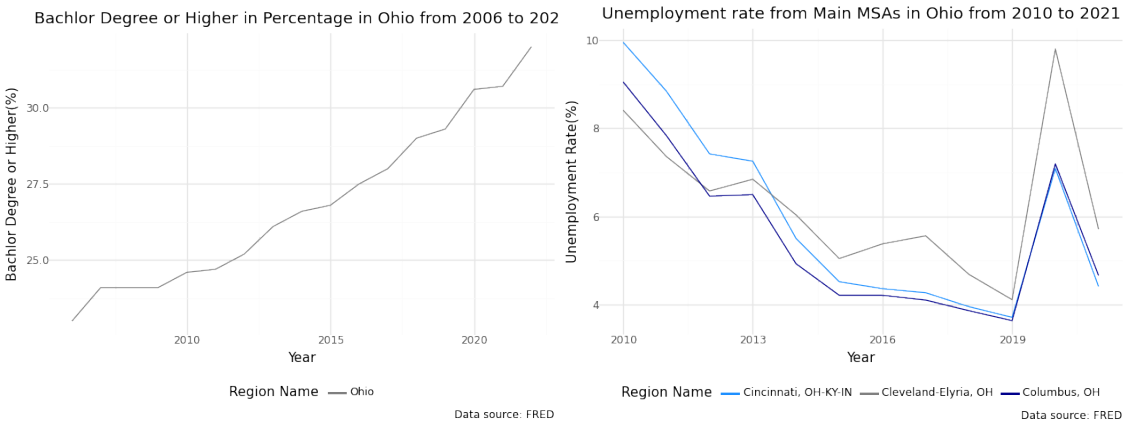
Figure 5 plots the GDP per square mile over time for the three major metropolitan areas, Cleveland, Columbus, and Cincinnati. GDP per square mile measures the economic output within a specific area relative to its size and is calculated by dividing the GDP by the total land area of the MSA. Similarly to the graph of GDP over time, there are dips from 2008-2009 and 2019-2020, with steady increases in the other years. After the Recession, Columbus and Cincinnati grew more steeper than Cleveland, and ended in 2021 with similar measures of GDP per square mile, at around 38-38.5 while Cleveland has a measure of around 29.

Social Indicators

Figure 6 looks at the overall trend of the percentage of Ohioans with a bachelor's degree from 2006 to 2022. From this graph, we see a continuously positive slope, except from 2007 - 2009 where the slope is 0. This means that there was not a change in the percentage of the population who held a bachelor's degree or higher. This could be explained by the 2008 recession, where for many, education was halted. This trend was not observed during the 2020 recession, where the majority of education was adapted to an online format.

Figure 7 measures the Unemployment Rate in the big three cities in Ohio from 2005 to 2021. There was a rapid increase starting in 2008 and peaking in 2010. It was significantly lower by 2012 and back to its original levels by 2014. This can be attributed to the recession of 2008. The highest recorded rate of unemployment in this time period was in 2020, when the rate rose abruptly in January 2020 to a peak. Unlike the 2008 recession, where recovery spanned over four years, the recovery post-pandemic back to pre-pandemic levels took place in about a year.

Figure 6. (left) Ohio education level; **Figure 7.** (right) Ohio unemployment rate over time



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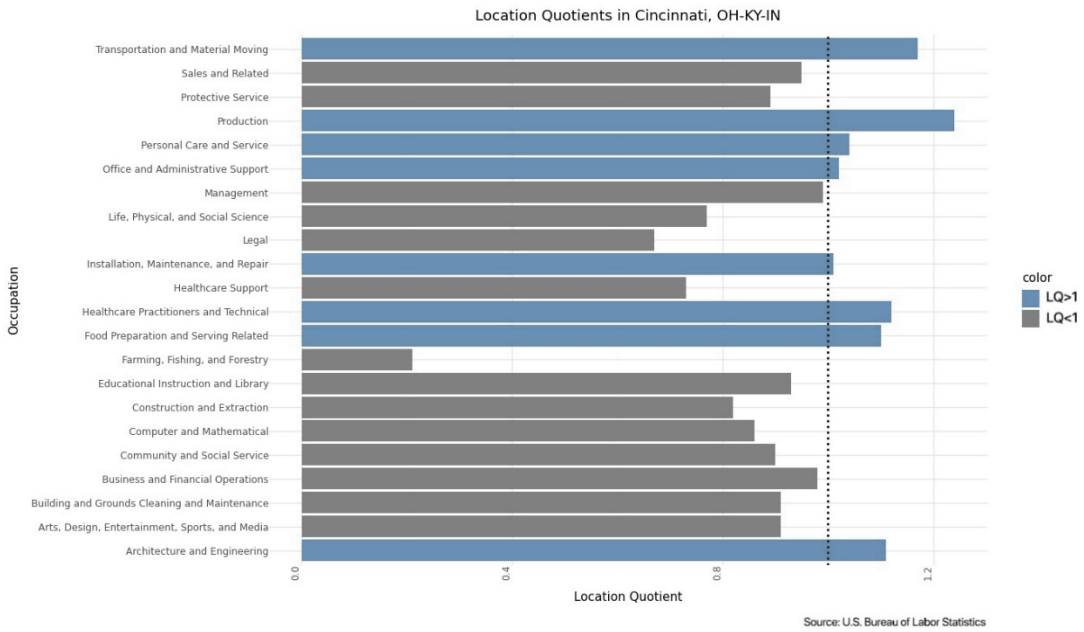
Economic Vulnerability:

Figures 8-10. LQs for Cincinnati, Cleveland, and Columbus



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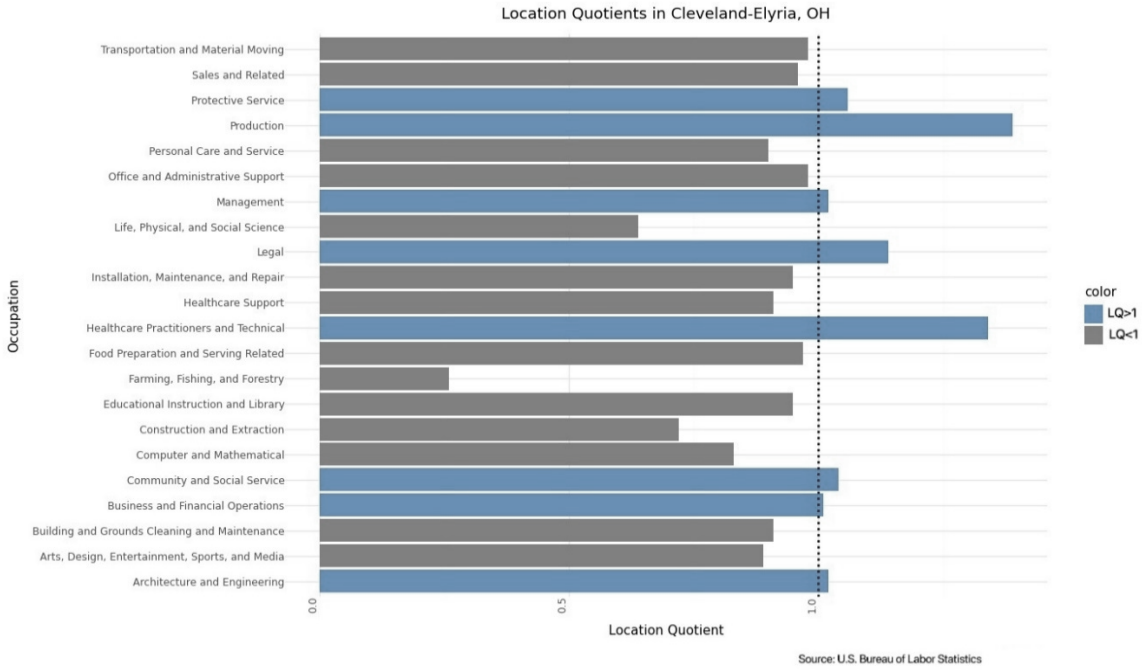
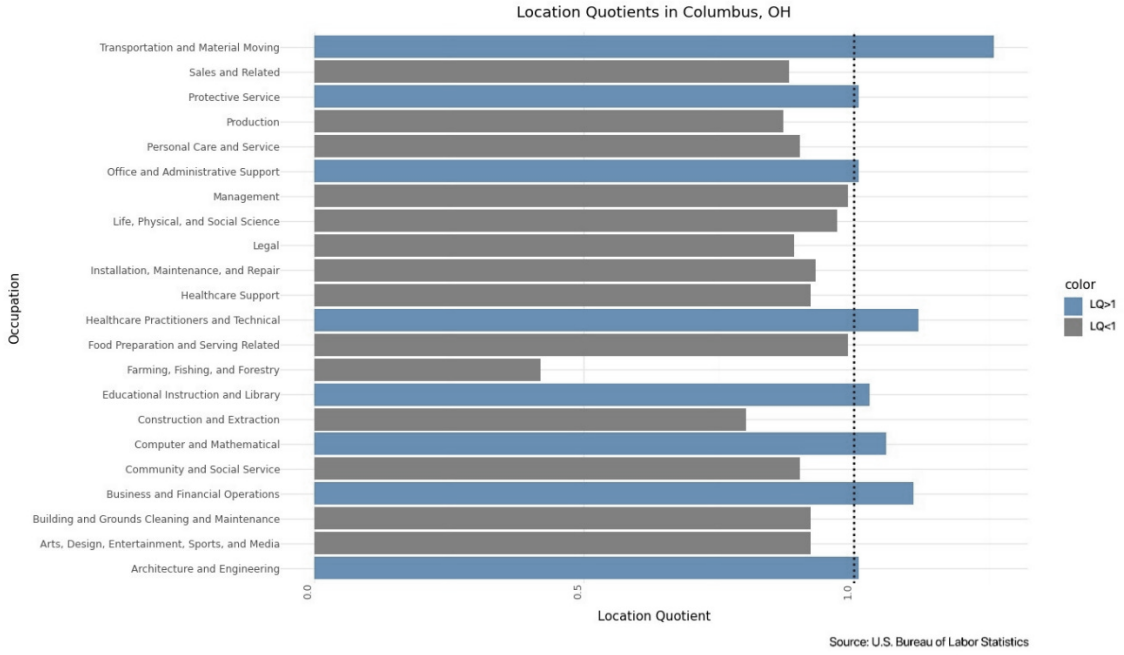
DOI: 10.28953/APPL00011120.1013


Location Quotients in Cleveland-Elyria, OH
Transportation and Material Moving
Sales and Related
Protective Service
Production
Personal Care and Service
Office and Administrative Support
Management
Life, Physical, and Social Science
Legal
Installation, Maintenance, and Repair
Healthcare Support
Healthcare Practitioners and Technical
Food Preparation and Serving Related
Farming, Fishing, and Forestry
Educational Instruction and Library
Construction and Extraction
Computer and Mathematical
Community and Social Service
Business and Financial Operations
Building and Grounds Cleaning and Maintenance
Arts, Design, Entertainment, Sports, and Media
Architecture and Engineering
Occupation
0.0
0.5
1.0
Location Quotient
color
LQ>1
LQ<1
Source: U.S. Bureau of Labor Statistics


Location Quotients in Columbus, OH
Transportation and Material Moving
Sales and Related
Protective Service
Production
Personal Care and Service
Office and Administrative Support
Management
Life, Physical, and Social Science
Legal
Installation, Maintenance, and Repair
Healthcare Support
Healthcare Practitioners and Technical
Food Preparation and Serving Related
Farming, Fishing, and Forestry
Educational Instruction and Library
Construction and Extraction
Computer and Mathematical
Community and Social Service
Business and Financial Operations
Building and Grounds Cleaning and Maintenance
Arts, Design, Entertainment, Sports, and Media
Architecture and Engineering
Occupation
0.0
0.5
1.0
Location Quotient
color
LQ>1
LQ<1
Source: U.S. Bureau of Labor Statistics

Analysis

Resilience Index:

To begin the calculations, the mean and standard deviation of each indicator must be calculated:

Table 1. Mean and standard deviation of each indicator used in the Resilience Index.

Indicator	**Mean ($\underline{\chi_i}$)**			**Standard Deviation (σ_i)**		
	Cincinnati	Cleveland	Columbus	Cincinnati	Cleveland	Columbus
Real GDP	124468.6	116859.8	109853.3	21200.58	14651.91	22500.89
Real GDP Growth Rate	0.0383	0.0256	0.0407	0.0277	0.0319	0.0269
House Price Index	165.33	146.23	173.5	29.783	22.108	36.377
GDP Per Capita	0.0744	0.0658	0.0747	0.0115	0.0085	0.0085
GDP Per Square Mile	25.888	42.528	34.663	4.966	5.332	7.100
Higher Education Rate	26.800	26.800	26.800	2.719	2.719	2.719
Ohio Unemployment Rate	5.953	6.317	5.554	4.083	1.560	1.743

Using these measures for the three MSAs combined, we measure the economic resilience of Ohio in any given year during this time period. Below, we will compare the MSA's during the year 2009 and 2021:

2009:

$$\textbf{Cincinnati Resilience Index}_{2009} = \frac{1}{n}\sum_{i=1}^{n}\omega_i \times \left(\frac{\chi_i - \underline{\chi_i}}{\sigma_i}\right)$$
$$= \frac{1}{7}\sum_{i=1}^{7} 1/7 \times \left(\frac{\chi_i - \underline{\chi_i}}{\sigma_i}\right)$$
$$= \frac{1}{49}(-0.9643 + 0.1836 + -0.51147 + -1.001 + -0.9643 + -0.993 + 0.4083) = \textbf{-0.078}$$

$$\textbf{Cleveland Resilience Index}_{2009} = \frac{1}{n}\sum_{i=1}^{n}\omega_i \times \left(\frac{\chi_i - \underline{\chi_i}}{\sigma_i}\right)$$
$$= \frac{1}{7}\sum_{i=1}^{7} 1/7 \times \left(\frac{\chi_i - \underline{\chi_i}}{\sigma_i}\right)$$
$$= \frac{1}{49}(-1.091 + -0.1175 + -0.689 + -1.077 + -1.091 + -0.993 + 0.501) = \textbf{-0.093}$$

$$\textbf{Columbus Resilience Index}_{2009} = \frac{1}{n}\sum_{i=1}^{n}\omega_i \times \left(\frac{\chi_i - \underline{\chi_i}}{\sigma_i}\right)$$
$$= \frac{1}{7}\sum_{i=1}^{7} 1/7 \times \left(\frac{\chi_i - \underline{\chi_i}}{\sigma_i}\right)$$
$$= \frac{1}{49}(-0.9917 + -0.0229 + -0.646 + -1.153 + -0.9917 + -0.993 + 1.116) = \textbf{-0.083}$$

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DOI: 10.28953/APPL00011120.1013

2020:

$$\textbf{Cincinnati Resilience Index}_{2020} = \frac{1}{n}\sum_{i=1}^{n}\omega_i \times \left(\frac{\chi_i - \underline{\chi_i}}{\sigma_i}\right)$$
$$= \frac{1}{7}\sum_{i=1}^{7} 1/7 \times \left(\frac{\chi_i - \underline{\chi_i}}{\sigma_i}\right)$$
$$= \frac{1}{49}(1.335 + 2.176 + 1.802 + 1.317 + 1.335 + 1.342 + -0.241) = \mathbf{0.185}$$

$$\textbf{Cleveland Resilience Index}_{2020} = \frac{1}{n}\sum_{i=1}^{n}\omega_i \times \left(\frac{\chi_i - \underline{\chi_i}}{\sigma_i}\right)$$
$$= \frac{1}{7}\sum_{i=1}^{7} 1/7 \times \left(\frac{\chi_i - \underline{\chi_i}}{\sigma_i}\right)$$
$$= \frac{1}{49}(1.201 + 2.274 + 1.708 + 1.232 + 1.201 + 1.342 + -0.139) = \mathbf{0.180}$$

$$\textbf{Columbus Resilience Index}_{2020} = \frac{1}{n}\sum_{i=1}^{n}\omega_i \times \left(\frac{\chi_i - \underline{\chi_i}}{\sigma_i}\right)$$
$$= \frac{1}{7}\sum_{i=1}^{7} 1/7 \times \left(\frac{\chi_i - \underline{\chi_i}}{\sigma_i}\right)$$
$$= \frac{1}{49}(1.313 + 2.519 + 1.911 + 1.197 + 1.313 + 1.342 + -0.255) = \mathbf{0.206}$$

In 2009, all three resilience indexes were negative, indicating that the MSA's were lower than the average values from 2005 to 2021. This coincides with the fact that the United States was facing a recession from 2008 to 2010, worsening the economy. However, in 2021, we see that all the indexes are positive, signifying that the three MSA's were doing better than average, even in the face of the COVID-19 pandemic, which started a year prior. Between the three MSA's in 2009, we see that Cleveland had the lowest value, meaning that it was affected the most by the Recession. Cincinnati had the highest, showing it was able to recover quicker from the Recession than the other two MSA's. In 2021, we see that Columbus had a higher index, meaning it was able to bounce back quicker than the other two MSA's during the pandemic. We also see that Cleveland had the lowest index, which could be attributed to its inability to recover fully after the 2008 Recession up until 2021.

Vulnerability Index:

In order to perform the calculations for the Vulnerability Index, the LQs and employment shares of the three MSA's must be listed for both tradable(T) and non-tradable industries (NT). Table 2 provides a list of the industries and data points included. We use 2023 data from the Bureau of Labor Statistics.

Table 2. Location quotients (LQ) and employment shares (ES) for tradable (T) and non-tradable (NT) industries for the Vulnerability Index.

Industry	**Cincinnati LQ(ES)**	**Cleveland LQ(ES)**	**Columbus LQ(ES)**
Management Occupations (T)	0.99 (.0682)	1.02 (.0702)	0.99 (.0681)
Business and Financial Operations Occupations (T)	0.98 (.0649)	1.01 (.0671)	1.11 (.0739)
Computer and Mathematical Occupations (T)	0.86 (.0293)	0.83 (.0282)	1.06 (.0361)
Architecture and Engineering Occupations (T)	1.11 (.0186)	1.02 (.0171)	1.01 (.0169)
Life, Physical, and Social Science Occupations (T)	0.77 (.0071)	0.64 (.0058)	0.97 (.0089)
Transportation and Material Moving Occupations (T)	1.17 (.1058)	0.98 (.0887)	1.26 (.1138)
Protective Service Occupations (T)	0.89 (.0206)	1.06 (.0244)	1.01 (.0233)
Sales and Related Occupations (T)	0.95 (.0841)	0.96 (.0846)	0.88 (.0778)
Office and Administrative Support Occupations (T)	1.02 (.1242)	0.98 (.1201)	1.01 (.1238)
Construction and Extraction Occupations (T)	0.82 (.0337)	0.72 (.0296)	0.80 (.0326)
Installation, Maintenance, and Repair Occupations (T)	1.01 (.0400)	0.95 (.0375)	0.93 (.0368)
Production Occupations (T)	1.24 (.0716)	1.39 (.0800)	0.87 (.0505)
Healthcare Support Occupations (NT)	0.73 (.0341)	0.91 (.0422)	0.92 (.0428)
Community and Social Service Occupations (NT)	0.90 (.0143)	1.04 (.0165)	0.90 (.0143)
Legal Occupations (NT)	0.67 (.0055)	1.14 (.0093)	0.89 (.0041)
Educational Instruction and Library Occupations (NT)	0.93 (.0535)	0.95 (.0545)	1.03 (.0591)
Arts, Design, Entertainment, Sports, and Media Occupations (NT)	0.91 (.0126)	0.89 (.0123)	0.92 (.0128)
Healthcare Practitioners and Technical Occupations (NT)	1.12 (.0682)	1.34 (.0818)	1.12 (.0684)
Food Preparation and Serving Related Occupations (NT)	1.10 (.0959)	0.97 (.0848)	0.99 (.0865)
Building and Grounds Cleaning and Maintenance Occupations (NT)	0.91 (.0265)	0.91 (.0264)	0.92 (.0269)
Personal Care and Service Occupations (NT)	1.04 (.0208)	0.90 (.0180)	0.90 (.0180)
Farming, Fishing, and Forestry Occupations (NT)	0.21 (.0006)	0.26 (.0007)	0.42 (.0012)

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DOI: 10.28953/APPL00011120.1013

Cincinnati Vulnerability Index $= \sum_{i=1}^{12} es_i \times \left(\frac{TLQ_i - 1}{12}\right) - \sum_{j=1}^{10} es_j \times \left(\frac{NTLQ_j - 1}{10}\right)$
$= (0.00125) - (-1.584 \times 10^{-4})$
$=$ **0.0014**

Cleveland Vulnerability Index $= \sum_{i=1}^{12} es_i \times \left(\frac{TLQ_i - 1}{Total\ TLQ}\right) - \sum_{j=1}^{10} es_j \times \left(\frac{NTLQ_j - 1}{Total\ NTLQ}\right)$
$= (8.73 \times 10^{-4}) - (0.00146)$
$= -0.000593 =$ **-5.93×10^{-4}**

Columbus Vulnerability Index $= \sum_{i=1}^{12} es_i \times \left(\frac{TLQ_i - 1}{Total\ TLQ}\right) - \sum_{j=1}^{10} es_j \times \left(\frac{NTLQ_j - 1}{Total\ NTLQ}\right)$
$= (0.00130) - (-1.861 \times 10^{-4})$
$=$ **0.0015**

All three values for the vulnerability indexes are close to zero, meaning that there is no heavy reliance on tradable or non-tradable industries. Both Cincinnati and Columbus have a positive vulnerability index, which signifies that they have more reliance on tradable industries. The industries with the highest LQs are Production Occupations and Transportation and Material Moving Occupations respectively, which are tradable. Comparatively, Cleveland has a negative vulnerability index, meaning that there is a stronger reliance on non-tradable industries. While their highest LQ is for Production Occupations, they also have LQs over 1 for Healthcare Practitioners and Technical Occupations, Community and Social Service Occupations, and Legal Occupations. Cleveland's lower vulnerability index can be a reflection of a number of factors, such as industry diversification and the strength of community resources.

Conclusion

The development of an Ohio Economic Resilience Index and Ohio Economic Vulnerability Index is important for understanding the state's economic stability and vulnerability. By assessing these aspects of Ohio's economy, policymakers can determine the factors shaping regional economic performance and the potential risks facing communities statewide. Further research can strengthen the Resilience Index by adding indicators that span economic, engineering, and social dimensions. Economic indicators could include measures of industry diversity. Engineering indicators cover infrastructure quality and energy usage. Social indicators might have measures of social capital and equity. With the development and application of Ohio's Economic Resilience and Vulnerability Indexes, Ohio can navigate future uncertainties and create a more resilient future for all its residents.

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Is Bigger Always Better? The Effect of a State's Urban Makeup on its Economy

By: Jesse Boockvar-Klein, Manav Bhandary, and Benjamin Kramer

Understanding the effect of a decentralized urban population, the movement of people and businesses from an established city to an urban fringe, is important in learning how certain cities respond to economic downturns, as well as the effect of urban policies on various regions. Researching decentralized urban populations compared to centralized urban populations can help people learn more about the economic characteristics of different cities, revealing the strengths and weaknesses of these cities. Furthermore, learning about the economic stability of different populations can lead to more informed policy responses. If decentralized cities demonstrate greater resilience, then policymakers may invest in more economic development programs to advocate for decentralization. In addition, it can help prepare for future challenges such as aging populations, digital inclusion, and economic diversification.

This research is significant because it can address the problem of social inequities in different cities. Some economic downturns may be worse for more vulnerable populations, and our research could prove that, helping social justice advocates to be more informed and fight for better outcomes for everyone. For Ohio specifically, is the seventh largest state in the country, yet doesn't have one massive city that a lot of states typically have. Instead, its main urban population is made up of the three smaller cities: Cleveland, Columbus, and Cincinnati. Is this beneficial to Ohio, or do states with one larger city perform better during economic downturns? This research aims to look at that question and see if there are any trends associated with the difference in Ohio's urban makeup compared to other states.

The first article we looked at was by the Macheras & Stanley (2017) from the Federal Reserve Bank of Richmond and researched the effect of population size on diversification and specialization. Regarding specialization, the article states that urban areas can grow because of agglomeration. Agglomeration is when companies locate themselves near other companies in the same industry to reap benefits that include a higher-skilled workforce, lower production costs, and knowledge spillovers. A higher-skilled workforce consists of highly trained and more educated workers who can complete complex tasks, and lower production costs are when it costs less to produce goods. Knowledge spillovers occur when employees can learn from other employees near them, leading to more innovations in different industries. The authors found a positive correlation between population size and industry diversity in urban areas, meaning that cities with more people tend to have a wider array of industries. Conversely, this means that smaller urban areas tend to be more specialized or less diverse.

The second article, Clifford et al. (2023) is a paper that investigates the relationship between city size, decentralization, and economic growth. It first details the trend of cities toward a more decentralized government, arguing that decentralization leads to higher economic growth and enhanced government effectiveness because citizens help the government make more informed decisions. The authors further address this relationship of whether better decision-making ability contributes to higher economic growth. The paper then views the effect of decentralization on growth in larger and smaller cities. The authors found that countries with more decentralization and larger city sizes had lower growth.

The third article, Frick (2017), studies how high population densities affect certain aspects of living such as wages, public services, and transportation. The authors first summarize existing evidence from around 180 studies. Then, they fill in gaps where estimates are inconsistent by utilizing data from the Organisation for Economic Co-operation and Development (OECD). Afterward, they categorize the evidence into 15 different categories. Finally, they assign monetary values to different categories to calculate the economic effect. The article analyzes the advantages and disadvantages of high population densities, stating that higher density is associated with higher wages and rents.

The data we are analyzing comes from two different places. The first is for each state bordering Ohio, including Ohio, so West Virginia, Michigan, Indiana, Illinois, Pennsylvania, and Kentucky, we used Statista to collect the data on each state's GDP from 2000 to 2022. The other data we used is we found the GDP of each MSA (Metropolitan Statistical Area) in those states from 2017 to 2022, downloaded from the St. Louis FRED website.

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DOI: 10.28953/APPL00011120.1013

Figure 1. The percentage of state GDP of the largest MSA in the state, as well as the three largest MSAs.

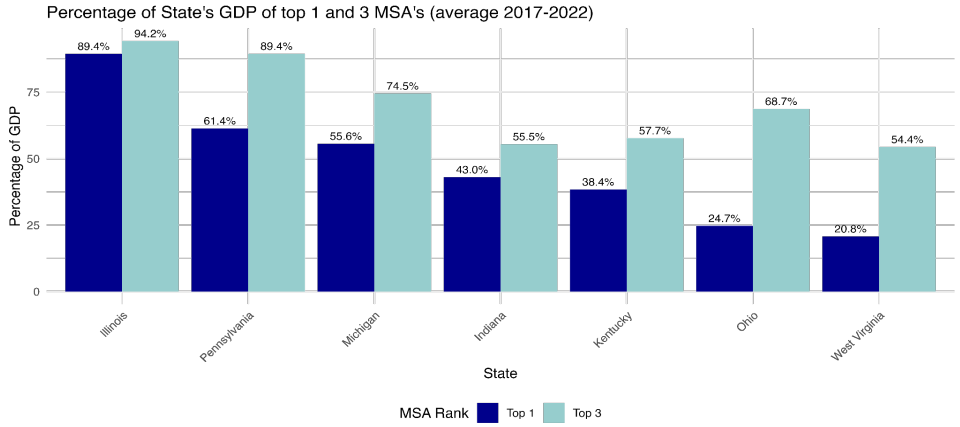

Figure 1, displaying the percentage of GDP of the largest MSAs relative to the percentage of the three largest MSAs denotes which states rely on a metropolis for their economic well-being. In particular, the Chicago-Naperville-Elgin MSA makes up 89.4% of Illinois' GDP, and the Philadelphia-Camden-Wilmington MSA 61.4% of Pennsylvania GDP. Contrary to this, the GDP of Ohio depends 24.7% on the Cincinnati MSA, which is relatively similar to the Columbus and Cleveland-Elyria MSAs, while West Virginia depends most on the Huntington-Ashland MSA 20.8%, which is relatively similar to the Charleston and Hagerstown-Martinsburg MSAs. This means that these states do not depend significantly on one metropolis, as the largest MSAs form less than 25% of the total state GDP. Thus, in order to determine whether our hypothesis that diversification of GDP growth from decentralization of cities throughout a state protects recession due to industry diversification, the growth rates of these four areas will be compared.

Figure 2. The GDP Growth Percentage for Ohio and its closest states, superimposed to display fluctuations.

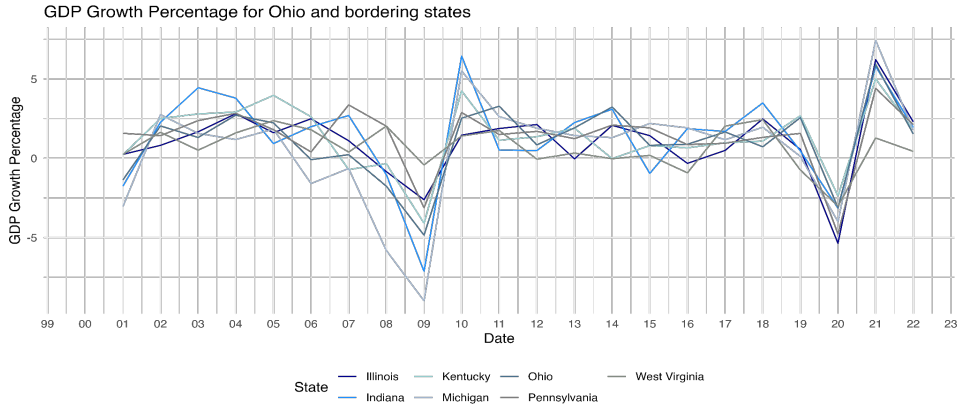

Figure 2 displays the GDP growth percentage for Ohio and its surrounding states from 2001-2022. Through the 2007-2008 financial crisis, the state least affected was West Virginia, which has decentralized cities in the state. However, the recession in Ohio was relatively similar to that of Illinois and Pennsylvania in size. As our hypothesis was also based on the diversification of industries, it is unable to determine what manufacturing industries, which are important to the Midwest area, were affected by the banking crisis. As all of these states besides West Virginia were affected similarly, our data is inconclusive based on this event. However, during the Covid-19 pandemic, Ohio and West Virginia found a minimum at ~-2.6%, contrary to the significant ~-5% in Illinois and Pennsylvania. This may be attributed to the diversification of industry in Ohio and West Virginia in different cities. This may be in particular due to certain restrictions on workers, due to a different political climate in Ohio and West Virginia, who may have been able to work more. Also, the manufacturing focus in Ohio is more widespread through different cities. This also led to the largest growth rate in Ohio relative to the other states, however West Virginia had the lowest, which may be due to general size.

Figure 3. The growth percentages for metropolitan statistical area's GPAs by state.

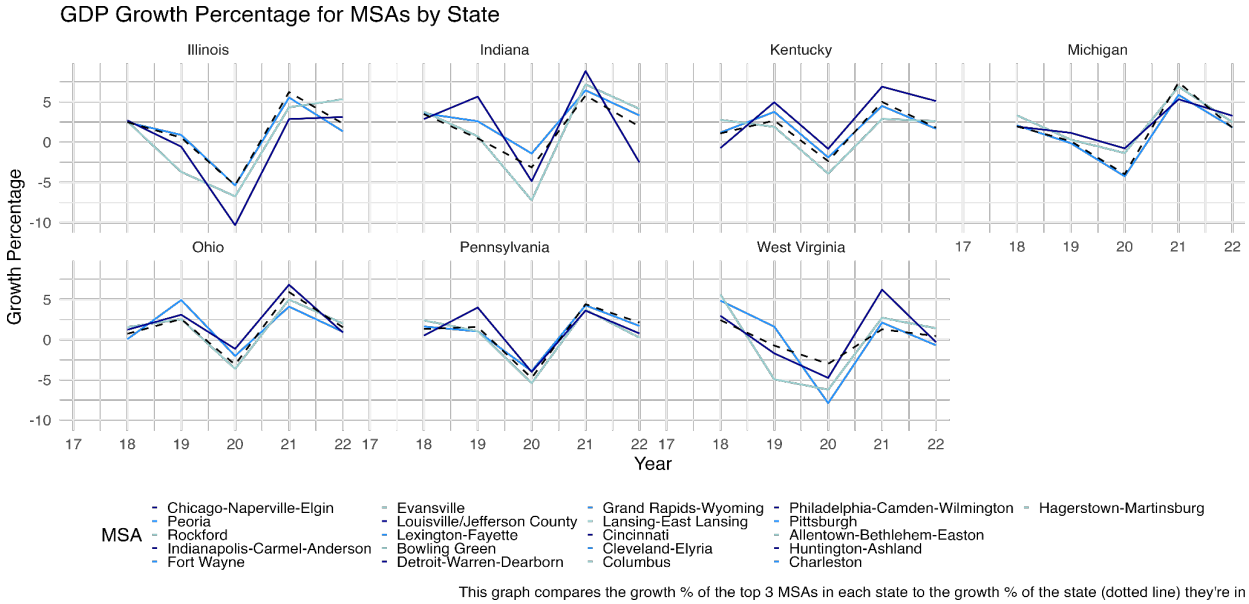

Figure 3 may be related to Figure 2 in that it shows the weights of the MSAs which may affect state economies. While all of Ohio's MSA's depicted are relatively similar in their movement, Illinois were similar besides their largest, the Chicago-Naperville-Elgin MSA. As this makes up a significant portion of the state economy, this less diverse buildup caused significant recessions specifically during the Covid-19 pandemic. As Ohio had multiple MSAs which contributed to its economy, any one of them could not have significantly affected GDP growth percent. However, this is not the case for Pennsylavania, whose different MSAs had a similar effect on the overall GDP growth rate.

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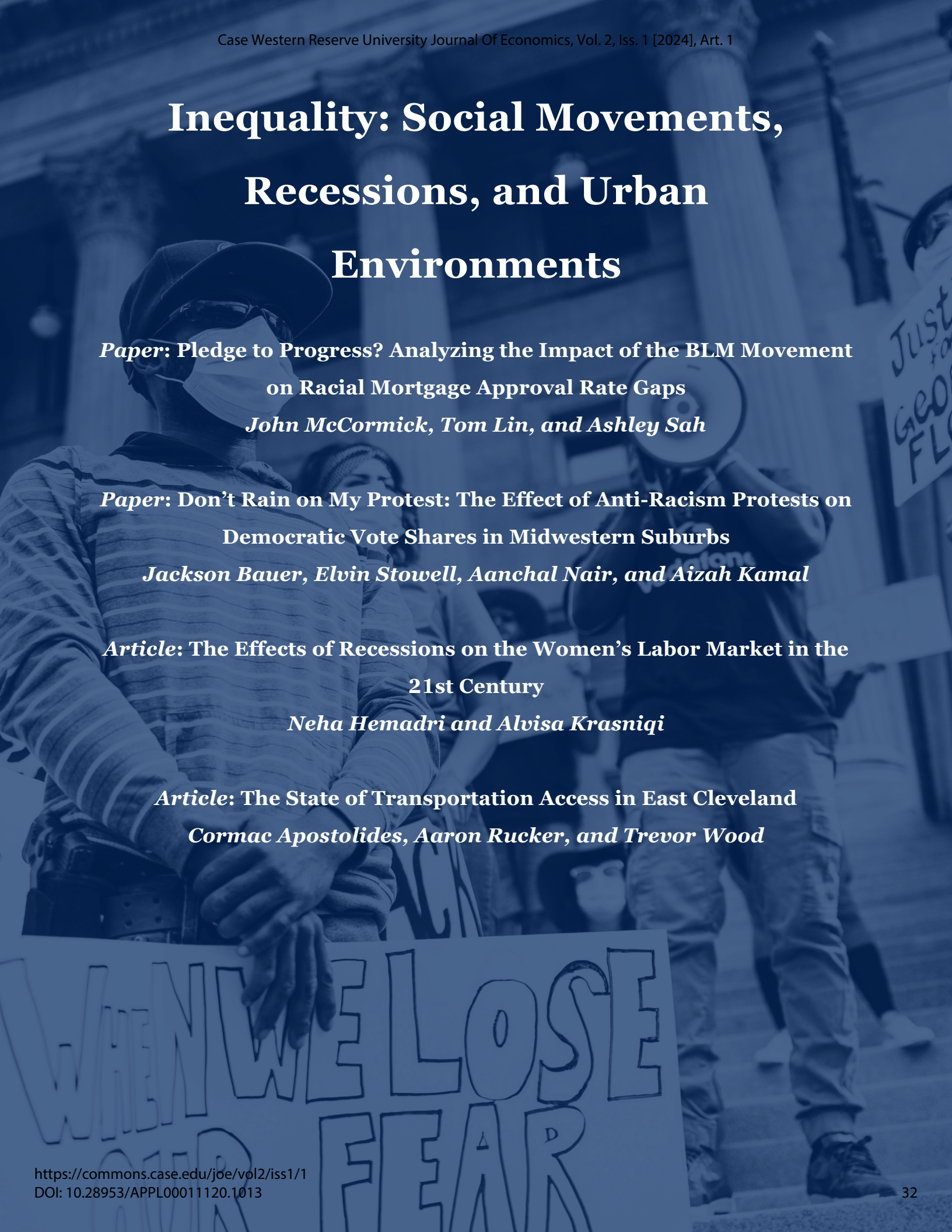
DOI: 10.28953/APPL00011120.1013

Inequality: Social Movements, Recessions, and Urban Environments



https://commons.case.edu/joe/vol2/iss1/1
DOI: 10.28953/APPL00011120.1013

Pledge to Progress? Analyzing the Impact of the BLM Movement on Racial Mortgage Approval Rate Gaps

John McCormick[1]
Tom Lin
Ashley Sah

Abstract

Following the surge of Black Lives Matter protests in 2020, prominent financial institutions announced their commitment to improving racial disparities in homeownership. Using the HMDA dataset from 2019-2022, this paper investigates the difference in home-loan approval rates between white and black borrowers in Ohio post Black Lives Matter movement using bank fixed effects. We found a statistically significant reduction in the approval rate gap between black and white borrowers post 2020.

Introduction

Banks historically have played a prominent role in mortgage discrimination on the basis of race, leading to home-ownership gaps between black and white families up to 30 percent (Gibbons et al.). These disparities are furthered by historical red-lining preventing black homeowners from owning homes in better economic areas (Federal Reserve History). Home value appreciation similarly sees large disparities between predominantly black and predominantly white neighborhoods, furthering the racial gap (Kermani et al.) Overall, Black families are less likely to own a home, and Black families who achieve home ownership are less likely to benefit from property value appreciation than their White counterparts.

Following the murder of George Floyd and the subsequent national Black Lives Matter protests, banks were forced to reckon with their part in systemic inequality. Between 2020 and 2021, banks made up over half of the corporate pledges to the Black Lives Matter movement (Hoyer et al.). In addition to pledges to the BLM movement, many banks initiated community development programs to address racial disparities in home-ownership. A majority of these pledges took the form of loans or investments, with some institutions also making commitments to improving the rates of black homeownership alongside their corporate pledges.

We look to use a bank fixed effects OLS regression model to see if the BLM movement and subsequent corporate pledges led to any changes in the difference of approval rates between black and white loan applicants.

Literature Review

Liao et al. analyzed the effect of BLM protests on local lending disparities. They found that following the BLM protests, the interest rate gap between Black and White borrowers in cities with BLM protests decreased. We aim to build on Liao et al. by looking at the acceptance rate gap between Black and White borrowers in Ohio following the BLM protests.

[1] Thank you to Professors Daniel Shoag and Jenny Hawkins for their guidance throughout our project.

Kau et al. and Gerardi et al. look at other sources of inequity in mortgages. Kau et al. finds that Black borrowers are less likely to terminate their loans early. Gerardi et al. finds that Black and White borrowers have much different likelihoods for refinancing during low federal funds rate time periods.

Wheeler and Olson found that from 1990 to 2013 Black borrowers were, on average, denied more often than their White counterparts, but that as housing prices became more inflated, the difference in approval rates decreased significantly. We look to see whether social movements like BLM and public pressure on financial institutions can also lower approval rate gaps.

Data and Methodology

The data comes from the 2019-2022 Home Mortgage Disclosure Act Data (HMDA) for Ohio. The HMDA data is an individual loan level dataset that includes both approvals and rejections. For this study the data was aggregated by year, bank, and race to get totals for the year by the bank and by race. Our variable of interest was the approval rate gap between black and white borrowers. The approval rate was calculated as:

$$\frac{pct\_approved}{pct\_approved + pct\_denied}$$

This method of calculating the approval rate disregards loan applications that were withdrawn. Taking the approval rate for black borrowers and the approval rate for white borrowers at each bank within one year gave us the approval rate discrepancy.

Descriptive Statistics

The data was aggregated by financial institutions for white and black loan recipients. Below a summary of key variables are shown along with the p-value from the pairwise t-test based on race.

Table 1: Comparison of loan data by derived race category

	Derived Race		
	Black or African American	**White**	**Test (p-value)**
Number of Loans	46.4 (139)	401 (1.8e+03)	<1.0e-03***
Pct approved	.88 (.24)	.903 (.208)	<1.0e-03***
Pct Denied	.02 (.108)	.014 (.076)	6.8e-03**
Loan amount	1.7e+05 (1.2e+05)	2.1e+05 (2.1e+05)	<1.0e-03***
Interest rate	4.27 (1.42)	4.47 (20.5)	.69
Property value	2.4e+05 (4.0e+05)	3.6e+05 (3.0e+06)	.108
Income	118 (1.2e+03)	145 (845)	.338
Pct in loan program	.32 (.361)	.174 (.282)	<1.0e-03***
Approval rate	.976 (.119)	.984 (.088)	.013*
Total dollars	7.4e+06 (2.1e+07)	7.1e+07 (2.9e+08)	<1.0e-03***
Rate spread	.919 (1.08)	.647 (1.03)	<1.0e-03***

Standard deviations in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Derived race is the same as primary applicant's race.

The table demonstrates several differences between loans given to White borrowers and Black borrowers. The number of loans approximately matches the ratio of the Black to White population in Ohio (approximately 1:8). Black borrowers are approved 2 percentage points less often than white borrowers and get smaller loans on average. The interest rate offered to black borrowers appear to be lower on average, but this is not statistically significant. Notably, Black loan applicants were 14 percentage points more likely to apply through a government loan program. Furthermore, the average rate spread for approved Black loans is .272 percentage points higher than the average White loan (significant at the 0.001 level). Ultimately, Black applicants are applying through government programs more often, have slightly lower approval rates, and get loans with higher rate spreads (indicating higher interest rates than the average prime offer rate).

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DOI: 10.28953/APPL00011120.1013

Hypothesis

We hypothesize that as a result of BLM and the subsequent corporate pledges to BLM, that lending approval gaps would shrink. We suspect the banks pledging to help improve racial housing disparities will adjust their lending practices to better fulfill this goal.

Empirical Analysis

Looking at the approval rate difference, two regressions were run. The first model was a bank fixed effects regression for the after period.

$$approval\_rate\_gap = \beta_0 + \alpha_i + \beta_1 After_{it} + \beta_\mu \mu_{it} + \varepsilon_{it}$$

Where α is bank fixed effects, and i is financial institution, and t is year.

To further analyze the impact over time, a second regression was run using an event study methodology in which the post BLM years (2021 and 2022) were given their own dummy variables to measure the difference between the yearly changes.

$$approval\_rate\_gap = \beta_0 + \alpha_i + \beta_i 2021_{it} + \beta_2 2022_{it} + \beta_\mu \mu_{it} + \varepsilon_{it}$$

Where α is bank fixed effects, and i is financial institution, and t is year.

For both regression models a simple regression was run with no covariate controls, and a regression was also run with controls, μ, in which we controlled for the percentage of loan applications that were pre-approved by the institution, the percentage of loan applications that conformed to the government sponsored entity (GSE) conforming loan limit, and the percentage of loan applications submitted through government loan programs for Black applicants.

Fixed Effects Regressions on Approval Gap

	(1) Simple FE Regression	(2) With Controls
After 2020	-0.00766*	-0.00787*
	(0.00384)	(0.00393)
% Black loans preapproved		-0.0233
		(0.0217)
% Black loans conforming loan limit		0.0284*
		(0.0132)
% black loans from loan program		0.000956
		(0.00491)
Constant	0.0159***	-0.0111
	(0.00284)	(0.0127)
Bank Fixed Effects	Yes	Yes
N	1615	1615
R^2	0.466	0.467

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In the bank fixed effects regression without covariate controls, the post BLM movement period is associated with a .766 percentage point decrease in White-Black approval rate gap. This indicates that the post-BLM period did see a statistically significant decrease in the approval gap at the 5% level. Then when adding in the covariate controls, the after period is still associated with a statistically significant decrease in the rate gap.

Fixed Effects Regressions on Approval Gap

	(1) Simple FE Regression	(2) With Controls
2021	-0.00465	-0.00486
	(0.00440)	(0.00451)
2022	-0.0109*	-0.0111*
	(0.00457)	(0.00460)
% Black loans preapproved		-0.0223
		(0.0214)
% Black loans conforming loan limit		0.0296*
		(0.0132)
% Black loans from loan program		0.00119
		(0.00495)
Constant	0.0159**	-0.0125
	(0.00284)	(0.0127)
Bank Fixed Effects	Yes	Yes
N	1615	1615
R^2	0.467	0.468

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In this second model we look closer at the post period reduction. The main reduction in the approval gap rate happens in 2022. The year 2022 is associated with a 1 percentage point decrease, statistically significant at the 0.05 level, in the approval rating gap. It appears that in 2022, the margin that did exist prior to 2022 had been cut by over half. The negative coefficient on the 2021 dummy variable suggests the year had an overall period of decreasing the racial loan approval gap, and in 2022 this reduction process has statistically significant results. It is also important to note the lack of change in the coefficients because of the covariate controls suggesting that these rates were dropping regardless of pre-approval rates, or government loan program applications for Black applicants.

Conclusion

Overall, we found that the approval rate gap did decrease following the BLM movement. This does suggest that community organizing, and public pressure can be a powerful force for improved equity in the U.S. However, based on the in-depth year effects, further research may have to be conducted to understand if inflation played a larger role in this effect. This was not possible to control because of our small dataset and the correlative trends of time and interest rates post covid. Our paper sheds light on the efficacy of social movements on conducting change. In the future we would like to look at how banks that made large pledges to racial justice compare to banks who opted to not make corporate pledges. Understanding this relationship helps put a tangible effect on the stated values of financial institutions and their actions in the lending market.

https://commons.case.edu/joe/vol2/iss1/1
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Don't Rain on My Protest: The Effect of Anti-Racism Protests on Democratic Vote Shares in Midwestern Suburbs

Jackson Bauer[1]
Elvin Stowell
Aanchal Nair
Aizah Kamal

Abstract

After George Floyd was murdered in May of 2020, a massive wave of anti-racism and anti-police brutality protests erupted across the United States. In addition to matters such as racial prejudice and awareness of racial discrimination, some studies have measured the effect of those protests on the 2020 presidential election. Previous research has shown that higher protest attendance in specific geographic areas causes increased vote shares in those areas for candidates aligned with the protests. We expand on this research, employing an instrumental variable (IV) model with rainfall as an exogenous source of variation in protest attendance to assess the effect of anti-racism protests in the summer of 2020 on vote shares in the 2020 presidential election in Midwest metropolitan areas. We use town and city level election results and protests within each city's metropolitan statistical area (MSA). Furthermore, we group towns and cities by the proportion of white residents to compare the effect of protest attendance on vote share across different racial demographic groups. Contrary to previous literature, we find that greater protest attendance decreased the Democratic vote share in suburbs surrounding six midsize Midwestern cities at a statistically significant level. However, the effect is not significantly different across the demographic groups.

Introduction

Several racial justice and anti-racism protests, often associated with the Black Lives Matter movement (BLM), erupted across the United States in summer of 2020 following the murder of George Floyd. The BLM movement became highly politicized; Democrats, including Joe Biden, generally supported the movement, incorporating themes of racial justice and police reform into their platforms, while Republicans, including Donald Trump, tended to criticize the protests for turning violent while downplaying racial justice narratives. This politicization, combined with the presidential election later that year, creates an opportunity to study the effect of the anti-racism protests on the 2020 election.

In this paper, we answer the question: what was the effect of anti-racism protest attendance in midsize rustbelt and Midwest cities on Biden's vote shares in areas surrounding those cities? Further, how does this effect vary between areas with different racial demographics? We hypothesize that greater attendance at anti-racism protests in Midwest cities leads to greater vote shares for Biden in surrounding suburbs, and that the effect is more positive in areas with lower proportions of white residents. We anticipate this since it aligns with the existing literature as well as the anti-racism protests aiming to address the unjust and inequitable treatment of black people, and areas with a larger white population might be more resistant for changes towards racial justice than areas with a smaller white population.

[1] We would like to thank the CWRU Journal of Economics for providing us with this research opportunity, and especially Henry Blyth and Annie Castagnero for helping us with our project as editors.

https://commons.case.edu/joe/vol2/iss1/1
DOI: 10.28953/APPL00011120.1013

We see two important implications of our results. First, we contribute to existing research on how demonstrations affect election results, specifically looking at anti-racism protests in Midwest cities and election results in the cities' suburbs. Second, by comparing the protest-to-vote-share effect between areas with different racial demographics, our results could be used by political activist groups to better target their efforts.

Literature Review

The following literature delves into how anti-racism protests may have shifted Democratic vote shares and examines the intersections between racial demographics and political outcomes. One study measured protest impact and attitude shifts using a nationally representative survey and propensity scores. It found that the heightened movement caused by the death of George Floyd caused an increased perception of discrimination, decreased favorability of police, and racial prejudice, as well as supported conclusions regarding how social protests have power to shift attitudes and policy preferences (Curtis, 2021). Another study specifically analyzes how effective BLM protests were by using county level survey data on prejudice and police reform. The findings included that prejudice was not reduced but a mix of violent and non-violent protests caused more conservatives in liberal areas to want police reformation than just nonviolent protests. Results from the study also showed that in areas with low Trump vote shares, there was a positive effect of violent and nonviolent protests and for areas with high Trump vote shares, there was a negative effect of violent and nonviolent protests, which helps conclude that conservatives were affected by BLM protests (Shuman et al., 2022). It is important to acknowledge that this literature segment used Trump vote shares by country rather than precinct/MSA areas.

The next relevant literature measures the effect of protests on the 2020 election using an instrumental variable regression with rain as the instrument. The study employed spatial weighting matrices and GMM to analyze biases from surrounding areas' influence. Again, BLM protests were found to positively influence Democratic vote share which highlights the importance of considering spatial effects on political attitudes/behaviors in surrounding regions (Teeselink & Meliosk, 2023). Our choice of using rainfall as an instrument was also inspired by a study that demonstrated how rainfall's exogenous variability provided a natural method of measuring the influence of rally size on political engagement and policymaking for the Tea Party movement in 2009 (Madestam et al., 2013).

Data

The scope of our study is six midsize Midwest cities — Cincinnati, Cleveland, Columbus, Milwaukee, Minneapolis, and Pittsburgh — and their suburbs. We defined suburbs as all jurisdictions (cities, townships, and villages) whose center is within a 30-minute drive from the major city's downtown. The list of jurisdictions for each city was obtained from Gigasheet and the driving distance was calculated via the Google Maps Routes API.

We gathered the following data for our primary results: precinct-level presidential election results in 2016 and 2020 from the MIT Election Lab and the Redistricting Data Hub; protest attendance estimates from May 25th, 2020 to June 25th, 2020 from the Crowd Counting Consortium; daily rainfall (in mm) by major city from May 25th, 2020 to June 25th, 2020 and average monthly rainfall (in mm) from May 25th to June 25th from the National Oceanic and Atmospheric Administration; jurisdiction-level population demographics from the U.S. Census Bureau; and shapefiles of the jurisdictions of Ohio, Minnesota, and Pennsylvania through each states' Department of Transportation and Wisconsin through the Legislative Technology Services Bureau.

From the election results, we group votes by jurisdiction and take the percentage of votes for Joe Biden. For protest attendance, we group protests by the MSA they occur in and normalize by the population of the MSA. To assess how the protest to vote share effect varies between areas with different racial demographics, we divide the jurisdictions into four groups based on how large their percentage of white residents is compared to the first quartile, median, and third quartile.

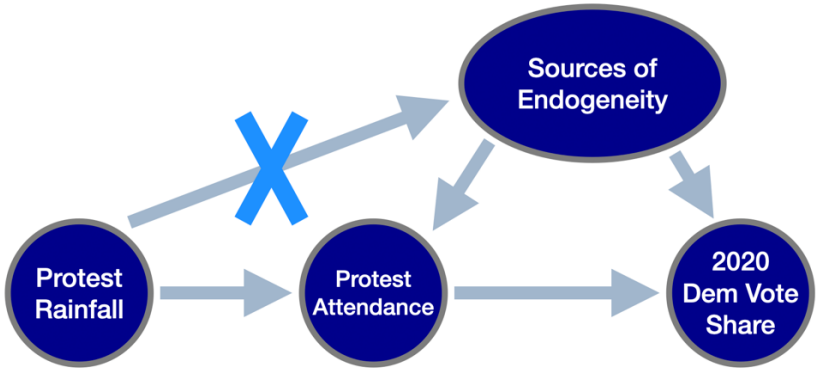
Table 1. Summary Statistics of Variables

Variable	N	Mean	SD	Min	Max	25th Percentile	50th Percentile	75th Percentile
2020 Democratic Vote Share	11912	0.5585615	0.1403553	0.1822581	0.9709035	0.4733467	0.54233	0.6400145
2016 Democratic Vote Share	11912	0.5104228	0.1456763	1.642036	0.9738652	0.4157303	0.4951299	0.579716
2020 Total Votes	11912	8331.613	11235.28	30	65109	1259	3891	9814
Protest Attendance	11912	0.0001877	0.0003705	4.79E-07	0.0047627	0.0000422	0.0000813	0.0001687
% of White Residents	11912	0.7646465	0.184649	0.0313293	0.9635417	0.7124682	0.8218168	0.8865503
Protest Rainfall	11912	1.654432	4.56968	0	22.4	0	0	0.3
Average Rainfall	11912	103.4982	4.916874	93.98	110.24	101.35	101.35	107.95

Methodology

To estimate the effect of protest attendance on Democratic vote share, we used an IV model with rainfall as an instrument. Protest attendance is likely endogenous in its effect on Democratic vote share, meaning there are unobserved variables that both affect protest attendance and Democratic vote share. The amount of rainfall on the day of the protest will likely decrease protest attendance as people may not want to go outside to protest the harder it rains, and the effect of a single day of rainfall will likely not impact the election results outside of affecting the protest attendance for that one day. Thus, rainfall on the day of the protest is likely relevant and exogenous, so it is a natural choice for our instrument.

Figure 1. Internal Validity Model Diagram



Note: A visual description of our IV regression. The arrows represent causality, and for the instrument to work, the only path from the rainfall to Democratic vote share must be through protest attendance.

We estimated the following first stage and reduced-form equations:

$$X = \alpha_0 + \alpha_1 Z + \alpha_2 DemVoteShare_{2020} + \alpha_3 White\%_{2020} + \alpha_4 Pop_{2020} + \alpha_5 AvgRain$$

$$Y = \beta_0 + \beta_1 Z + \beta_2 DemVoteShare_{2020} + \beta_3 White\%_{2020} + \beta_4 Pop_{2020} + \beta_5 AvgRain$$

Here, X is protest attendance, Y is Democratic vote share in 2020, and Z is rainfall on the day of the protest. In addition to our endogenous variable and instrument, we included the Democratic vote share in 2016, the percentage of the jurisdiction that is white in 2020, the population of the jurisdiction in 2020, and the average rainfall during the month as controls. We also run additional regressions that place weights on each jurisdiction equal to the total number of votes in the jurisdiction in 2020, and ones that use the total protest attendance for each MSA in the month and the total rainfall on protest days rather than the attendance and rainfall for each individual protest.

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DOI: 10.28953/APPL00011120.1013

Results

We found that the IV coefficient of protest attendance on Democratic vote share in 2020 was negative and significant at the 1% level. Furthermore, this effect persisted in both the weighted and unweighted regressions. The magnitudes of the effect are extremely large, which is due to protest attendance being very small relative to Democratic vote share on average. To better interpret the coefficients, we can look at the effect of an increase in the standard deviation of protest attendance, or 0.00037 percentage points. An increase of this amount in protest attendance leads to around a 0.02 percentage point decrease in Democratic vote share in 2020 per jurisdiction. The coefficient of the weighted regression cannot be interpreted in the same way, although it did increase compared to the unweighted one, suggesting that the effect was larger for populous jurisdictions.

Table 2. Regression Results

	2020 Democratic Vote Share (Unweighted)	**2020 Democratic Vote Share (Weighted)**
Protest Attendance	-54.07**	-54.07**
	(-2.71)	(-2.71)
2016 Democratic Vote Share	1.018***	1.018***
	(211.2)	(211.2)
% of White Residents	0.0796***	0.0796***
	(25.46)	(25.46)
Population	5.73e-7***	5.73e-7***
	(16.79)	(16.79)
Average Rainfall	0.00315***	0.00315***
	(42.54)	(42.54)
Constant	-0.346***	-0.346***
	(-32.59)	(-32.59)

Note: Unweighted and weighted results. Both the unweighted and weighted F-statistics were greater than 10, indicating that rainfall on the day of the protest was relevant for both regressions.

Separating by racial demographics, we find that none of the coefficients are significant. Furthermore, none of them have an F-statistic greater than 10, indicating rainfall is a weak instrument when the sample is divided into the demographic groups. As a result, this provides no evidence that jurisdictions with higher white populations were affected by the protests differently than jurisdictions with lower white populations.

Table 3. Regression Results by Groups

	2020 Democratic Vote Share (Group 1)	2020 Democratic Vote Share (Group 2)	2020 Democratic Vote Share (Group 3)	2020 Democratic Vote Share (Group 4)
Protest Attendance	-99.11	-1.929	-46.81	-62.67
	(-1.6)	(-0.1)	(-1.59)	(-1.27)
2016 Democratic Vote Share	0.973***	1.001***	1.046***	1.026***
	(99.4)	(182.38)	(135.48)	(56.88)
% of White Residents	0.0728***	0.0243***	0.240***	0.603***
	(8.81)	(1.5)	(7.83)	(12.16)
Population	5.44e-7***	1.81e-7***	7.24e-7***	5.72e-7***
	(9.74)	(3.75)	(9.18)	(6.69)
Average Rainfall	0.00315***	0.00379***	0.00329***	0.00209***
	(12.72)	(36.31)	(24.64)	(11.5)
Constant	-0.303***	-0.357***	-0.516***	-0.721***
	(-12.4)	(-22.91)	(-14.87)	(-14.16)

Note: Our results when dividing the sample into groups based on the percentage of white residents in the jurisdiction. Jurisdictions with a percentage less than the first quartile of jurisdictions were placed in Group 1, jurisdictions with a percentage in between the first quartile and median were placed in Group 2, jurisdictions with a percentage in between the median and the third quartile were placed in Group 3, and jurisdictions with a percentage greater than the third quartile were placed in Group 4.

When estimating the effect of the total protest attendance throughout the month using total rainfall on protest days throughout the month as an instrument, we find a negative and significant effect for the unweighted regression. However, the instrument was weak, so we are unable to conclude anything about the effect of total protest attendance in the observed month. The weighted regression also contained a weak instrument and did not have a significant result.

Table 4. Collapsed Regression Results

	2020 Democratic Vote Share (Unweighted)	2020 Democratic Vote Share (Weighted)
Protest Attendance	-19.88*	-26.9
	(-2.25)	(-1.5)
2016 Democratic Vote Share	0.990***	0.976***
	(28.03)	(16.56)
% of White Residents	0.0909***	0.0882*
	(3.32)	(2.11)
Population	5.69e-7**	0.00000014
	(3.12)	(0.78)
Average Rainfall	0.00598***	0.00648**
	(4.08)	(2.64)
Constant	-0.492***	-0.466***
	(-4.66)	(-3.39)

Note: Our results for the unweighted and weighted IV regression of Democratic vote share in 2020 on total protest attendance throughout the month as a percentage of the population of the MSA, using rainfall during the protest as an instrument.

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DOI: 10.28953/APPL00011120.1013

Conclusion

Our paper investigated the effect of the anti-racism protests following the murder of George Floyd on the result of the 2020 election in Midwest suburbs. We found that protest attendance was negatively correlated with Democratic vote share when using rainfall on the day of the protest as an instrument. Furthermore, we did not find evidence to support that this effect varied with the percentage of white residents in an area. Our research suggests that the anti-racism protests in May and June of 2020 shifted the results of the 2020 election to be more conservative, which runs contrary to the prior literature on the protests and our hypothesis. One potential explanation of this effect could be a conservative backlash to the protests that was more focused on rallying support for the 2020 election than rallying for institutional change.

Our paper has a few limitations that restrict how much can be generalized from our results. Although we believe our instrument to be exogenous, there is the potential of rainfall on certain days being correlated to an unobserved variable such as crime rate. If this is the case, our findings only suggest a correlation between protest attendance and Democratic vote share. We had missing data for a couple of jurisdictions, but a very small number. We also had to reduce the scope of our study, as we initially planned to cover Detroit, Indianapolis, and Buffalo suburbs as well. This restriction was due to time and data limitations, and likely impacted our ability to find significance when we restricted our sample size by the demographic groups. Finally, our data for protest attendance was not perfectly accurate, since it was obtained through crowd counting and some protests did not have crowd estimates. Future studies could address these limitations, as well as investigate a potential conservative backlash to the anti-racism protests.

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https://commons.case.edu/joe/vol2/iss1/1
DOI: 10.28953/APPL00011120.1013

The Effects of Recessions on the Women's Labor Market in the 21st Century

By: Neha Hemadri & Alvisa Krasniqi

In the wake of the 2008 global financial crisis and then the COVID-19 pandemic, the United States labor market has experienced major changes, impacting women and men significantly differently. This paper delves into the gender disparities, analyzing their effects on industries, labor dynamics, and individual livelihoods. Contrasting the 2008 recession with the COVID-19 pandemic presents a valuable opportunity for studying the evolving dynamics of gender within the labor market. Recessions, as natural experiments, offer a platform to observe these changes firsthand. The 2008 recession, characterized by widespread job losses, had a far greater impact on men than women. Conversely, the COVID-19 pandemic had a greater impact on women than men according to labor participation and unemployment rates. Recognizing these disparities is essential for devising targeted policies aimed at mitigating negative consequences, that serve as an economic safety net to conserve gender equality.

We consider the following economic indicators for our analysis:

> **Labor Force Participation Rate -** measures the percentage of the working-age population employed or actively seeking employment.
>
> **Unemployment Rate** - measures the percentage of people within the labor force that do not have a job and are actively looking to get one.

Shock 1: 2008 Recession

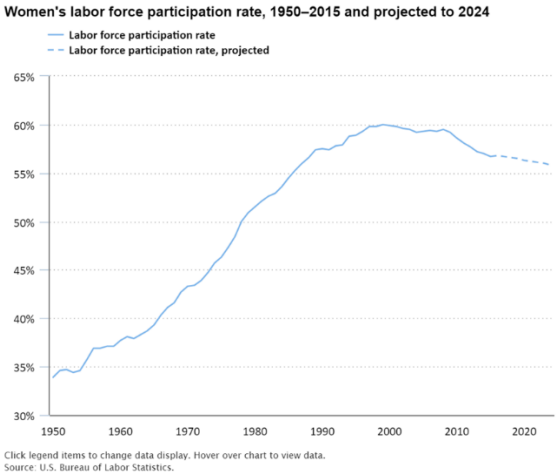
For this section, we analyze graphs from Toossi and Morisi (2017) from the Bureau of Labor Statistics.

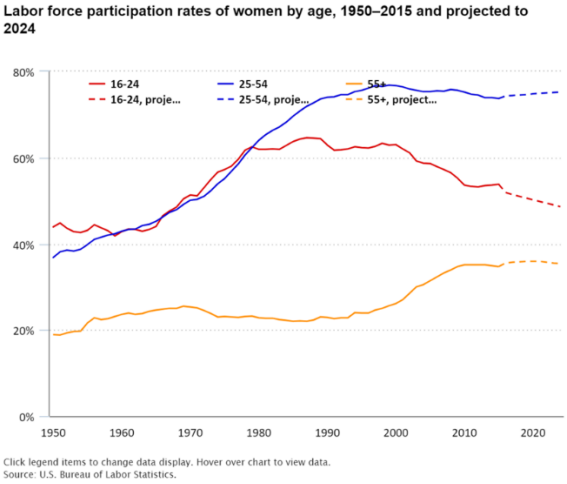
On Women's Labor Force Participation Rate

According to Figure 1, the growth of the U.S. labor force in the latter half of the twentieth century was greatly influenced by a significant rise in women's labor force participation. This trend was fueled by economic expansion and the entry of baby boomers into the workforce. However, since its peak in 1999, women's labor force participation has been on a downward trajectory, attributed to factors such as aging baby boomers and the repercussions of the 2007–09 recession. Projections from the Bureau of Labor Statistics (BLS) indicate a continued decline in women's labor force participation rates throughout the 2014–24 decade (Toossi and Morisi, 2017).

Women's labor force participation surged through the 1960s to the late 1990s, peaking at 60% in 1999, despite economic downturns. However, since then, it has steadily declined, contributing to an overall decrease in labor force participation. Since the midpoint of the Great Recession in 2008, it has dropped by 2.8 percentage points to 56.7% in 2015.

Figure 1. (left) Women's labor force participation rate, 1950-2015 and projected to 2024 (Toossi and Morisi, 2017);
Figure 2. (right) Labor force participation rates of women by age, 1950-2015 and projected to 2024 (Toossi and Morisi, 2017)





The labor force participation rate among women aged 16 to 24 peaked at 64.6 percent in 1987 but has seen a significant decline since 2000. This trend is expected to continue, with a pre-pandemic projected rate of 48.6 percent by 2024. Factors contributing to this decline include increased school enrollment and competition for jobs from older and foreign-born workers, as well as economic fluctuations.

Women aged 25-54 have the highest labor force participation rates, though they have declined since 1999. This group's participation is less impacted by economic downturns due to their skills and experience. For women over 55, participation peaked at 35.1% in 2010, slightly dropping to 34.7% by 2015. The need for employer-provided health insurance may drive older women to stay in the workforce.

On Women's Unemployment

Overall, in 2008, men bore 78 percent of the job losses. Over the same period, the unemployment rate for men rose from 4.9 percent to 8.9 percent, while the rate for women rose by only half as much, from 4.7 percent to 7.2 percent (Wall, 2009). According to Christina Hoff Sommers of the American Enterprise Institute, "Men are bearing the brunt of the current economic crisis because they predominate in manufacturing and construction, the hardest-hit sectors." Women, on the other hand, "are a majority in recession-resistant fields such as education and health care" (Sommers, 2009). This divergence highlights the importance of sectoral composition in understanding the differential impacts of economic crises on men and women in the labor market. It also emphasizes the resilience of certain industries during challenging economic times.

Shock 2: The Pandemic

Unlike the 2008 recession, women faced steeper job losses than men at the start of the pandemic (Clapp, 2023). To illustrate this, we analyzed the graphs by Clapp (2023) from the US Census Bureau.

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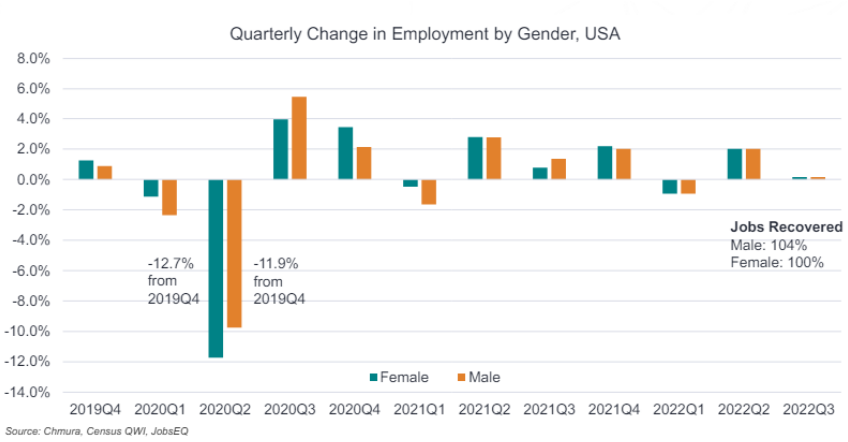
DOI: 10.28953/APPL00011120.1013

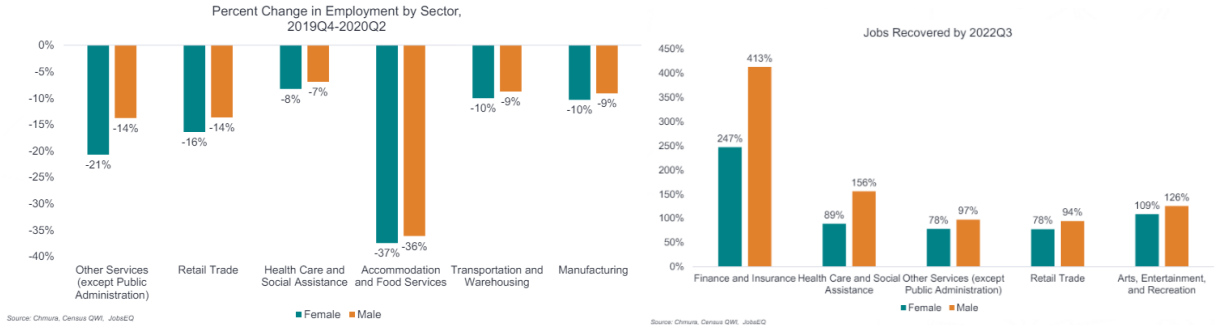
Figure 3. Quarterly change in employment by gender, USA (Clapp, 2023)



According to Figure 3, the impact of job losses was disproportionately heavier on women in the 4th quarter of 2019, as reflected in a significant -12.7% change in unemployment rates, contrasting with men who encountered a relatively smaller decline of -11.6% during this timeframe.

Women accounted for a larger proportion of lost jobs across various industries during the pandemic as demonstrated in Figure 4. In retail trade, women had a 16% decrease in employment versus 14% decrease for men. In healthcare and services, women decreased by 8% compared to 7% for men. Across industries (except public administration), women had a significant 21% decrease in employment versus 14% for men.

Figure 4. (left) Quarterly change in employment by gender, USA (Clapp, 2023);
Figure 5. (right) Jobs recovered by the third quarter of 2023 (Clapp, 2023)



Compared to men, women had slower workforce recovery rates. For example, in finance and insurance, women's recovery was 247% versus men's 413%. In healthcare, women's recovery was 89% versus men's 156%. This trend extended across industries as seen in Figure 5. These challenges persist for women in reentering employment post-economic downturns.

On Women's Unemployment

Labor Force Participation remains below pre-pandemic levels as of January 2023. So why were women affected more than men by the pandemic, but the opposite was true in 2008?

Women's labor force attachment theory, also known as labor force attachment theory or labor force attachment model, is a framework used to understand and analyze the factors influencing women's participation in the labor force (Compton and Pollak, 2013). The theory emphasizes the interplay between individual characteristics, societal

structures, and economic incentives that shape women's decisions regarding employment, job-seeking behaviors, and workforce participation.

At its core, the theory posits that women's attachment to the labor force is influenced by various factors, including personal preferences, family responsibilities, educational attainment, economic conditions, and social norms. It recognizes that women's decisions regarding work are often shaped by a complex interplay of these factors rather than solely driven by economic considerations.

Hypothesis for why women were hit harder:

> **Occupational Segregation:** Women are overrepresented in sectors heavily impacted by lockdowns and social distancing measures, such as retail, hospitality, and healthcare. These sectors experienced significant job losses or reduced hours during the pandemic, leading to disproportionate effects on women's employment.
>
> **Caregiving Responsibilities:** Women often shoulder a disproportionate burden of unpaid caregiving responsibilities, including childcare and eldercare. With the closure of schools and daycare facilities during the pandemic, many women faced increased caregiving demands, making it difficult to maintain employment or work remotely.
>
> **Healthcare and Essential Workers:** Women make up a significant portion of frontline healthcare workers and essential workers in sectors such as retail and food service. These workers faced increased exposure to the virus and heightened health risks during the pandemic.

Conclusion

Comparative research on the COVID-19 pandemic and the 2008 recession's effects on the labor market has revealed notable differences between how men and women handle economic downturns. Gendered outcomes are significantly shaped by the adaptability and resilience of various sectors.

Additionally, caregiving duties became a significant factor in determining women's employment outcomes. Moving forward, our aim is to develop a Workplace Gender Equality Index that offers a comprehensive evaluation of gender equality within workplaces, incorporating a broader range of indicators for a more nuanced assessment.

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https://commons.case.edu/joe/vol2/iss1/1
DOI: 10.28953/APPL00011120.1013

The State of Transportation Access in East Cleveland

By: Cormac Apostolides, Aaron Rucker, Trevor Wood

A recent data analysis has revealed striking variations in how income levels can significantly influence the quality of transportation alternatives available to individuals in the center of East Cleveland and its neighboring areas. According to the reports, in addition to the benefits of higher wages, residents of affluent communities like Bratenahl, Shaker Heights, and University Heights also benefit from lower average commute times (Hidalgo). On the other hand, commutes are a little longer in lower-class neighborhoods like Richmond Heights, Euclid, and East Cleveland; interestingly, East Cleveland has the lowest median income. This discrepancy emphasizes how urgently targeted transportation infrastructure upgrades are needed to close the mobility and wealth divides.

The Regional Transit Authority (RTA) has reacted proactively to these discrepancies and the wider need for improved public transit alternatives. Development in the Lorain Avenue corridor will be aided by a $700,000 grant from the Federal Transit Administration, which was recently awarded. To improve accessibility and promote ridership, this project will link nearby residential and commercial buildings with bus rapid transit routes. The program is a component of a bigger plan to improve transit lines' connectivity to residential and commercial areas. The RTA wants to change urban transportation to be more efficient and equitable for all citizens, regardless of income level, by concentrating on five vital routes. In addition to meeting urgent transportation requirements, this strategic strategy supports larger urban development objectives that promote inclusive, sustainable communities.

Barkley, Brett, & Gomes examined the problems related to public transportation accessibility for jobs in Northeast Ohio. This paper explored the impact of commuting accessibility on economic possibilities, particularly for low-income and minority groups. When compared to other American urban areas, Northeast Ohio's transportation coverage and frequency are superior. Nonetheless, the accessibility of jobs by public transportation is still below average, suggesting that regional growth and transportation planning are not well coordinated. The report examines the availability of jobs by industry type and skill level across several areas. It reveals differences in employment opportunities according to industry, region, and demographics. The study demonstrated that jobs with a salary of less than $1250 per month and those with only a high school degree have the fewest career options. The paper also shows that minority and low-income groups find it more difficult to obtain work that suits their qualifications or is close to where they live. This combined with limited public transportation access, makes finding work more challenging. The authors argue for continuing investment and policy focus in these areas to improve the general quality of life in Northeast Ohio, highlighting the importance of efficient public transportation networks and improved job accessibility for social fairness and economic competitiveness.

With a few exceptions in specific areas, Yeganeh et al. discovered that low-income and non-White areas often have greater access to jobs via public transit. This discovery aligns with previous research highlighting the benefits of public transportation for these populations. Higher-income groups typically have easier access to jobs in major areas such as New York, Washington, DC, Chicago, and Houston. This finding supports earlier studies that found a relationship between income levels and the Central Business District (CBD), showing that people from wealthier origins are more likely to live nearer to city centers or to places where the majority of the population is lower income. While income is a significant factor in transit equity analysis, other factors that must be taken into account include racial demographics, the percentage of White residents in a certain area, and the percentage of the population with limited English proficiency. These elements are essential for conducting a detailed analysis of the trends in job accessibility among various populations.

Based on the findings of the extensive research conducted by the Federal Reserve Bank of Cleveland and Yeganeh, Armin Jeddi et al., which revealed systemic problems with job availability and public transportation accessibility throughout Northeast Ohio, we now turn our attention to the local effects of these larger trends in East Cleveland. Our research and findings highlight the critical role that public transportation plays in boosting economic competitiveness and social fairness. Shortly, the city of Cleveland and neighboring northeast Ohio cities are investing to renovate and improve public transportation.

Using information from DataUSA.io, we have carried out an investigation on East Cleveland and the surrounding neighborhoods to investigate and enhance the findings by the Federal Reserve of Cleveland and Yeganeh, Armin Jeddi, et al. Our goal was to examine how socioeconomic differences within these particular areas impact the quality and accessibility of transportation, both of which are essential for ensuring effective daily commutes and the general well-being of the community.

Figure 1. (left) Black versus White population in Cleveland neighborhoods; **Figure 2.** (right) Median income by neighborhood

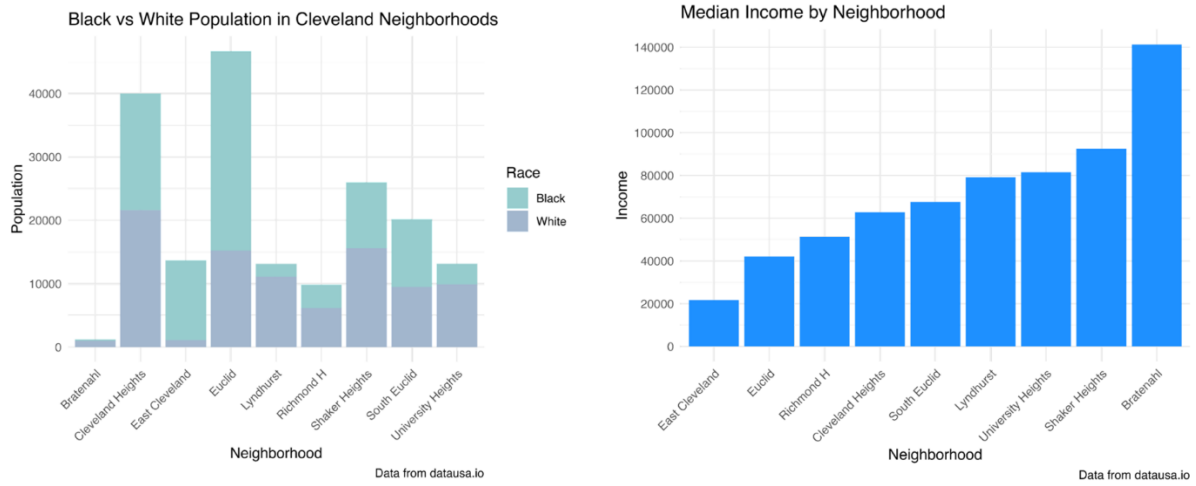
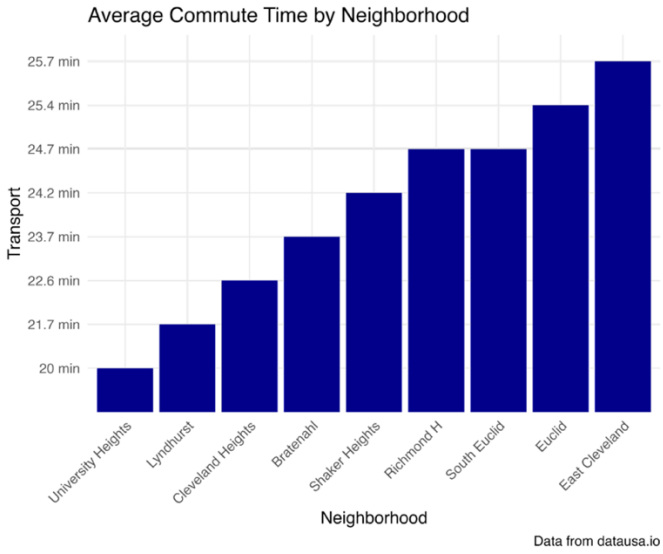


Figure 3. Average commute time by neighborhood



We conducted data analysis of the Black and White populations within East Cleveland and eight surrounding neighborhoods (Figure 2). East Cleveland had the highest Black population with 12,600 and Cleveland Heights had the highest White population with 21,600.

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DOI: 10.28953/APPL00011120.1013

In Figure 3, our analysis of the median income of each neighborhood resulted in East Cleveland being the lowest at $21,699 and Bratenahl being the highest at $141,250. These results are significant because they showcase the disparities in wealth between neighborhoods with a high Black population and a high White population.

The data analysis we conducted on average commute time across the neighborhoods revealed East Cleveland having the highest time at 25.7 minutes and University Heights having the shortest time at 20 minutes. These results indicate that neighborhoods with the highest populations of Black citizens are not only less wealthy but take longer to travel where they want to go in the city. The data analysis we conducted for East Cleveland and surrounding neighborhoods revealed critical information about how the level of income can negatively impact the quality of transportation for residents. The results of our data analysis indicate there is a need to change the transportation quality for residents living in East Cleveland. Although the transportation times are roughly comparable between the neighborhoods, East Cleveland needs a sizable increase in transportation to make up for the lack of access to quality jobs.

It is essential to recognize that the relationship between minority populations and transit accessibility is nuanced and varies across different urban contexts. While some minority-majority neighborhoods may indeed face transit deserts, characterized by limited access to public transportation, others may benefit from extensive transit networks driven by factors such as population density, political influence, and historical investment in infrastructure. These variations underscore the need for tailored approaches to addressing transit disparities that consider the unique characteristics and needs of each community. Moreover, income levels further complicate these dynamics, as lower-income households in minority-majority neighborhoods disproportionately rely on public transportation as their primary mode of travel. For these residents, access to reliable and affordable transit is not just a matter of convenience but a fundamental necessity for accessing employment, education, healthcare, and other essential services. Conversely, higher-income residents often gravitate towards neighborhoods with robust transit connectivity, contributing to gentrification pressures and reshaping community demographics.

Policies aimed at improving transit accessibility must adopt a multifaceted and holistic approach that considers the intersecting influences of race, income, and neighborhood characteristics. Targeted investment in transit infrastructure and services should prioritize underserved minority-majority neighborhoods, addressing existing gaps in accessibility and promoting economic development and social inclusion. Additionally, efforts to enhance job access through transit-oriented development, workforce development programs, and affordable housing initiatives can help mitigate the barriers to economic opportunity faced by marginalized communities. Ultimately, addressing the nexus of minority populations, income levels, and transit accessibility in urban neighborhoods requires a concerted effort from policymakers, urban planners, community advocates, and stakeholders. By prioritizing equity and inclusion in transportation planning and policymaking, cities can work towards building more resilient, sustainable, and inclusive communities where all residents have the opportunity to thrive.

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Employment: Technological Change, Health Crises, and Migration

Paper: Manufacturing on Autopilot: Ohio Automation on Manufacturing Wages and Employment

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https://commons.case.edu/joe/vol2/iss1/1
DOI: 10.28953/APPL00011120.1013

Manufacturing on Autopilot: Ohio Automation on Manufacturing Wages and Employment

Joanna Chiu[1]
Téa Tamburo
Lien Tran

Abstract

In 2017, automation was forecasted to see a 47% increase in the next two decades (Bughin et al. 2017). With the usage of algorithms, automation can now be used for more than routine tasks and has the ability to replace labor in cognitive tasks, greatly expanding the range of roles in the labor market it could take on (Frey et al. 2017). With this, there will be the subsequent impacts on Ohio's economy and productivity levels in manufacturing and productivity. Ohio is a main state in manufacturing, and 7.6% of Ohio jobs have a high level of exposure to automation (Exposure to Automation in Ohio 2021). We use data from the Bureau of Labor Statistics to create initial data visualizations on Ohio's manufacturing employment. Through this initial research, we hypothesize a negative correlation between robotic expenditures and manufacturing employment and wages. However, in the future, we hope to run regressions with variables such as robotic expenditures and robot count using data from national manufacturing surveys.

Literature Review

A Dive into Automation

McKinsey Global Institute produced a report in January 2017 that analyzes how these technologies' could automate current labor tasks and impact workforce productivity. Specifically, labor costs that can be associated with work that's more prone to automation will be decreased within the labor markets. If human-preformed labor tasks are automated, supply will increase and could be redeployed to other roles if demand allows. One of the key types of automation replacing human labor are robots. The paper "Robots and Jobs: Evidence from U.S. Labor Markets" from NBER says there is little evidence of the equilibrium impact of robots on employment and wages. The study estimates the equilibrium impact of one type of industrial robots on U.S. labor markets, utilizing data from the International Federation of Robotics. The authors discuss the outcomes of the displacement and productivity effect. They utilize the measure of exposure to robots using data from the IFR on the increase in robot usage in 19 industries and Census data for employment shares.

Economists Carl Benedikt Frey and Michael A. Osborne released a paper in 2017 and found the pace of technological innovation is increasing, and more sophisticated technologies are making laborers redundant. Frey and Osborne highlight that automation and computerization, historically, were used for routine tasks, but, now with algorithms, it can replace labor in cognitive tasks that are not limited to routine, expanding the range of roles in the labor market it could take on. In turn, Frey and Osborne provide evidence that wages and educational attainment exhibit a strong negative correlation with the probability of automation and computerization. McKinsey displays models showing that some of the key hinderings of implementation are the lag in developed technology and the ability to implement it into workable products. They reference the past implementation rates of 25 previous technologies in hardware, software and business and consumer technologies, finding that the timeframe between commercial

[1] Thank you to Professor David Clingingsmith, Professor Susan Helper and Professor Jenny Hawkins for their insightful comments and recommendations. Thank you to Brooke Hathhorn and Vaishnavi Kumar for guiding us through the research process.

availability and widespread (90%) implementation ranges from 8-28 years; for a rate of 50% implementation, this timeframe ranges from 5-16 years. The researchers then incorporated these historical examples into S-shaped curves, concluding that implementation of automation technologies will depend on several factors, such as overcoming public policy barriers. They note that the modeled timeframe for physical activities (those that are labor-intensive) is longer in emerging economies because of lower wages compared to the cost of hardware-based automation solutions, and the pace of robotic implementation will differ in the development level of economies and the type of activity of it.

Exposure to Automation in Ohio

According to the Ohio Department of Job and Family Services, for 2018 employment, 7.6% of Ohio jobs have a high level of exposure to automation. This is slightly lower than the 8.1% average in the U.S. However, 35.4% of Ohio jobs have a moderately high level of exposure to automation compared to the 32.3% average in the U.S. Those with education at a high school or less than high school level has the highest exposure to automation on occupation. It is projected that there will be employment growth of 6.2% for low exposure occupations and decrease in employment growth of 2.7% for high exposure occupations. There are projected to be 263,389 annual openings in Ohio for jobs. In the 2018 paper, "Manufacturing a High-Wage Ohio," by Michael Shields, manufacturing employed about 12.9% of the state's workers at the time of publication. Not only was Ohio a state with a large manufacturing employment rate, average sector wages in 2016 were $59,000 per year, exceeding other sectors by $11,000. However, Shields doesn't account for the gender wage gap in this statistic, and this is also pre-pandemic.

2023 research from Policy Matters Ohio discusses that while Ohio has restored the number of jobs lost to the pandemic, that recovery was confined to only Columbus, Cincinnati, Springfield, and Dayton — metro areas with significant job growth. This research also found rising tensions between laborers and those overseeing the labor in the forms of wage negotiation, childcare and work-from-home flexibility. They saw pay growth was limited to low-wage jobs. However, this pay increase wasn't enough to reverse inequity between more and less privileged workers, saying that low wages especially harm workers of color, women, and migrants — all of whom are more likely to be underpaid. While outlining the current effects of the pandemic on Ohio's labor market, they cannot yet conclude if these issues will become structural changes to the workforce.

Initial Data Visualizations and Analysis

Overall, there's an observable downward trend in employment in manufacturing in Ohio from 2000-2024, suggesting a long-term decline in manufacturing due to automation or a shift in economic structure. In 2007-2008, there's a sharp decline in employment that aligns with The Great Recession, and the market slowly recovered. Another sharp decline is noticeable in 2020 due to the COVID-19 lockdowns and supply chain disruptions. However, employment levels in manufacturing recovered significantly faster than they did post-recession. Since 2020, there's been some fluctuation due to the volatility of the market and the changes in interest rates. As highlighted with the general trend line, employment in manufacturing has been declining for the past two decades.

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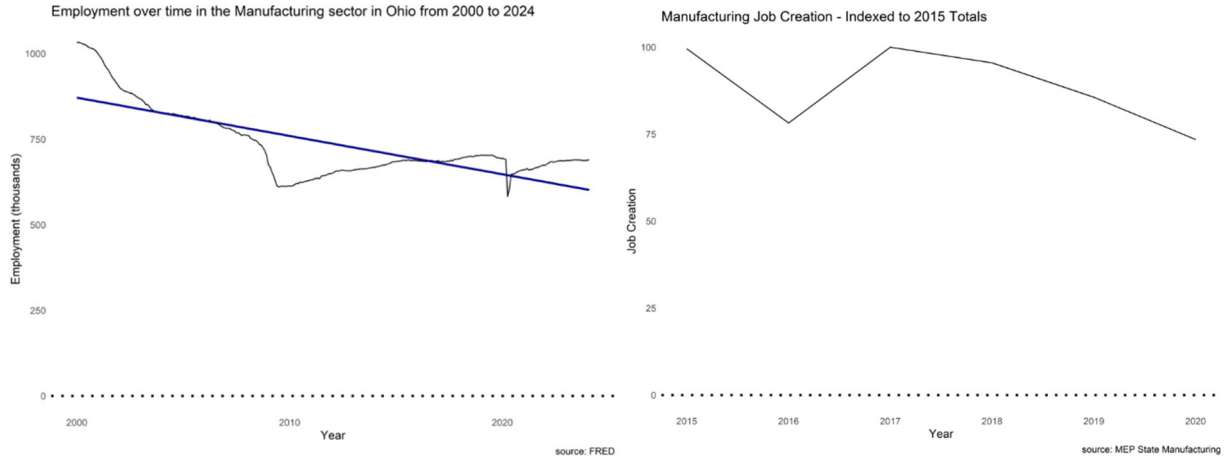
DOI: 10.28953/APPL00011120.1013

Figure 1. (left) Employment count of Ohio's manufacturing sector from 2000 to 2024; **Figure 2.** (right) Job creation within Ohio's manufacturing sector from 2015 to 2020



Analyzing the trend of manufacturing job creation in Ohio from 2015-2020, as indexed to the 2015 baseline, we observe an initial uptick in job numbers from 2015-2016, suggesting a period of growth or resurgence in the manufacturing sector. However, the trend reverses after peaking in 2017, with job creation entering a consistent decline through to 2020. This steady decrease, particularly after a year of growth, indicates a shift in the sector's employment landscape. The reasons behind such a shift could range from economic policy changes to industry-wide restructuring, but the data distinctly shows that from 2017 onward, the number of manufacturing jobs being created each year was falling.

The impact of automation on manufacturing in Ohio seems to align with the broader narrative of technological advancement leading to the reduction in traditional manufacturing roles. The decline in job creation post-2017 points towards the integration of automation systems that can perform tasks previously done by human labor. This can lead to a decreased demand for traditional manufacturing roles and could potentially push the sector toward a more technology-oriented workforce. The consistent downturn in job creation in the years following the peak suggests that manufacturing facilities may have increasingly adopted automated solutions, possibly reflecting a state-wide pivot towards embracing these efficiencies, despite the potential impact on job numbers.

Future Steps

Hypothesis and Literature Review

After analyzing general trends of employment in the manufacturing industry for Ohio, we have a strong structure to use an econometric model to determine the correlation between automation on manufacturing employment. We hypothesize robotic expenditures are negatively correlated with Ohio manufacturing and employment jobs based on our initial literature review and data exploration. Robots in the manufacturing industry are sometimes employed as substitutes and complements. We hope to dive deeper into whether the substitution and income effect for employees and robots can deduce a determinant outcome for employment and wages.

We will conduct a detailed literature review of "The Work of the Future Building Better Jobs in an Age of Intelligent Machines" by Autor, Mindell and Reynolds which is about the cumulation of economic literature on automation. We will also conduct additional literature reviews on papers including Helper, Martins & Seamens (2019), Autor (2022), Acemoglu, Lelarge & Restrepo (2020), and Feigenbaum & Gross (2020)

Methodology

The Annual Survey of Manufactures and Annual Capital Expenditures included survey questions on robotic equipment in 2018 which has data on "industrial robotic expenditures, the number of new robots purchased, and the total stock of robots in operation." This data is restricted by time especially due to the COVID-19 pandemic in 2020. We would use this data to correlate the change in robots with employment while controlling for industry. We would run regressions on three variables.

$$firm\_employment_{i,t} = \beta_0 + \beta_1 percent\_robotic\_exp_{it} + z_{i,t} + \Theta_i + \Theta_t + \varepsilon_{i,t}$$
$$wages = \beta_0 + \beta_1 percent\_robotic\_exp_{i,t} + w_{i,t} + \Theta_i + \Theta_t + \varepsilon_{i,t}$$

Where:

Θ_i , Θ_t: industry and time fixed effects ; $z_{i,t}$: other controls for employment; $w_{i,t}$: other controls for wages

We use total employment and average wages of a firm from years 2018-2019. The main regresser is the percentage of total firm expenditures that are robotic expenditures. We control for the firm's industry and time fixed effects. We would brainstorm potential controls that impact the firm employment and average wages for $z_{i,t}$ and $w_{i,t}$ respectively. This regression will allow us to analyze the average change in firm employment and wages associated with a one percentage point increase in robotic expenditures as a share of total expenditures holding constant time, firm industry and $z_{i,t}$, $w_{i,t}$.

$$firm\_employment = \beta_0 + \beta_1 new\_robots_{i,t} + \beta_2 total\_robots_{i,t-1} + z_{i,t} + \Theta_i + \Theta_t + \varepsilon_{i,t}$$
$$firm\_employment = \beta_0 + \beta_1 new\_robots_{i,t-1} + \beta_2 total\_robots_{i,t-1} + z_{i,t} + \Theta_i + \Theta_t + \varepsilon_{i,t}$$
$$wages = \beta_0 + \beta_1 new\_robots_{i,t} + \beta_2 total\_robots_{i,t-1} + w_{i,t} + \Theta_i + \Theta_t + \varepsilon_{i,t}$$
$$wages = \beta_0 + \beta_1 new\_robots_{i,t-1} + \beta_2 total\_robots_{i,t-1} + w_{i,t} + \Theta_i + \Theta_t + \varepsilon_{i,t}$$

The main regresser in these regressions is new robots purchased this year. We control for the firm's industry and time fixed effects, total robots from the previous year and additional controls that impact employment and wages. We also add a lag for new robots purchased to account for robotic implementation time, as it might take longer to set up larger robots and train employees for full functionality. This regression would allow us to analyze the average change in firm employment and wages associated with one new robot purchased holding constant total robots from the past year, time, firm industry and $z_{i,t}$/$w_{i,t}$.

$$firm\_employment = \beta_0 + \beta_1 total\_operating\_robots_{i,t} + z_{i,t} + \Theta_i + \Theta_t + \varepsilon_{i,t}$$
$$wages = \beta_0 + \beta_1 total\_operating\_robots_{i,t} + w_{i,t} + \Theta_i + \Theta_t + \varepsilon_{i,t}$$

The main regresser in these regressions is total operating robots for the firm. We control for the firm's industry and time fixed effects and additional controls that impact employment and wages. This regression will allow us to analyze the average change in firm employment and wages associated with one additional robot in operation holding constant time, firm industry and $z_{i,t}$/$w_{i,t}$.

By running these regressions, we hope to find robotic expenditures and the number of robots in operation have a negative correlation with firm employment and average wages.

https://commons.case.edu/joe/vol2/iss1/1
DOI: 10.28953/APPL00011120.1013

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Opioids and the Workforce: An Analysis of the Relationship between Opioid Deaths and Ohio's Economy

Annie Castagnero[1]
Vaishnavi Kumar
Allison Su
Junsun Yoo

Abstract

In 2016, Ohio was ranked third in the nation for opioid deaths. The number of opioid-related deaths was over double the national average (Cooper et al. 2020). By 2021, opioids were involved in nearly 75% of overdose deaths (CDC 2023). In 2023, opioid manufacturers and pharmacies were charged with paying Ohio 679.6 million dollars over the next 15 years, as retribution for their involvement in the opioid epidemic (Ohio Attorney General 2023). One of the reasons for this payment is the impact the opioid crisis has had on the labor market. There is much literature on the impact of opioid prescription rates on the labor market, but less research on the impact of opioid deaths (Aliprantis 2019). We utilize the Ohio Integrated Behavioral Health Dashboard to retrieve annual opioid death statistics by county in Ohio for 2019 to 2021, as well as the employment-to-population ratio by county for 2019 to 2021 from the Ohio Labor Market Information Database. We hypothesize a negative and bidirectional relationship between these variables. We utilize two cross-sectional regressions to model the impact of both directions in all 88 Ohio counties: the effect of the opioid death-to-population ratio on the employment-to-population ratio and the effect of the employment-to-population ratio on the opioid death-to-population ratio. We model this in an attempt to investigate the difference in the magnitude of the relationship in both these directions to uncover which relationship is dominant. We find that a stronger labor market in 2019 (lower employment-to-population ratio) is associated with a lower opioid death-to-population ratio in 2021 at a statistically significant level. We procure a negative but insignificant result in the converse model. Our work contributes to understanding the directionality of the relationships between the opioid epidemic and the labor market.

Introduction

Ohio, once emblematic of American industry, now struggles with the repercussions of its opioid epidemic. It currently stands at the crossroads of economic adversity and public health crisis. Opioid-related deaths have devastated communities and left behind a tale of human suffering and economic decline. In our article, we delve into the intricate relationship between opioid deaths and employment, shedding light on the dynamics that underlie Ohio's struggle with addiction and its toll on the workforce.

The opioid epidemic has numerous deaths due to unintentional overdose nationwide since the 1990s. The three primary types of opioids are prescription opioids, fentanyl, and heroin (CDC, 2023). The first wave of the opioid epidemic was from 1999 to 2010 (CRS, 2022) and was attributed to an increase in the prescription rate of opioids (Boysen et al., 2023). Opioid misuse and deaths doubled from 2.9 to 6.8 deaths per 100,000 people during the first wave (CRS, 2022). In the second wave, from 2010 to 2016, heroin usage began to rise and the rate of deaths involving heroin increased from 1 to 4.9 per 100,000 people (CRS, 2022). By 2016, fentanyl-related deaths exceeded the rate of

[1] Thank you to Editor Katherine Merritt, Professor Mark Schweitzer, and Professor Mark Votruba.

https://commons.case.edu/joe/vol2/iss1/1
DOI: 10.28953/APPL00011120.1013

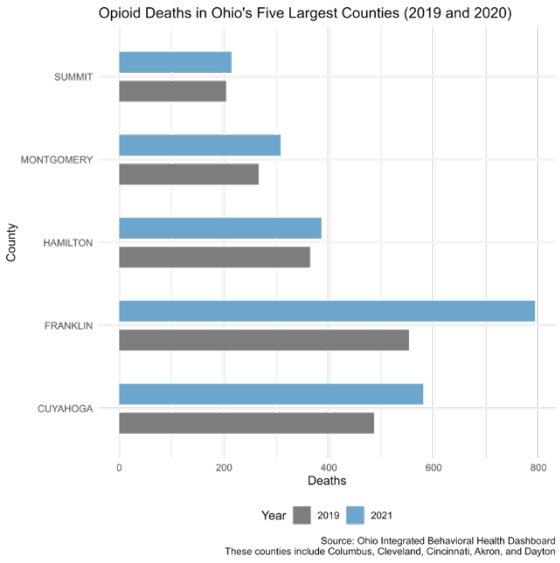
deaths attributed to prescription opioids and heroin, which marked the start of the third wave of the epidemic as the death rate doubled again from 10.4 to 21.4 per 100,000 people. (CRS, 2022). The Ohio population is among the states hardest hit by the opioid epidemic, especially during COVID-19. The usage of opioids has increased during the COVID-19 pandemic due to mental health issues and social isolation (Vieson et al., 2021).

Opioid use and employment have a nuanced and delicate relationship. Aliprantis et. al (2019) elucidates the fact that increases in opioid prescription rates are associated with a decrease in employment in prime-age adults. Meanwhile, Cho et al. (2021) shed light on the disproportionate impact of heroin use on employment and labor force engagement, particularly among marginalized demographics. They also showed that it reduced employment. Finally, Hill et al. (2021) highlighted that the COVID-19 pandemic exacerbated labor market vulnerabilities, fostering a fertile ground for heightened opioid transactions, and exacerbating the already dire nexus between economic distress and substance misuse. Collectively, these studies underscore a need for the exploration of Ohio's opioid epidemic and its effects on the workforce.

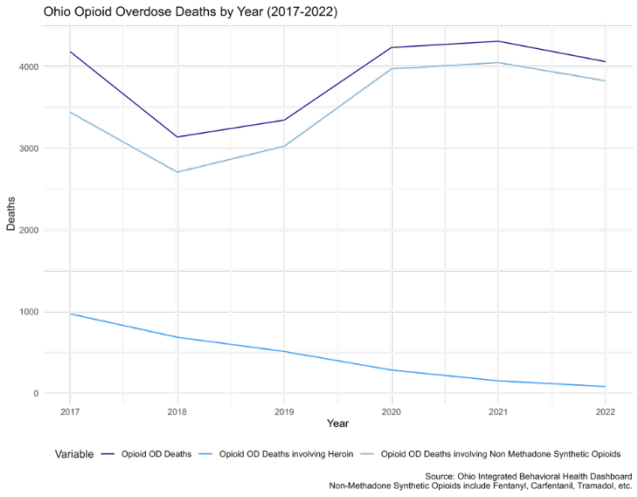
Data

We inspect the bidirectional causality between opioid deaths and employment dynamics with 2 cross-sectional regression models across Ohio's 88 counties from 2019-2021. We use the employment/population ratio to view employment, and opioid deaths/population ratio to view opioid deaths. We ran 2 sets of regressions; one with employment and one with opioid deaths as an outcome variable to gauge which relationship has a stronger effect. We weighted the regression by county size. We hypothesize that there is a negative and bidirectional relationship between opioid deaths and the employment-to-population ratio across counties. We also hypothesize that the magnitude of the relationship between the employment-to-population ratio and opioid deaths with opioid deaths as the outcome is larger than the converse. We source our employment data from the Ohio Labor Market Information Database, opioid death data from the Ohio Integrated Behavioral Health Dashboard from the Ohio Department of Health, and population data from the Census Bureau.

Figure 1. (left) Opioid deaths in Ohio's five largest counties (2019 and 2020); **Figure 2.** (right) Ohio opioid overdose deaths by year (2017-2022)



Note: There is a clear increase in Opioid Deaths from 2019-2021, which is seen throughout the five most populous counties in Ohio. The increase could be due to many variables, including COVID-19.



Note: This graph clearly shows the decrease in heroin use since 2017. The gap between Opioid Deaths and Opioid Deaths due to synthetic drugs such as fentanyl becomes smaller as we move closer to 2022. The two lines are also almost parallel, which shows that trends in opioid deaths are mostly decided by fentanyl, carfentanil, and other illicit synthetic opioids.

Methodology and Theoretical Model

Opioid usage and employment rates are related bidirectionally by multiple factors. On one hand, the impact of employment on opioid usage can be viewed through the lens of Becker's rational crime model, wherein economic strain increases the appeal of illicit activities, including drug usage as individuals seek to increase their marginal utility during times of financial distress. The lower opportunity cost associated with unemployment provides scope for substance abuse as individuals have reduced employment prospects. Conversely, opioid usage can have a large effect on employment. The surge in opioid supply within Ohio has increased widespread opioid usage. This has reduced labor force productivity and has caused a negative income effect that undermines worker efficiency and reduces effective income. Moreover, the substitution effect also plays into role wherein the perceived benefits of leisure overpower the appeal of labor, and individuals allocate resources towards sustaining their drug habits rather than pursuing employment opportunities.

Regression and Results

The regression models we ran were as follows:

Model 1: Employment/Population Ratio as an Outcome

$$1a.\ Emp/Pop_{C,2021} = \beta_0 + \beta_1 OD_{C,2019} + \beta_2 Emp/Pop_{C,2019} + \mu_{C,2021}$$

$$1b.\ Emp/Pop_{C,2021} = \beta_0 + \beta_1 OD_{C,2019} + \beta_2 Emp/Pop_{C,2019} + \beta_3\, \Delta OD_{C,2019-2020} + \mu_{C,2021}$$

Model 2: Opioid Deaths/Population Ratio as an Outcome

$$2a.\ OD_{C,2021} = \beta_0 + \beta_1 Emp/Pop_{C,2019} + \beta_2 OD_{C,2019} + \mu_{C,2021}$$

$$2b.\ OD_{C,2021} = \beta_0 + \beta_1 Emp/Pop_{C,2019} + \beta_2 OD_{C,2019} + \beta_3\, \Delta Emp/Pop_{C,2019-2020} + \mu_{C,2021}$$

Model 1 uses the employment/population ratio as an outcome of opioid deaths/population ratio, and Model 2 does the converse. Model 1a and 2a have an added control variable; this accounts for the changes in the employment/population ratio and opioid deaths/population ratio between 2019 and 2020 in each model respectively. This allows us to isolate the effects of the variables from 2019 to 2021.

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DOI: 10.28953/APPL00011120.1013

The results of each of the models are shown below:

Table 1. Regression results with dependent variable employment/population ratio by county

	Dependent Variable: Employment/Population Ratio in 2021	
	Model 1a	Model 1b
Opioid Death/Population Ratio: 2019	-0.0001	-0.0001
	(0.0001)	(0.0001)
Employment/Population Ratio: 2019	0.865***	0.868***
	(0.022)	(0.022)
Change in Opioid Death/Population Ratio: 2019-2020		0.0001
		(0.0001)
Constant	0.049***	0.047***
	(-0.01)	(-0.011)
Observations	88	88
R^2	0.95	0.951
Adjusted R^2	0.949	0.949
Residual Std. Error	0.0001	0.0001
	(df = 2; 85)	(df = 3; 84)
F Statistic	815.433***	546.052***
	(df = 2; 85)	(df = 3; 84)

Table 2. Regression results with dependent variable opioid deaths/population ratio by county

	Dependent Variable: Opioid Deaths/Population Ratio in 2021	
	Model 2a	Model 2b
Opioid Death/Population Ratio: 2019	-110.505***	-110.505***
	(37.661)	(37.661)
Employment/Population Ratio: 2019	0.738***	0.738***
	(0.139)	(0.139)
Change in Opioid Death/Population Ratio: 2019-2020		
Constant	69.799***	69.799***
	(17.737)	(17.737)
Observations	88	88
R^2	0.344	0.344
Adjusted R^2	0.328	0.328
Residual Std. Error	0.096	0.096
	(df = 85)	(df = 85)
F Statistic	22.278***	22.278***
	(df = 2; 85)	(df = 2; 85)

In both tables, our coefficients of interest are those in the first row. In Table 1, we see that both coefficients are -0.0001 and statistically insignificant, meaning that we cannot infer anything about the effect of opioid deaths on employment across Ohio counties. On the other hand, both our variables of interest from models 2a and 2b are statistically significant, meaning that we can make inferences about the relationship that employment has on opioid deaths in Ohio. We will focus on our coefficient from model 2b since we conclude it is a better estimate due to the added control. The number -99.446 implies that a 10 percentage point decrease in the employment/population ratio is associated with 9.9 more opioid deaths per 100,000 in Ohio counties. Our main takeaway is that there is a negative and statistically significant association between the employment/population ratio in 2019 and the opioid death/population ratio in 2021 with the opioid death/population ratio in 2021 as an outcome.

Our study underlines the vulnerability of counties with weaker labor markets in 2019 to experience increased opioid deaths in 2021, thus emphasizing how economic disparities can shape the trajectory of the opioid epidemic. Despite this insight, we acknowledge several limitations, including the short timeframe of data collection, potential

issues of serial correlation among variables, and the omission of crucial factors such as manufacturing share and endogeneity within our model. To address these limitations and advance our understanding of Ohio's opioid crisis, we look to explore the differences between the waves of the epidemic, asses regional disparities in opioid usage, and compare trends with other neighboring states within the Rust Belt region.

Conclusion

In conclusion, our study offers a simplified examination of the intricate relationship between opioid deaths and employment across Ohio counties. This allows us to focus on the impact of the labor market on opioid deaths in the future, possibly researching a causal relationship based on more nuanced characteristics of Ohio counties. Highlighting the mechanisms driving these relationships will allow stakeholders and policymakers to devise strategies to mitigate the adverse effects of the opioid epidemic and improve economic and health resilience across Ohio. With our findings, it is possible to justify economic support going to counties with poor labor markets, to decrease the association between the labor market and opioid deaths. These findings show the impact of opioid deaths, instead of different indicators like prescription rates or opioid use rates, on the labor force which adds to the literature focused on the labor market and opioid use.

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https://commons.case.edu/joe/vol2/iss1/1
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Is the Grass Always Greener on the Other Side? An Analysis of Migration and Retention of Ohio's Working Age Population

An Doan[1]
Jamie Goldfarb
George Merrifield

Abstract

Analyzing the relationship between average salary of individuals and retention rates of individuals in Ohio, this paper seeks to understand the talent migration trends among those with varying levels of education. A stark contrast is observed between the mobility of people with higher wages than those with lower wages, with a significantly higher percentage of the former leaving the state. The hypothesis suggests that earning higher wages outside of Ohio may reduce the likelihood of Ohio residents staying within the state. The research utilizes a probit regression model to estimate retention probabilities, controlling for age, whether the individual is employed, whether or not the individual was originally from the state, and whether the individual obtained a bachelor's degree. Preliminary data from the CPS, serves as the foundation for analysis. Anticipated findings suggest that higher salaries of individuals correlate with lower retention rates. The study holds substantial implications for policymakers, educators, and employers, allowing for benchmarking against states with higher rates of retention and providing insight for learning about the policies and practices of these other states, which can help Ohio policymakers implement an effective plan for increasing their own retention rate.

Introduction

The ability to attract and retain a skilled workforce is a critical factor in driving economic growth and competitiveness for any state or region. In recent years, there has been growing concern about the potential exodus of talent from the state of Ohio, particularly among individuals born within its borders. This phenomenon, often referred to as "brain drain," can have significant consequences for the state's economic development and long-term prosperity. One of the main factors believed to contribute to this talent outflow is the lure of higher incomes offered in other states. As individuals seek to maximize their earning potential and advance their careers, they may be enticed to leave Ohio in pursuit of more lucrative employment opportunities elsewhere. This raises important questions about the trade-off between competitive compensation and the retention of skilled professionals within the state.

This study aims to uncover the extent to which income levels influence the decision of Ohio-born individuals to start their careers in other states. By analyzing migration patterns and career trajectories, we seek to understand the flow of talent and the potential impact of income differentials on retention rates. If talent is indeed flowing to states that offer more competitive compensation, it becomes imperative to assess the trade-off between the costs associated with providing higher salaries and the potential loss of valuable human capital. Our central hypothesis is that greater income opportunities in other states reduce the likelihood that individuals born in Ohio will choose to remain and pursue their careers within the state's boundaries. By testing this hypothesis and examining the underlying factors that shape individuals' decisions, we can provide insights to policymakers and stakeholders on strategies to optimize the retention of talent while managing the financial resources allocated for this purpose.

[1] Special thanks to Henry Blyth and Jakob Danninger for incredible assistant and help for this project.

Through a comprehensive analysis of migration data, income levels, and career trajectories, this study aims to shed light on the complex interplay between compensation and talent retention in Ohio. The findings have the potential to inform policy decisions and initiatives aimed at fostering a robust and sustainable workforce, ultimately contributing to the state's long-term economic prosperity.

Literature Review

The article "Does Uncertainty Affect Graduates' Decision to Relocate for Work? Evidence at China's City Level" by Xiaoli Ding, Sang Cheng, Wenjing Qin, and Xin Gu examines the effect of economic policy uncertainty (EPU) on the choices of employment city by individuals aged 15-24 years old in China. It strives to answer whether economic uncertainty affects graduates' decision to relocate for work. The findings reveal that individuals with more economic uncertainty are more likely to stay in their hometown after obtaining a degree. The model in this study examines the factors influencing graduates' relocation decisions, particularly focusing on the impact of economic policy uncertainty on the likelihood of graduates returning to their province of origin after graduation using a logistic regression analysis. Their data consists of 46,804 graduates. The dependent variable is a dummy variable "Nonlocal_province", which is indicative of a graduate returning to the province they originated from after graduation; they assigned a value of 1 to the variable when the employment location of the graduate did not match their place of study. The explanatory variables are Economic Policy Uncertainty (EPU) and Trade Policy Uncertainty (TPU). Control variables used in this study control for individual-level characteristics (Ij), like gender, field of study, and education level, as well as for Economic Development (Ej), measured by GDP per capita, average wage, value added of tertiary industry as a proportion of GDP (%), and house price. They also control for Living Environment (Lj), through the number of international internet users and population density, Public Services (Pj), through the number of schools, and the number of hospitals, and Natural Environment (Nj), through SO_2 emissions, and garbage disposal rate.

While this literature provides valuable insights on the general effects of economic policy uncertainty, our research question more closely examines the effect of income as a primary factor on retention rates of individuals in Ohio. By narrowing the scope of the question, we can offer insights directly relevant to policymakers who are concerned with workforce development and talent retention in Ohio. Further, our research contributes to existing literature by providing information that sheds light on the factors that drive retention rates in a specific regional context. The existing study provides insights on the broader dynamics of labor market behavior, but our analysis can inform more specific policies and strategies aimed at retaining talent and fostering economic growth in Ohio. By emphasizing wage in our regression, we plan to deepen our understanding of the relationship between economic factors and retention decisions among individuals.

Data and Methodology

The data for this study was obtained from the Current Population Survey (CPS), a monthly survey conducted by the U.S. Census Bureau and the Bureau of Labor Statistics. The CPS is a valuable source of information on various demographic, economic, and labor force characteristics of the U.S. population. Specifically, the CPS dataset provided crucial information on retention rates for individuals within the state of Ohio. This data allowed us to identify individuals who were born in Ohio and whether they remained in the state or relocated to another state for employment purposes after graduating. The CPS dataset is particularly valuable for our analysis as it provides a comprehensive and nationally representative sample of the U.S. population. The survey employs a rotating panel design, with households being interviewed for four consecutive months, followed by an eight-month break, and then interviewed again for another four consecutive months. This design ensures a robust and up-to-date dataset, making it well-suited for our investigation into retention rates and the impact of income levels. By leveraging the extensive information available in the CPS dataset, we were able to construct our regression models and analyze the relationship between wage income and the likelihood of Ohio-born individuals staying in the state after graduating, while controlling for various individual characteristics.

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DOI: 10.28953/APPL00011120.1013

Table 1. Percent of individuals born in state that moved out of states.

State	Percent moving out of state (%)	State	Percent moving out of state (%)
Alabama	68.13%	Montana	49.30%
Alaska	38.39%	Nebraska	65.41%
Arizona	40.77%	Nevada	22.49%
Arkansas	61.25%	New Hampshire	39.31%
California	77.11%	New Jersey	66.00%
Colorado	37.67%	New Mexico	58.25%
Connecticut	63.41%	New York	78.66%
Delaware	46.44%	North Carolina	51.53%
Florida	45.19%	North Dakota	57.18%
Georgia	52.18%	**Ohio**	**78.27%**
Hawaii	61.77%	Oklahoma	59.81%
Idaho	41.92%	Oregon	45.00%
Illinois	75.68%	Pennsylvania	74.90%
Indiana	68.34%	Rhode Island	60.51%
Iowa	70.23%	South Carolina	53.25%
Kansas	58.23%	South Dakota	57.74%
Kentucky	66.63%	Tennessee	55.32%
Louisiana	79.40%	Texas	66.37%
Maine	61.07%	Utah	61.60%
Maryland	49.81%	Vermont	48.57%
Massachusetts	68.60%	Virginia	48.87%
Michigan	82.30%	Washington	48.35%
Minnesota	68.61%	West Virginia	64.23%
Mississippi	70.08%	Wisconsin	72.17%
Missouri	65.82%	Wyoming	0.00%

According to Table 1, an alarming 78.22% of individuals are moving out of Ohio. This out-migration rate ranks among the highest in the nation and is particularly high when compared to other states in the Midwestern region. For instance, neighboring states such as Indiana (61.77%), Illinois (75.68%), Wisconsin (72.19%), Missouri (65.82%), and Kansas (58.23%) all exhibit lower percentages of their populations leaving, painting a stark contrast with Ohio's situation. While a few states, like New York (78.66%), North Carolina (78.47%), and Delaware (83.41%), have slightly higher out-migration rates than Ohio, the state's numbers are still cause for significant concern, especially within the context of the Midwest. Michigan (82.39%), the only Midwestern state with a higher out-migration rate than Ohio, is only marginally higher at 82.39%.

The high rate of individuals leaving Ohio raises important questions about the factors driving this exodus and the potential consequences for the state's economic development and competitiveness. One potential factor contributing to this trend could be the pursuit of better employment opportunities and higher incomes elsewhere, as hypothesized in our research. If talented individuals are leaving Ohio in search of more lucrative career prospects in other states or regions, it could lead to a depletion of human capital and a shortage of skilled workers in critical industries. This brain drain phenomenon could hamper Ohio's ability to attract and retain businesses, stifling economic growth and innovation.

Furthermore, the loss of a significant portion of the state's population could have ripple effects on various sectors, including housing, consumer spending, tax revenue, and public services. As individuals leave, it could lead to a decline in demand for housing, reduced consumer spending, and decreased tax revenue for the state, potentially impacting the quality of public services and infrastructure. While the reasons behind Ohio's high out-migration rate are likely multifaceted and complex, the data presented in this study serves as a call to action for policymakers and stakeholders in the state. Addressing this issue and implementing strategies to retain talent and foster a vibrant workforce should be a top priority to ensure Ohio's long-term economic resilience and competitiveness.

To further investigate the causality between wage and out-migration, we use a probit model that predicts the likelihood that an individual will stay in Ohio after graduating. We ran separate probit models for all 50 US states. Our β_1 value is wage for each individual. We plan to compare the wage value of individuals born in Ohio that stayed in Ohio with the wage value of individuals born in Ohio that left Ohio.

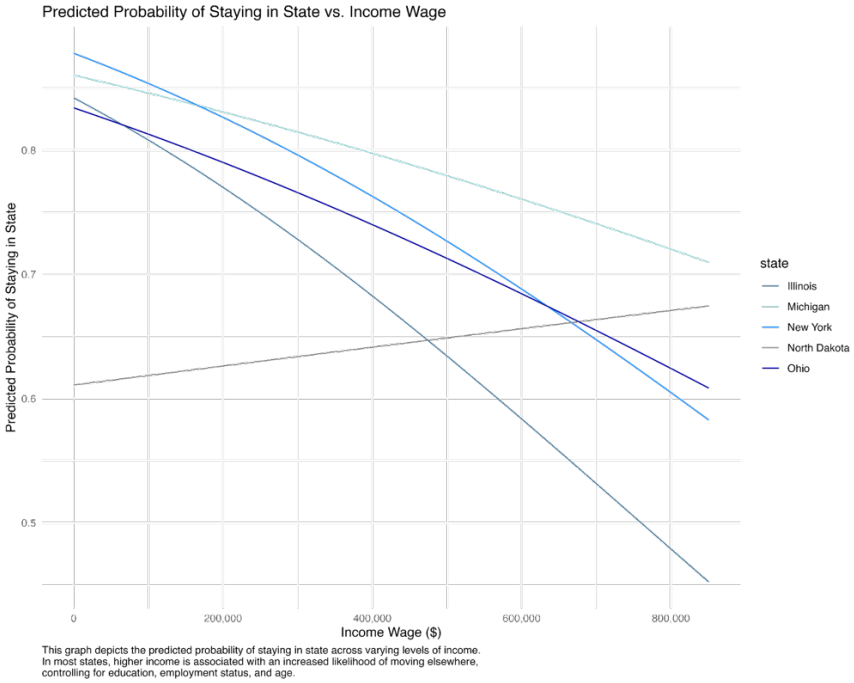
The control variables include: (1) Age, (2) Employed or unemployed (dummy), (3) Born in state or not born in state (dummy), and (4) Obtained a bachelor's degree or not (dummy). We ran one probit model regression for each of the 50 states, emphasizing how Ohio compares to other states. The regression is as follows:

$$stay\_in\_state = \beta 0 + \beta 1 * wage + \beta 2 * age + \beta 3 * employed + \beta 4 * born\_in_{state} + \beta 5 * bachelors$$

Results

The regression results revealed that the effect of wage on the likelihood of staying in a state varied across different states. To quantify and compare these effects, we calculated the average marginal effects (AMEs) of wage for each state. The AMEs represent the average change in the predicted probability of staying in a state associated with a one-unit increase in wage, averaged across all observations.

Figure 1. Predicted Probability of Staying in State vs. Income Wage



The regression results suggest that for most states, particularly those with large population centers and metropolitan areas, such as Ohio, New York, Michigan, and Illinois, higher incomes tend to be more predictive of individuals moving out of the state. This pattern aligns with the hypothesis that the availability of more lucrative employment opportunities elsewhere serves as a pull factor, enticing talented individuals to leave their home states in pursuit of higher-paying jobs and career advancement. However, an interesting contrast emerges when examining states like North Dakota, where higher wages seem to be associated with a higher likelihood of individuals staying within the state. This divergence from the broader trend observed in densely populated states may be attributable to the distinct economic landscape and industry composition of states like North Dakota.

Figure 1, which compares states with industry compositions comparable to Ohio, provides further context. States with major urban agglomerations and diverse economic bases, such as Ohio, New York, Michigan, and Illinois, exhibit a higher tendency for individuals to move out of state when they gain higher incomes. This phenomenon could be driven by the intense competition for talent and the widespread availability of job opportunities across various sectors in these states. In contrast, the positive relationship between higher wages and retention rates observed in sparsely populated states like North Dakota may be linked to the dominance of specific industries, such as energy or natural resources extraction. These industries often offer competitive salaries and may have a more concentrated geographic footprint within the state boundaries. As a result, individuals in these industries may find it advantageous to remain in

https://commons.case.edu/joe/vol2/iss1/1
DOI: 10.28953/APPL00011120.1013

the state, as higher wages are likely to be accompanied by fewer alternative employment options outside the state that offer comparable compensation.

Additionally, the cost of living and quality of life factors could play a role. In densely populated states with major urban centers, higher incomes may be offset by higher living costs, prompting individuals to seek better opportunities elsewhere. Conversely, in less populated states like North Dakota, higher wages may translate to a more substantial improvement in living standards, incentivizing individuals to stay.

Table 2. Regression Results for Midwestern States

Dependent Variable: Stay in Ohio			
Variables	**Coefficients**		
	Estimates	Z-value	
Wage	-8.17E-07	-13.78	***
BachelorDeg	-0.29	-37.32	***
Employed	0.12	7.71	***
Age	-0.0016	-3.74	***

Dependent Variable: Stay in Indiana			
Variables	**Coefficients**		
	Estimates	Z-value	
Wage	-6.93E-07	-8.5	***
BachelorDeg	-0.25	25.6	***
Employed	0.13	6.9	***
Age	-0.0023	-4.38	***

Dependent Variable: Stay in Michigan			
Variables	**Coefficients**		
	Estimates	Z-value	
Wage	-6.22E-07	-8.88	***
BachelorDeg	-0.26	-28.97	***
Employed	0.12	7.04	***
Age	-0.0014	2.82	**

Dependent Variable: Stay in Illinois			
Variables	**Coefficients**		
	Estimates	Z-value	
Wage	-1.32E-06	-29.84	***
BachelorDeg	-0.4	-53.97	***
Employed	0.14	8.83	***
Age	0.00067	1.6	

Dependent Variable: Stay in North Dakota			
Variables	**Coefficients**		
	Estimates	Z-value	
Wage	2.01E-07	0.886	
BachelorDeg	0.0041	0.151	
Employed	0.11	1.881	
Age	0.0075	5.028	***

The regression results provide insights into the factors influencing the retention rates of individuals in several Midwestern states, including Ohio, Indiana, Michigan, Illinois, and North Dakota. In Ohio, the coefficient for wage is -8.17E-07 and highly significant (z-value = -43.78), indicating that higher wages are associated with a lower probability of individuals staying in the state. This negative relationship between wage and retention supports our hypothesis that higher income opportunities elsewhere may entice individuals to leave Ohio in pursuit of better-paying jobs. The coefficients for having a bachelor's degree (-0.029) and being employed (-0.12) are also negative, suggesting that more educated and employed individuals are less likely to stay in Ohio.

A similar pattern is observed in Indiana, Michigan, and Illinois, where the wage coefficients are negative and statistically significant at the 1% level. In Indiana, a higher wage decreases the likelihood of staying (-6.93E-07), while in Michigan (-6.22E-07) and Illinois (-1.32E-06), the negative effect of wage on retention is even more pronounced. Interestingly, in North Dakota, the wage coefficient is positive (2.01E-07) but statistically insignificant,

implying that higher wages do not have a significant impact on the retention rates in this state. This could be due to unique economic factors or industry dynamics in North Dakota that may influence individuals' decisions to stay or leave. The coefficients for having a bachelor's degree are positive and significant for Ohio, Indiana, and Michigan, suggesting that individuals with higher educational attainment are more likely to stay in these states. However, in Illinois, the coefficient for bachelor's degree is negative (-0.4), indicating that more educated individuals are less likely to remain in the state.

Employment status also plays a role, with being employed generally associated with a higher likelihood of staying in Ohio, Michigan, and North Dakota, as indicated by the positive coefficients. However, in Indiana and Illinois, the coefficients for employment status are negative, albeit statistically insignificant. Age appears to have a mixed impact across the states, with older individuals being more likely to stay in Ohio and Michigan (positive coefficients), but less likely to stay in Indiana and Illinois (negative coefficients). In North Dakota, age has a positive and significant effect on retention rates.

Conclusion

The findings indicate a significant relationship between income levels and the likelihood of individuals staying in Ohio. Across most states, the likelihood of individuals moving elsewhere is associated with higher incomes, which suggests that individuals with higher wages are more inclined to leave Ohio. Our regression analysis, a probit model conducted using the data from the Current Population Survey (CPS) reveals that earning higher wages negatively impacts the probability of individuals staying in state. This trend remains after controlling for other factors of the individual such as age, employment status, state of origin, and education attainment.

The analysis of the predicted probability of staying in-state across varying levels of income reveals insights into talent retention across different states. While the general trend in Ohio, Illinois, Michigan, Indiana, and New York indicates that higher incomes are associated with an increase in likelihood of moving elsewhere, an exception is observed in North Dakota. Contrary to the trend in the other states, North Dakota reveals an association between higher incomes of individuals and their decreased likelihood of moving elsewhere. Higher-earning individuals in North Dakota are more likely to stay in state, possibly due to job opportunities, favorable economic conditions, or quality of life factors that haven't been controlled for in our regression.

While our regression provides insight into the relationship between income levels and retention rates among individuals in Ohio and other states, it is important to acknowledge the limitations of our study. The presence of omitted variable bias, additional factors not controlled in our regression that could influence migration patterns, could lead to biased estimates and potentially misleading conclusions about the true association between income and retention. Despite these limitations, the implications of these findings are important for policymakers and employers in Ohio. Understanding the factors that influence talent retention is crucial for workforce planning efforts and the state's economic development. With further analysis of the influence of income on migration patterns, strategies can be targeted to retain and attract talent which fosters the economic growth and competitiveness of Ohio.

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https://commons.case.edu/joe/vol2/iss1/1
DOI: 10.28953/APPL00011120.1013

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The CWRU Journal of Economics is made possible by students who researched, wrote, designed, and edited this publication with support from faculty members of the Department of Economics.

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https://commons.case.edu/joe/vol2/iss1/1
DOI: 10.28953/APPL00011120.1013

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