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Lockdown Policies and Domestic Air Travel

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Historical Tariffs in Ohio

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EdChoice and Academic Performance

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Telehealth Utilization in the Midwest

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## Letter from the Editors

Dear CWRU Journal of Economics Reader,

On behalf of the Editorial Board, I would like to thank you for taking the time to read the fourth edition of our Journal. Now, at the end of its second year, the Journal continues to grow from its original mission: to introduce Case Western Reserve University students to the world of economic research while offering meaningful, hands-on learning experiences. What began as a small club has blossomed into a vibrant community of over 50 passionate, driven, and thoughtful students, all united by a shared curiosity for economics.

This semester, we were especially excited to debut the Regional Analysis Division's Freshmen Training Capstone, a program designed to provide first-year students with the opportunity to engage in research from the beginning of their college journeys. Their work exceeded all expectations and stands as a testament to the remarkable talent and potential of our new members. We also included essays from our high school essay competition, and were equally impressed by the thoughtfulness and insights demonstrated by these young scholars. It has been inspiring to watch our Journal evolve into not just an organization, but a collaborative and welcoming space where students support and learn from one another.

Economic research remains more relevant than ever in a world facing growing economic uncertainty, from inflation concerns to labor market disruptions. It offers us the tools to make sense of these changes, uncover patterns, and imagine new solutions. The articles in this volume reflect that very spirit, with projects spanning topics such as finance, healthcare, education, and public policy, some focused on issues in Ohio and others examining broader national and international trends.

This edition is a bittersweet one for me and many of my peers on the Editorial Board, as it marks our final semester at Case Western Reserve University. As we prepare to graduate, I speak on behalf of the entire Board in saying that we hope to leave behind not just a collection of published research but a legacy of curiosity, kindness, and a strong sense of community among aspiring economists on this campus.

We extend our sincere thanks to the Department of Economics faculty for their ongoing guidance and support, and to the staff of the Weatherhead School of Management. Most of all, we thank our Journal members, past and present, for making this organization what it is.

It is with pride and gratitude that we present the fourth volume of the CWRU Journal of Economics. We hope it inspires you as much as it has inspired us.

Sincerely,

Vaishnavi Kumar  
*President & Editor-in-Chief*





# Research and Editorial

 *Washington, D.C., USA*



# Cutting the Commute: Did COVID reduce the economic advantage of living in metro areas?

Tom Lin, Aizah Kamal

The COVID-19 pandemic sparked a widespread shift toward remote work, fundamentally shifting the geographic distribution of work and income in the U.S. This paper investigates whether the traditional income advantage associated with living in metropolitan areas declined as a result of these changes. Using the American Community Survey, we used a fixed effects model to investigate how the growth in mean household income diverged between metropolitan and nonmetropolitan areas after the pandemic. Although there was a temporary drop in the income gap after COVID-19 pandemic, it subsequently widened and continued to grow in the following years. These results suggest that recent structural and behavioral changes have ultimately reinforced the income advantages associated with metropolitan residence.

## Introduction

Living in a metropolitan area is often associated with higher wages, greater job density, and improved access to employment opportunities. Recent estimates indicate over a 35% premium between individual workers compared to historical figures from the past 50 years which were roughly half that amount (Butts et al., 2023). Proximity to economic centers allowed workers to leverage agglomeration effects—the concentration of firms and workers in cities fostering knowledge spillovers, networking, and higher wages (Duranton & Kerr, 2015). However, the pandemic disrupted traditional labor dynamics. Remote work rapidly expanded, allowing many white-collar professionals to perform their jobs outside of urban cores. As a result, questions emerged about the future of urban income advantages and whether geographic proximity to work would remain economically relevant.

Our paper investigates whether the income premium associated with living in a metropolitan area declined in the aftermath of the pandemic. By comparing real household income in metro and non-metro areas before and after COVID-19, we aim to uncover how structural and behavioral changes may be shifting the geographic distribution of economic opportunity.

## Literature Review

Brooks et al. analyzed data from the U.S. Current Population Survey (CPS) to study post-pandemic labor force related outcomes between rural and urban areas. They found that between May 2020 and February 2021, urban workers had a more significant detriment in the short term as they were more likely to be unable to work and go unpaid for missed hours compared to rural workers. These results highlight the uneven labor disruptions caused by the pandemic. We aim to build on Brooks et al. by extending the time horizon to see the longer term effects of the pandemic.

Cho et al. analyzed data from the U.S. Current Population Survey (CPS) to examine differences with regards to employment across non metropolitan areas and metropolitan areas of different sizes near the onset of the COVID-19 pandemic. They found that between April 2019 to April 2020, the employed at work rate fell by 9.6 percentage points in nonmetropolitan areas compared to 14.6 percentage points in MSAs. They note how population density makes large metros more sensitive to pandemics, and also suggest that these areas are likely to recover differently.

Althoff et al. analyzed how the sudden shift to remote work during the COVID-19 pandemic uniquely affected different types of workers and cities across the U.S. In particular, they highlight two types of workers: high skill business service workers who are high income and remote capable, and lower-wage consumer service workers with less flexibility. They found that remote work allowed high-wage workers to leave big cities, taking their spending with them, resulting in economic harm and widened income disparities for the lower-wage urban workers who remained.

Lombard analyzed the phenomenon of migration to small towns and rural counties emerging over the COVID-19 pandemic. In particular, he notes that these “zoom towns” are attractive to the young adults who’ve become enabled by remote work over the pandemic and are drawn to their natural amenities. As a result, these elevated income levels boost the average household income averages in rural counties with high natural amenity scores, as defined by the Economic Research Service, and potentially contribute to a temporary narrowing of the income gap between metro and non-metro households.

## Data and Methodology

We used the American Community Survey (ACS) within the IPUMS USA dataset to aggregate demographic information at the household level across the United States during the past decade (2013-2023). We focused on household income data and differentiated households as being located in metropolitan and nonmetropolitan areas based on the ACS classification. To focus on traditional households, we further excluded “group quarters”, which are specific group living arrangements defined by the Census Bureau. These include correctional facilities, nursing homes, and college dorms. Lastly, we excluded households that had an indeterminate metro status or reported negative income.

In order to adjust for inflation, which would naturally widen income disparities over time, we found the annual average Consumer Price Index (CPI) from the Bureau of Labor Statistics for each year. We then used the following formula to adjust household income to 2023 dollars for comparability.

$$I_{real,t} = I_{nominal,t} \times \left( \frac{CPI_{2023}}{CPI_t} \right) \quad (1)$$

We used a fixed effects model with state and year fixed effects to analyze changes in real income levels between metropolitan and nonmetropolitan areas in each state between 2013 and 2023. A fixed effects model is able to eliminate state-specific factors that might influence household income, ensuring we only focus on variations within each state. In addition, we also used an interaction term to capture how the metro premium changes after the COVID 19 pandemic. Finally, we clustered our standard errors at the state level to ensure that the correlations of errors within a state are accounted for.

## Statistics

We created the following summary of metro and non-metro household incomes adjusted for inflation from 2013 to 2023. The metro observations account for 88% of our sample, roughly matching the 86% figure reported by the Census Bureau for the last year.

Table 1: Summary Statistics by Metro Status

	Mean	SD	Median	N
<i>Real Income</i>				
Non-Metro	90,451.1	84,022.6	71,983.7	3.4e+6
Metro	134,592.3	135,610.9	99,535.3	2.55e+7
Overall	129,171.5	131,182.1	95,3443.7	2.8e+7
<i>Household Size</i>				
Non-Metro	3.1	1.7	3	3.4e+6
Metro	3.3	1.7	3	2.5e+7
Overall	3.3	1.7	3	2.8e+7

## Hypothesis

We hypothesize that as a result of COVID 19 pandemic, the income gap between a metropolitan area and non metropolitan area resident decreased as the traditional advantages associated with living in a metropolitan area decreased.

## Analysis

We ran the following regressions with and without household size as a covariate control to account for the impact of household size on household income.

$$realincome_{ist} = \beta_1 \cdot ismetro_i + \beta_2 \cdot (ismetro_i \times post_t) + \beta_3 \cdot size_i + \alpha_s + \gamma_t + \epsilon_{ist} \quad (2)$$

where  $\alpha$  is state fixed effects,  $s$  is state,  $i$  is household, and  $t$  is year.

Table 2: Regression Results

	(1)	(2)
	Simple FE Regression	With Controls
Metro	31426.2*** (1922.9)	32293.6*** (2092.4)
Metro × Post	5805.7*** (1019.1)	5714.3*** (1026.1)
Household Size	11015.9*** (968.0)	
Constant	63679.8*** (3455.4)	99037.7*** (1800.7)
N	27,989,762	27,989,762

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

The key variable of interest is the interaction term between  $ismetro_i$  and  $post_i$ , which estimates how the income of metro households changed after the onset of the COVID-19 pandemic relative to non-metro households. In the state fixed effects model without covariate controls, we found that metro households experienced an additional increase of \$5,806 in real income. This indicates a statistically significant widening of the income gap at the 0.1% level, contrary to our hypothesis. We found an increase of \$5,714 with the household size control, suggesting that part of the metro premium is explained by larger household sizes in metro areas.

The following image shows the mean real income for both metropolitan and nonmetropolitan households from 2013 to 2023. We can observe that metro households consistently report higher incomes than non-metro households.

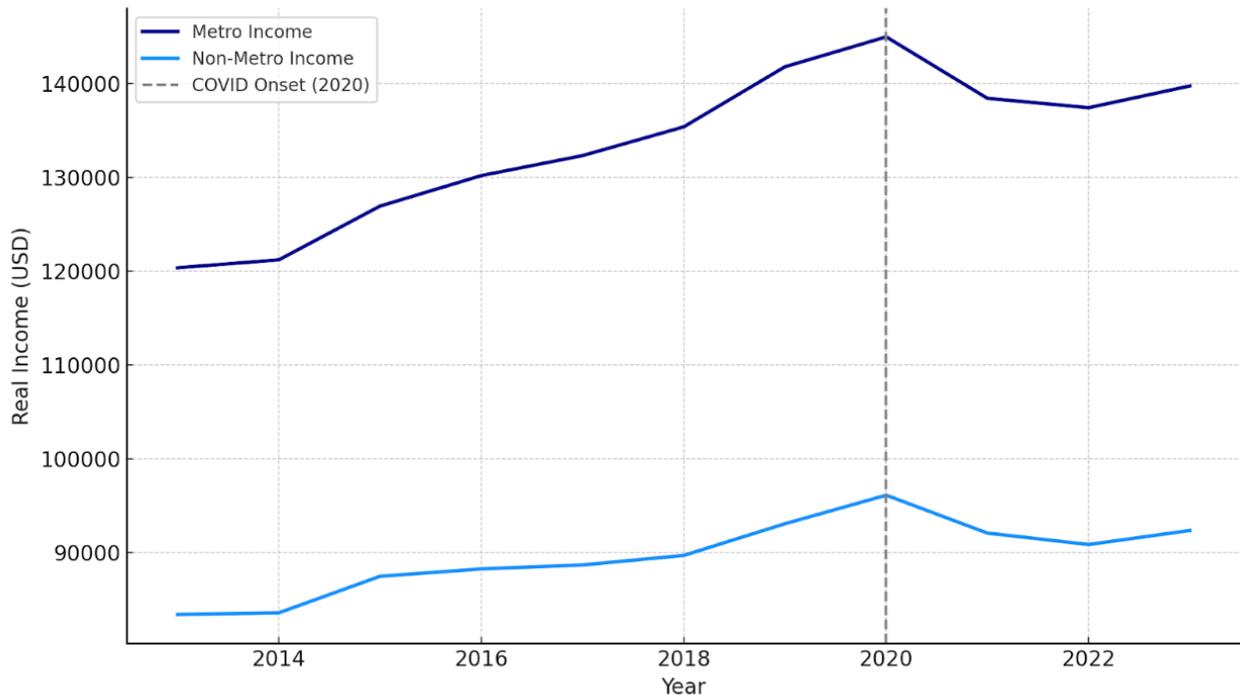


Figure 1: Metro vs. Non-Metro Real Household Income.

The following image shows the income gap amount. We observe that between 2013 and 2020, the income gap between the two groups rises steadily. After 2020, we see that the income gap ends up shrinking, but is shortly followed by gap expansion in 2022 and 2023. This temporary expansion is supported by Lombard as the migration of workers temporarily boosts non-metro incomes and reduces the income gap.

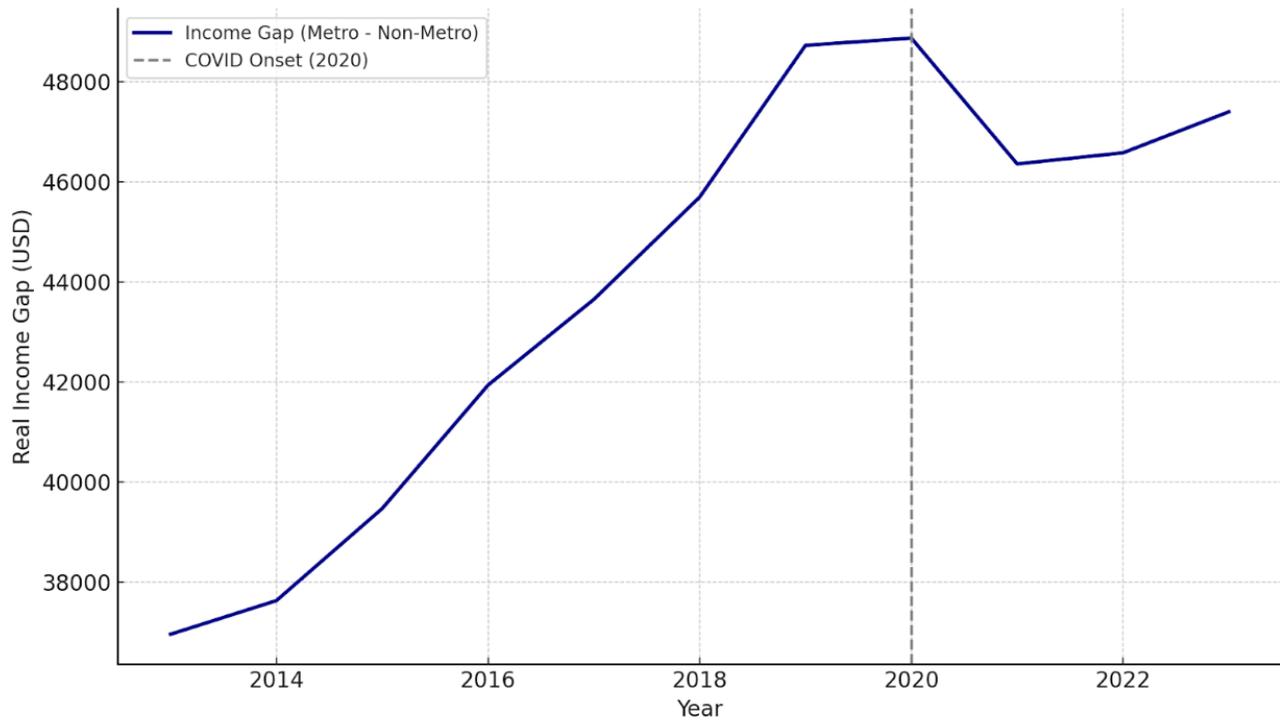


Figure 2: Metro vs. Non-Metro Income Gap

## Conclusion

We found that while income increased for both metropolitan and nonmetropolitan households after the COVID-19 pandemic, the income gap between the two continued to widen. This suggests that the shift toward remote work did not diminish the traditional advantages of living in a metropolitan area as expected. Instead, metro households saw even greater gains, possibly due to better access to high-paying remote or hybrid jobs. However, our findings come with important limitations as the ACS is collected at the household level and cross sectional. As a result, we are unable to analyze individual-level characteristics that might impact income such as education attainment or health status, nor can we observe the same households each year. Further analysis with longitudinal data on an individual level could help address these limitations and provide a more complete understanding of post-pandemic income dynamics.

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# Effects of Differing COVID-19 Lockdown Policies on Domestic Air Travel

Alex Giordano, Emerson Au

Our research looks at whether differences in COVID-19 lockdown stringency between departure and destination states influenced interstate air travel in the United States during 2020–2021. Using route-level passenger data from the Department of Transportation (DoT) merged with state-level case counts and lockdown stringency indices from the Centers for Disease Control and Prevention (CDC), we estimate an ordinary least squares model to assess the impact of pandemic policies on air travel behavior. Contrary to the hypothesis that policy mismatches across states would deter travel, we find no significant effect of differences in lockdown stringency on passenger volumes. However, we find that destination-state stringency significantly reduced average daily passengers (69 fewer), with a larger magnitude than departure-state policies (59 fewer). These results suggest that travelers were more responsive to perceived restrictions at their destination rather than to policy asymmetries. The findings underscore the dominant role of public health concerns in shaping travel decisions during the pandemic and highlight the limited role of interstate policy divergence in influencing air travel during this period.

## Introduction

The COVID-19 pandemic prompted governments worldwide to implement varying degrees of lockdown measures, resulting in a patchwork of restrictions that often differed between regions, states, and countries. These disparities in policy, particularly between departure and arrival locations, created a dynamic environment that may have influenced daily passenger volumes and the spread of the virus. Consumer choice theory suggests that mobility restrictions influence travel demand by altering the costs and benefits of movement. Therefore, stricter lockdowns at departure locations may discourage outbound travel due to curfews, quarantine mandates, or business closures. Conversely, arrival-location restrictions, such as lengthy testing requirements or entry bans, can deter inbound travelers. These asymmetric policies introduce friction in travel decisions, potentially reshaping mobility patterns and impacting economic activity in sectors reliant on passenger flow, such as transportation, tourism, and hospitality.

Beyond economic implications, the effect of differing lockdown policies could also hold public health significance. If restrictive policies in an arrival location fail to align with looser measures at departure points, there may be an increased risk of cross-border virus transmission. Conversely, overly restrictive policies could suppress travel to the extent that they negatively impact labor mobility and economic recovery. Understanding these effects requires examining the causal relationship between policy stringency and daily passenger volumes, holding COVID-19 case and average daily passengers pre-COVID constant.

Lockdowns, while disruptive, were undeniably necessary to mitigate the rapid spread of COVID-19. However, the fragmented and inconsistent nature of policy implementation may have amplified economic uncertainty and health risks, demonstrating the critical need for cohesive and coordinated policy-making. In the United States specifically, state and regional variations in lockdown policies further complicated travel dynamics. Some states implemented early and stringent measures, sharply reducing mobility and air travel, while others adopted looser restrictions that allowed relatively higher travel volumes. These inconsistencies contributed to complex mobility patterns, presenting challenges for national transportation networks, airlines, and public health management.

Researching the effects of differing lockdown policies on mobility patterns and economic outcomes is critical for designing effective crisis responses in the future. Variation in restrictions across states can create uncertainty for travelers and businesses, potentially distorting economic activity and slowing recovery. Understanding how these policy differences influence behavior can help policymakers assess the trade-offs between public health goals and economic mobility. If certain types of restrictions or inconsistencies deter travel more than others, this insight could inform the development of coordinated, targeted policies that reduce friction, improve communication, and support both containment efforts and economic resilience during future public health emergencies.

## Literature Review

The COVID-19 pandemic has profoundly disrupted the global air transportation sector, leading to unprecedented declines in passenger volumes, airline revenues, and broader economic repercussions. Various economic studies have explored these extensive disruptions from multiple perspectives, providing valuable insights into the interplay between pandemic-related shocks and the responses of the aviation industry.

A prominent theme in recent literature highlights the direct impact on airline financial markets. Atems and Yimga (2021) illustrate the significant and enduring negative effects of COVID-19 on US airline stock prices, emphasizing that the declines were primarily driven by declining passenger demand rather than increases in operational costs. Expanding on financial vulnerability, Lin (2022) examined airfare pricing during the pandemic, revealing how quickly airlines adjusted fares in response to passenger confidence level, regulatory restrictions, and cost pressures. These findings imply that pricing became more responsive and dynamic at the regional level, reflecting greater attempts to sustain profitability amid volatility.

According to Gössling (2020), the pandemic was a disruptor, revealing a long-standing structural weakness in the aviation sector that had previously gone unnoticed or overlooked. He criticized the industry’s strong reliance on constant growth, its use of strategies like overbooking and load factor maximization, and its overall lack of adaptability during emergencies. Gössling (2020) claims that these problems not only increased the industry’s vulnerability to disruption but also limited its ability to quickly adjust to global shocks like COVID-19. He supported a shift toward leaner, more robust, and more sustainable models, arguing that the crisis offered the aviation industry a chance to reevaluate its foundational strategies. Sun, Wandelt, and Zhang (2022) expanded on this need for strategic change by stressing the need for stronger risk management frameworks and the incorporation of public health concerns into aviation planning. Their findings support the view that future resilience depends not only on operational efficiency, but also on the industry’s ability to anticipate and prepare for complex interdisciplinary challenges.

Broader socio-economic effects have been examined by several authors. Iacus, Natale, Santamaria, Spyrtos, and Vespe (2020) highlighted the wide-reaching economic effects of reduced air travel, both freight and passenger, projecting that global GDP declined between 1.41% and 1.67% as a result. This potentially affected 25-30 million jobs worldwide by the end of 2020. Their findings illustrate the far-reaching and consequential ramifications of aviation disruptions across business, trade, and tourism. Supporting this line of thinking, Abu-Rayash and Dincer (2020) discovered that the stringent lockdown measures enforced globally resulted in significant decreases in mobility patterns, further limiting economic activity and underlining the transportation sector’s vulnerability to outside shocks. Their study shows how, although being required for public health reasons, mobility limitations severely slowed economic growth in almost every part of the world.

In contrast, Andreana, Gualini, Martini, Porta, and Scotti (2021) offered a regionalized view of the disruption by focusing on European air travel. They examined variations in passenger numbers across nations using Interrupted Time Series (ITS) models and found significant variance in recovery. Their findings showed that national policy decisions, including the timing of lockdowns, reopening strategies, and clarity of travel instructions, had a direct impact on the speed of aviation recovery. While fragmented or reactive actions resulted in prolonged decline in passenger activity, countries with more planned and transparent approaches showed faster and more constant signs of recovery. In order to protect the industry against prolonged declines and to promote a more stable recovery, this study emphasizes the vital role that government intervention plays in the aviation industry.

Building upon these avenues of research, our study contributes uniquely by examining the specific impacts of varying lockdown stringencies in departure and destination locations on air travel within the United States, not just the overall effect of lockdowns on the industry. By identifying operational inefficiencies and bottlenecks resulting from inconsistent state and local policies, our research highlights the need for coordinated national strategies. We theorized that a unified policy framework across the United States could have significantly mitigated these operational challenges, reducing passenger uncertainty and optimizing airline scheduling and resource allocation. Our work thus emphasizes the importance of policy coherence in enhancing resilience and efficiency within aviation infrastructure during widespread crises that restrict passenger capacity.

## Data & Methodology

We compiled data from a variety of sources, including the U.S. Department of Transportation (DoT) for flight routes within the United States and their respective average daily passenger volumes, CDC-reported COVID-19 case counts, and CDC policy tracking data on the stringency of state-level lockdowns. To prepare the dataset for analysis, we first restricted the time frame to between the first quarter of 2020 (Q1 2020) and the fourth quarter of 2021 (Q4 2021), capturing the period during which lockdown policies were most relevant and variable. We then pivoted the data such that the unit of observation is a unique departure-destination state pair for each quarter. Each observation includes average daily passenger volume between the two states, COVID-19 case counts in the departure and destination states, and numerical measures of lockdown stringency in both locations. These data were merged to create a dataset containing both epidemiological and policy variables for each route-quarter combination.

We used this merged panel to estimate an ordinary least squares (OLS) regression model that captures how variation in state-level lockdown policies and COVID-19 prevalence influenced domestic air travel. Our baseline model includes COVID-19 case counts in both the departure and destination states, average pre-pandemic passenger volume (to control for underlying route demand), and an indicator for whether the destination state had more stringent lockdown measures than the origin. A second, expanded model includes continuous measures of policy stringency at both the departure and destination states. The empirical model is specified as follows:

$$\begin{aligned} \text{Passengers}_{ijt} = & \alpha + \beta_1 \text{Cases}_{it} + \beta_2 \text{Cases}_{jt} + \beta_3 \text{AvgPassengers}_{ij} \\ & + \beta_4 \text{DiffStringency}_{ijt} + \beta_5 \text{GreaterDestStringency}_{ijt} \\ & + \beta_6 \text{DepartStringency}_{it} + \beta_7 \text{DestStringency}_{jt} + \varepsilon_{ijt} \end{aligned} \quad (1)$$

Here,  $\text{Passengers}_{ijt}$  represents the average daily number of passengers traveling from state  $i$  to state  $j$  in quarter  $t$ .  $\text{Cases}_{it}$  and  $\text{Cases}_{jt}$  denote the number of reported COVID-19 cases in the departure and destination states, respectively.  $\text{AvgPassengers}_{ij}$  captures pre-pandemic average daily traffic for the route, included as a control.  $\text{DiffStringency}_{ijt}$  is an indicator for whether the lockdown stringency index differs between the departure and destination states, while  $\text{GreaterDestStringency}_{ijt}$  is a dummy variable of the destination state being more restrictive than the departure state. Finally,  $\text{DepartStringency}_{it}$  and

$\text{DestStringency}_{jt}$  capture the whether the respective lockdowns at departure and destination are mandatory or voluntary.  $\varepsilon_{ijt}$  is the error term. We would expect to see  $\beta_4 < 0$ , indicating that differing lockdown policies between departure and destination states create friction for travelers, thereby reducing passenger volume.

Our methodology has several limitations worth noting. Firstly, the COVID-19 case data we incorporated reflects state-level cases, which may not accurately represent the local-level risk experienced by travelers in specific cities or metropolitan areas. Aggregating cases at the state level likely masks significant variations within states, especially those with heterogeneous population densities and varying public health responses. Furthermore, the lockdown stringency index employed provides a broad categorization of restrictions and does not capture more granular variations in specific policy measures or compliance rates, which might significantly influence travel decisions. Lastly, our model does not account for additional economic and social activities, such as employment shifts, telecommuting adoption, or regional economic disruptions, that could independently impact passenger volumes beyond lockdowns and COVID-19 cases. Future analyses could benefit from incorporating finer geographic resolutions for both case data and lockdown policies, as well as considering broader socioeconomic variables to better isolate and understand the determinants of interstate travel behavior during pandemics.

## Results & Analysis

Our main findings show that while lockdown stringency did affect passenger volume, it was primarily driven by the stringency of policies at the destination rather than by differences between departure and destination policies. Travelers were significantly more responsive to restrictions at their intended destinations, suggesting that perceived limitations upon arrival had a stronger influence on travel decisions than policy inconsistencies between states. Looking at our aviation data, we did see that COVID-19 case counts were inversely related to passenger volume, but their direct statistical influence on travel decisions was limited, with travelers responding more notably to general public health conditions rather than precise fluctuations in case numbers. Furthermore, historically well-traveled routes showed greater resilience in maintaining passenger volumes, indicating that route popularity pre-pandemic was an essential predictor of travel behavior during the crisis.

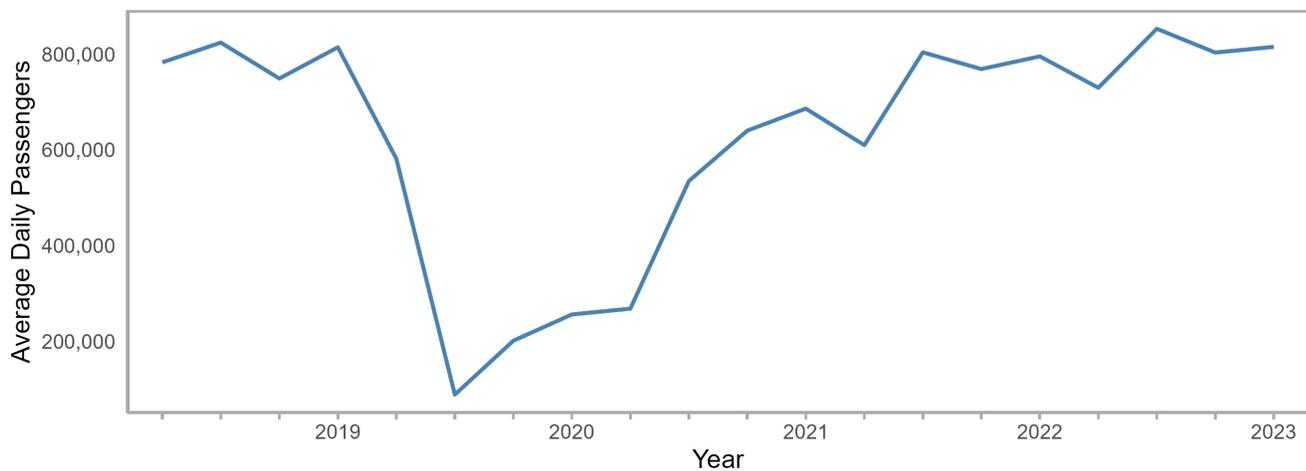


Figure 1: Average Daily Air Travel Volume (2019-2023). The graph highlights the steep decline of passenger volume after the onset of the COVID-19 pandemic in 2020 and the slow recovery to pre-COVID volumes in 2022. (*Consumer Airfare Report: Table 1 - Top 1,000 Contiguous State City-Pair Markets | Department of Transportation - Data Portal*, n.d.)

Figure 1 shows the average daily passengers immediately before and during the COVID-19 pandemic. A sharp drop occurs in early 2020 when cases begin to appear across the globe and the immediate impacts of lockdowns. A slight uptick in early 2021 coincides with the rollout of the first vaccines, suggesting a modest return to travel and a gradual recovery afterwards. Throughout 2021 and 2022, there are fluctuations likely tied to new outbreaks and subsequent restrictions and reopening, but recovery is quite clear. By 2023, passenger volumes had reached pre-pandemic levels as almost all travel restrictions had been lifted in the United States.

Figure 2 presents a scatter plot showing the relationship between the number of COVID-19 cases and the average daily passengers. The graph shows a higher density of daily passengers when there are fewer COVID-19 cases and more sporadic clusters when cases are high. The drop in volume indicates that as COVID-19 cases increased, the number of flights and average daily passenger volumes tended to decrease. When the number of COVID-19 cases is low, the number of passengers varies. But once the number of cases rises above several hundred thousand, we see most of the passenger numbers staying low and grouped closely together, with major air routes contributing the majority of passengers. Volumes dropping in response to a growing number of cases supports the findings of Abu-Rayash and Dincer (2020), who documented the significant reduction in flight due to pandemic restrictions, and Andreana et al. (2021), who emphasized the importance of public health and government-imposed restrictions had a direct suppressive effect on the demand for air travel. The dispersion of data points

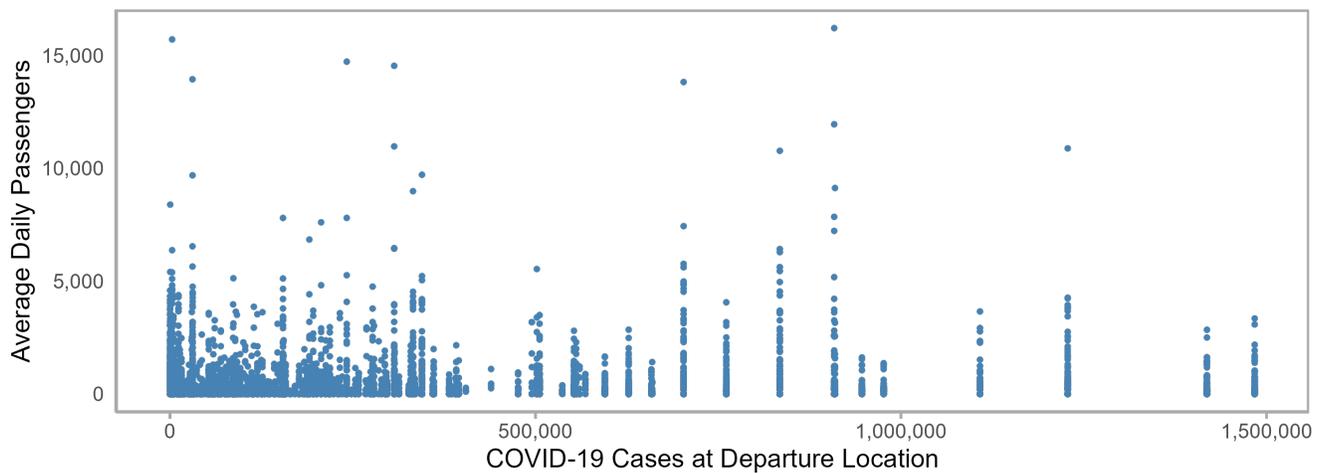


Figure 2: Average Daily Air Travel Volume vs COVID-19 Cases at Departure Location (2020-2021). This figure shows a decline in flight frequency as case counts grow, with commonly traveled routes staying active despite increased risks. (*Weekly United States COVID-19 Cases and Deaths by State*, n.d.)

when case numbers are low might be due to times when travel was less restrictive or because different states had different policies.

The OLS regression in Table 1 identifies several key factors influencing domestic air travel during the early stages of the COVID-19 pandemic. Across both models, the coefficient on historical average daily passengers is positive and highly significant ( $\beta_3 = 0.144$ ,  $p < 0.01$ ), indicating that pre-pandemic route traffic is a strong predictor of passenger volume during the pandemic. This suggests that historically well-trafficked routes retained relatively higher traffic levels despite public health restrictions.

Table 1: COVID-19 Stringency Effects on Airline OLS Regressions

	Dependent variable: Average Daily Passengers	
	Model 1 (1)	Model 2 (2)
Departure State COVID Cases	0.0001** (0.00002)	0.00004* (0.00002)
Destination State COVID Cases	-0.00001 (0.00002)	-0.00002 (0.00002)
Average Daily Passenger Pre-COVID	0.144*** (0.001)	0.144*** (0.001)
Different State Stringency	28.849* (15.425)	2.691 (17.044)
Greater Destination Stringency	1.916 (18.122)	18.921 (21.919)
Departure State Stringency		-68.714*** (14.527)
Destination State Stringency		-58.843*** (13.564)
Constant	-12.156 (11.603)	83.076*** (17.632)
Observations	8,560	8,560
R <sup>2</sup>	0.613	0.616
Adjusted R <sup>2</sup>	0.613	0.615
Residual Std. Error	553.341	551.755

Note: \* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

COVID-19 case counts in the departure state ( $\beta_1$ ) and destination state ( $\beta_2$ ) were not statistically significant in either model, though the coefficient on departure cases was marginally larger in magnitude. This implies that travelers may have been slightly more responsive to outbreak severity in their home states, but overall, case counts alone did not significantly influence air travel volumes during this period.

In Model 1, the indicator for whether lockdown stringency differed between the departure and destination states ( $\beta_4 = 28.85$ ,  $p < 0.1$ ) was marginally significant but positive, contrary to the expectation that mismatched policies would reduce travel due to increased uncertainty or friction. However, in the expanded Model 2, this effect diminishes and becomes statistically

insignificant ( $\beta_4 = 2.69$ ,  $p > 0.1$ ), suggesting that differences in policy stringency were not a consistent driver of travel behavior.

The most notable findings relate to the coefficients on lockdown stringency levels themselves. In Model 2, the coefficient on destination state stringency is negative and statistically significant ( $\beta_7 = -68.71$ ,  $p < 0.01$ ), as is the coefficient on departure state stringency ( $\beta_6 = -58.84$ ,  $p < 0.01$ ). These results indicate that stricter lockdown policies in both the departure and destination states suppressed passenger volume, with the destination state exerting a somewhat larger negative effect. This finding is notable because it contrasts with the initial hypothesis that stricter departure policies would more strongly discourage outbound travel. Instead, it appears that travelers were more sensitive to restrictions in their intended destination, potentially due to perceived risks or limitations on activities upon arrival.

## Conclusion

Our study provides insights into the relationship between COVID-19 lockdown policies and domestic air travel behavior in the United States during the pandemic, travelers were significantly more responsive to restrictions at their intended destination. Aviation data from the Department of Transportation showed a sharp decline in average daily passenger volumes at the onset of the pandemic, followed by a gradual recovery that closely tracked public health developments such as vaccine rollouts and the easing of restrictions. The data also revealed a clear negative relationship between rising COVID-19 case counts and passenger numbers, indicating that public health conditions played a major role in shaping travel decisions.

Our regression analysis examines the influence of both departure and destination lockdown policies on travel behavior. While we expected that differing levels of lockdown stringency between states would discourage travel, we found no strong evidence to support this. However, we did find that lockdown stringency at the destination had a significantly greater impact (approximately 69 fewer daily passengers) on passenger volume than at the point of departure (59 fewer passengers). This suggests that travelers were more sensitive to restrictions in their intended destination, potentially due to perceived risks or limitations on activities upon arrival. In contrast, mismatches between state policies did not have a statistically significant effect, underscoring the limited influence of policy inconsistency across states on travel decisions.

These results indicate that while differences in state policy existed, they were not the primary factor influencing passenger behavior. Instead, broader public health conditions, particularly at the destination, appear to have played a more decisive role in determining travel activity. Additionally, our findings reinforce the importance of route popularity as a driver of travel resilience, as historically well-traveled routes were more likely to retain passengers even during periods of heightened restrictions. This underscores the enduring relevance of travel demand patterns established prior to the pandemic.

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# How are Labor Markets within the Midwest being Impacted by the Adoption of Artificial Intelligence?

David Smith, Paisley Tuel, Ryan Cesar Irizarry

This case study examines the impact of Artificial Intelligence (AI) on job displacement in two high-risk sectors—manufacturing and finance—across five Midwestern states. These sectors were identified as particularly vulnerable due to their historical susceptibility to automation and high AI adoption rates, especially among larger firms. Drawing on 2022–2023 Occupational Employment and Wage Statistics (OEWS) data from the U.S. Bureau of Labor Statistics (2025), we analyzed employment and wage trends in Ohio, Michigan, Missouri, Illinois, and Indiana. Contrary to expectations of widespread displacement, our analysis finds no significant job losses in either sector. Instead, both sectors experienced increases in hourly median wages and had stable total employment. Even after adjusting for wide differences in occupation size, we observed no major shifts in employment distribution. These findings suggest that AI is currently functioning more as a productivity-enhancing tool than a labor-replacing force. We conclude that continued research is needed to assess long-term labor impacts and to guide the development of targeted re-skilling policies for the evolving Midwestern workforce.

Keywords: Artificial Intelligence (AI); Job Displacement; Manufacturing; Finance, Midwest; Labor Market Trends

## Introduction

Artificial Intelligence (AI) has become a transformative force in the global economy, influencing various sectors from manufacturing to services. As technology has advanced, businesses have leveraged automation and analytics to improve efficiency, reduce costs, and enhance customer experiences. Looking at Asana’s 2024 State of AI at Work Research Report, 69% of those who use Generative AI at work say there have been productivity gains but from this same report, there are 33% of workers who are concerned about AI possibly replacing their roles. There are also 47% concerned about the reliability of Generative AI being used in decision making (Work Innovation Lab & Anthropic, 2024). The productivity gains from AI are very important for the future as the number of workers decreases. Maintaining the country’s current level of productivity is important, but these tools can offer increased productivity, although that is not completely understood yet. It’s also raised concerns, particularly regarding possible job displacement among workers and what the future of work will look like.

In the Midwest, the effects of AI on the economy and job market aren’t as strongly understood. The region is known for its strong manufacturing and agriculture sectors. As AI continues to be used in manufacturing and finance, and other sectors, we’ve seen concerns about job displacement. Several roles in manufacturing, such as assembly line workers and standard operating procedures, are susceptible to automation (Acemoglu & Restrepo, 2020).

This paper examines whether the adoption of AI is causing any potential changes to the important job markets in the Midwest. We hypothesize that AI positively augments productivity for gains in wages, which leads to a decrease in the number of workers. To evaluate this prediction, we’ll examine the current trends in total employment and hourly median wage to indicate AI’s effect in the short run. Understanding this helps us to better understand if AI has a greater production augmentation effect.

## Literature Review

AI adoption has grown steadily across industries, with notable implications for labor markets in both the Manufacturing and Finance sectors. According to the OECD (2023), 42% of employers in the financial sector and 29% in the manufacturing sector reported using AI technologies. Larger firms were significantly more likely to implement AI than smaller firms, underscoring how organizational scale influences technology adoption (OECD, 2023). This trend supports the premise that firms capable of absorbing AI technologies often experience productivity enhancements that allow them to pay higher wages, yet may simultaneously reduce their reliance on human labor as AI substitutes for routine work.

There is, however, considerable variation in AI adoption estimates depending on the data source. Official surveys conducted by national statistical agencies often report lower adoption rates than private surveys by consultancies or research institutions. For example, a European Commission (2020) survey found that 42% of companies were using at least one form of AI technology. Similarly, IBM’s Global AI Adoption Index (2022) reported that one-third of IT professionals claimed their organization was using AI, while McKinsey’s Global Survey on AI reported a 57% adoption rate among executives and managers (McKinsey & Company, 2021). These discrepancies reflect not only measurement differences but also the complex and rapidly evolving nature of AI’s role in augmenting firm-level productivity.

AI is employed differently in sector-specific contexts. In finance, it is primarily used for data analytics (52%) and fraud detection (50%), whereas in manufacturing, its use is concentrated in production processes (60%) and maintenance tasks (40%) (OECD, 2023). These divergent applications influence which jobs are most affected by AI and, by extension, how labor demand shifts in response to productivity gains. In finance, AI augments high-skill roles and reduces administrative burdens, enabling firms to shift compensation toward analytical workers without expanding headcount. In manufacturing, automation

of lower-skilled roles—such as assemblers and machine operators—boosts output per worker, allowing firms to maintain or increase wages for technical staff while displacing routine labor (Acemoglu & Restrepo, 2020).

Scholars have noted that AI-induced job displacement is concentrated in routine-intensive occupations. Brynjolfsson and McAfee (2014) argue that while AI and automation can replace repetitive tasks, they simultaneously complement roles requiring social intelligence or complex decision-making. This bifurcation supports our hypothesis: as firms adopt AI to enhance productivity, the remaining workers often see higher wages due to the increased value of their complementary skills, even as total employment declines.

Furthermore, the speed of AI adoption is accelerating due to competitive pressures, with firms racing to improve efficiency and gain strategic advantage (Tambe, Cappelli, & Yakubovich, 2019). As firms realize productivity gains, labor becomes a smaller share of input costs—leading to scenarios where firms can afford to pay more per worker even as they employ fewer overall. This dynamic reinforces the importance of understanding sector-specific trends, as the path from AI adoption to labor displacement and wage growth is shaped by the type of tasks being automated or augmented.

Overall, the literature demonstrates that AI's adoption is uneven across sectors, firm sizes, and occupations, with consequences for productivity and workforce structure. However, much of the existing research focuses on national or international trends and lacks granular, region-specific analysis, particularly in economically diverse areas like the American Midwest. Moreover, while there is growing awareness of sector-level impacts, few studies quantify AI-driven job displacement alongside wage changes by occupation across multiple states using real-time labor data. This paper seeks to fill that gap by examining how AI adoption in finance and manufacturing contributes to rising productivity, changes in wage structures, and ultimately, reductions in the number of workers employed.

## Data Collection & Analysis

We will be using data collected from the Bureau of Labor Statistics on occupational Employment and Wage Estimates collected from the states of Ohio, Michigan, Missouri, Illinois, and Indiana from May 2020 to May 2024 in their manufacturing and finance sectors. The time range was chosen from the initial release of Generative AI in 2020 and extends to the most recently available data. These states were selected primarily for their higher populations compared to other Midwestern states. We are seeing if the changes in total employment in these sectors are consistent with other states in the Midwest since the release of Generative AI. We are also seeing whether there has been any change in the hourly median wage of workers in these sectors. This is primarily to see if there is a correlation as Generative AI has been adopted, and total occupations along with the hourly median wage. We are also interested in seeing if there are any changes within the distribution of total employment to see what the possibly correlated effect is.

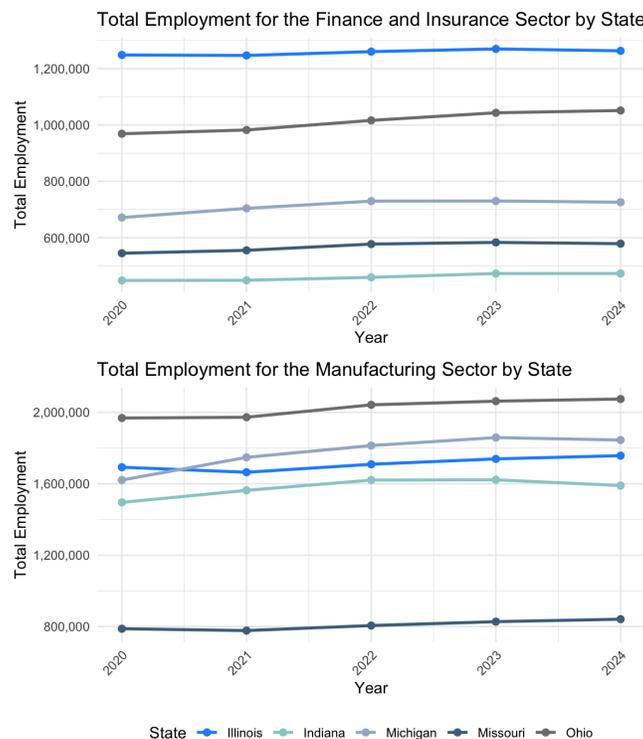


Figure 1: Comparison of total employment within the Finance/Insurance and Manufacturing Sector between Ohio, Michigan, Missouri, Illinois, and Indiana over May 2020-2024

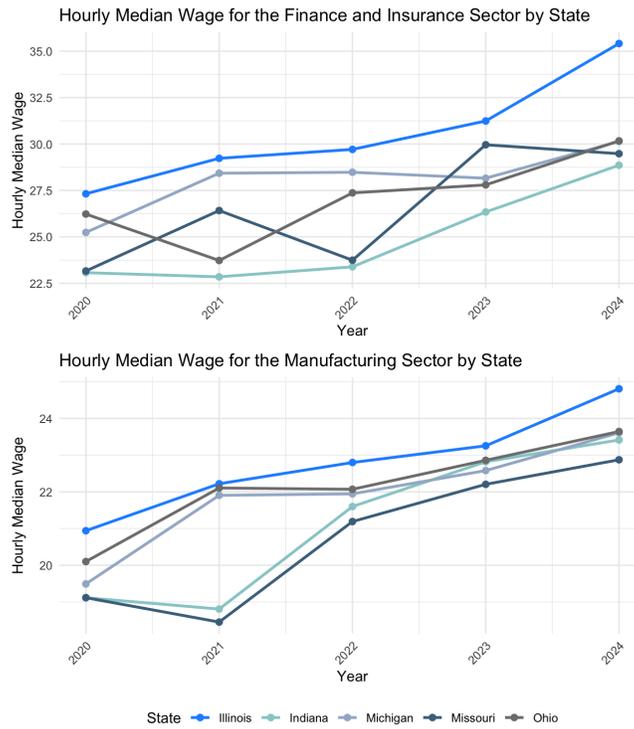


Figure 2: Comparison of the hourly median wage in the Finance/Insurance and Manufacturing Sector between Ohio, Michigan, Missouri, Illinois, and Indiana over May 2020-2024

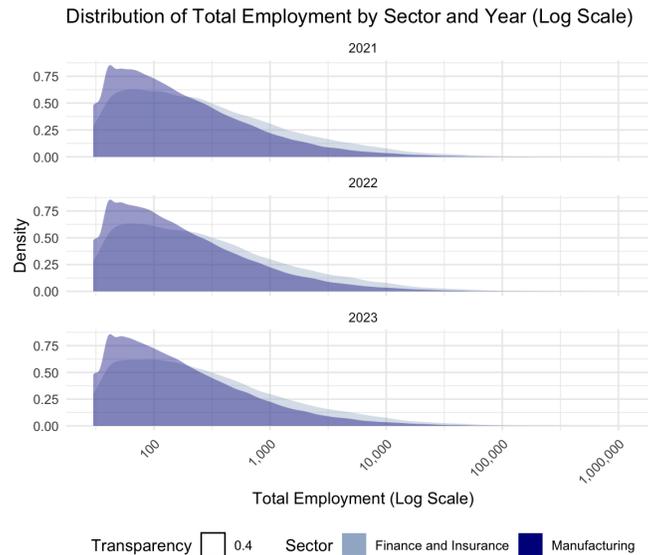


Figure 3: Distribution of total employment within the Finance/Insurance and Manufacturing Sector across the years 2021, 2022, and 2023

## Results

The figures, from the data, reflect that—for the Manufacturing Sector—there has been a trend of slight increase in total employment and a definite trend of increases in the hourly median wage. For the Finance and Insurance Sector, there is a trend of no change in total employment and a trend of increases in the hourly median wage. These results are in line with our hypothesis, as there have been overall gains in total employment and in the hourly median wage for both sectors in the Midwest.

Comparison across these two sectors may also be viewed in an aggregate, nation-wide scope. In the context of the

hypothesis: If AI positively augmented productivity leading to decreased workers (the hypothesis's outcome), we might expect to see a shift in the employment distribution towards occupations with lower total employment over time, particularly in sectors more susceptible to AI adoption. Visually, this would potentially manifest as the density curves shifting leftward (towards lower values on the log-scaled Total Employment axis) from 2021 to 2023, suggesting a higher proportion of smaller occupations. However, a brief visual inspection of this graph does not immediately provide strong evidence for a consistent decrease in workers across all employment levels in either sector over the three years. The distributions appear relatively stable, with perhaps some minor shifts in the peaks and tails, but no dramatic leftward shift indicating a widespread decrease in the size of occupations.

Therefore, based solely on this visualization of the distribution of total employment, there is no clear and strong indication supporting the hypothesis of AI-driven productivity gains leading to a broad decrease in the number of workers in these sectors between 2021 and 2023. Further analysis, such as examining the total employment numbers and wage trends directly, would be needed to evaluate the hypothesis more thoroughly.

## Conclusion

This case study explored how the adoption of AI is shaping job displacement across two high-risk sectors—Manufacturing and Finance—in the Midwest. Drawing on employment and wage data from 2022–2023 in five Midwestern states, we found that AI-related technologies are correlated to an increase in employment within the manufacturing sector and an increase to the hourly median wage. We also found that the Finance sector in the Midwest experienced little change in total employment but showed an increase in hourly median wage. This shows that AI is primarily augmenting productivity rather than replacing administrative roles.

These early findings suggest that AI's labor market impact won't be reflected in changes to the total employed within a sector, but is shown through changes in the median wage. Some of our hypothesized productivity augmentations seem to be seen in both the manufacturing and finance sectors. None of the possible effects of job displacement were seen in the manufacturing and finance sectors, with the manufacturing sector experiencing some growth in total employment. This study is primarily exploratory in nature and works to contribute to a clearer understanding of how AI is already influencing employment structures in the Midwest. Further data and analysis are needed to examine differences across individual states and long-term trends. The development of AI within the workplace does not have a pronounced effect on total employment, though there has been an increase in the hourly median wage. This study only shows correlation and not causation, so we cannot directly infer from this study that AI has driven these changes. Policymakers should invest in targeted re-skilling programs that align with sector-specific AI applications, ensuring workers can transition into roles complemented by emerging technologies. Additionally, ongoing state-level monitoring of wage and employment trends is essential to proactively address imbalances in labor demand as AI adoption accelerates.

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# The Salary Scramble: Global Budgeting and Maryland's Physician Market

Lidia Rodriguez, Lily Eattimo, Noam Greenberg

This paper examines the effect of Maryland's global budgeting system on physician wage growth compared to neighboring fee-for-service (FFS) states. Using inflation-adjusted wage data from 2004 to 2023, we analyze trends across Maryland, Vermont, Delaware, New Jersey, Virginia, and West Virginia. Our results show that Maryland experienced slower and more stable wage growth following the implementation of global budgeting in 2014, while FFS states, particularly Vermont, saw more rapid and variable increases. These findings support our hypothesis that global budgeting reduces the marginal revenue product of labor, leading to flatter wage trajectories. As Vermont prepares to implement a similar system through the AHEAD Model in 2026, Maryland's experience provides valuable insights into the potential effects on physician compensation. By examining wage trends under a global budget system, this study shows how changes in healthcare payment models affects physician compensation and healthcare spending.

## Introduction

In the United States, healthcare costs continue to pose significant financial challenges for both patients and hospitals. As costs of healthcare rise, policymakers are faced with a looming issue: what is the most cost-effective way to expedite healthcare? Today, the vast majority of hospitals in America operate following a fee-for-service (FFS) model, where hospitals are reimbursed for each individual service they provide (e.g. tests, procedures, consultations, etc).

While this model may make billing more straightforward, it can unintentionally incentivize physicians to increase the number of services performed (Fan et al., 1998). In fact, studies have shown that the FFS model can result in unnecessary treatments that will increase healthcare costs while providing minimal improvements to patient outcomes (Fan et al., 1998).

In 2014, Maryland was the first state to introduce a global budget system for hospitals, where they receive a fixed annual budget regardless of the number of services provided. By implementing this system, Maryland aims to control costs and improve care quality, which has proven to achieve reductions in hospital utilization and expenditures while maintaining hospital profitability and improving care quality (Kilaru et al., 2022). However, because hospitals are no longer paid more for delivering more services, their marginal revenue of physician output declines, which can create new financial limitations that could affect how physicians are compensated.

We hypothesize that the global budgeting system reduces the physician growth rate compared to FFS models, because wages become less dependent on marginal productivity. Physician compensation under FFS reflects the marginal revenue product of labor (MRPL), where each additional unit of labor yields more income. Under the global budget system, compensation is fixed, so physicians are paid on a set salary, and their wages grow more slowly.

If the global budgeting system consistently results in lower or flatter wage growth, states using these models may face challenges in attracting and retaining physicians, especially in high-income specialties. This could lead to physician brain drain, where physicians move to states with more lucrative FFS compensation structures.

As Vermont aims to implement a new, federal program, the AHEAD Model, in 2026, Maryland's experience provides valuable insight into the economic trade-offs involved. Our research contributes to this idea by examining whether wage stabilization in the global budgeting system is able to maintain a competitive and sustainable healthcare labor market.

## Literature Review

Global budgeting is a healthcare payment model where hospitals receive a fixed annual budget to cover the costs of delivering care. This model shifts the incentive from service quantity to service quality and cost-efficiency. A 1993 review of the global budgeting system across OECD countries, explains that global budgets are typically established and regulated by government agencies, who assess regional health needs and allocate funds accordingly (Wolfe & Moran, 1993). Additionally, the Commonwealth Fund (2017) further notes that the global budgeting system encourages hospitals to reduce unnecessary services and improve care coordination.

In contrast, under the FFS system, physicians are reimbursed for each individual service they provide, which directly links physician compensation to the volume of services given. As Fan et al. (1998) points out, this structure encourages overtreatment and can lead to higher healthcare spending with minimal improvements in patient outcomes. On the other hand, global budgeting limits the revenue regardless of the number of services provided, which shifts the incentive toward efficient resource utilization. An experimental study from 1997 in the *Journal of Economic Behavior & Organization* explored physician behavior under a global budget model and found that physicians are more likely to shift their decision-making to prioritize long-term efficiency and cost reduction, even if it means reducing service quantity.

On an international level, global budgeting has been implemented successfully in many healthcare systems. The OECD review states that countries like Canada, Germany, and the United Kingdom have used a global budget system to control costs. In particular, Canada demonstrates the feasibility to manage hospital costs without reducing the quality of care. However, these systems also encounter issues with provider moral and delayed technological advancements because of limited capital flexibility (Wolfe & Moran, 1993).

In 2014, Maryland became the first U.S. state to fully implement the global budgeting system statewide. Several studies have evaluated its outcomes. For example, in 2018, JAMA health forum performed a study that found that the introduction

of global budgets led to reductions in emergency department visits and hospital admissions, without any effects on the quality of care provided. Additionally, Kilaru et al. (2022) and Done et al. (2019) also report that rural hospitals under global budgeting systems showed improved cost containment and stable operating margins. However, these studies do not focus on the specific impact on physician wages.

Although not fully implemented, Vermont has begun to explore payment reform through their CMS AHEAD (Advancing All-Payer Health Equity Approaches and Development) Model. This program is similar to Maryland's approach by setting a fixed budget.

While no study provides definitive evidence on the wage effects of global budgeting, we can assume that under the FFS model, physician compensation reflects marginal revenue product, where each additional service directly translates to higher earnings. On the other hand, global budgeting provides a fixed hospital income, which incentivizes salary-based payment structures. As hospitals face budget constraints, growth in wages may not change, especially in specialty positions such as a surgery.

## Data

To evaluate the effects of Maryland's global budget system on physician wages, we conducted a comparative analysis using real physician wage data from 2004 to 2023 across six U.S. states: Maryland, Vermont, Delaware, Virginia, West Virginia, and New Jersey. Maryland is the only state operating under a global budget model since 2014, while the others follow the traditional FFS system during the study period. Vermont, while currently operating under a FFS system, is planning to implement a global budget model through the AHEAD program in 2026, making it a key state for future comparison.

Physician wage data was sourced from the Bureau of Labor Statistics' Occupational Employment and Wage Statistics (OEWS) database. We adjusted wage data for inflation and put values in terms of 2023 dollars using the Consumer Price Index (CPI) to ensure stable comparisons across years. Annual mean wages and percentile distributions (where available) were analyzed.

To discuss how the introduction of global budgeting influences wage trends, we divide the data into two periods: pre-2014 and post-2014. We calculated the average annual wage growth rates for each period and state. Additionally, we visualized the data through line plots of annual mean wage vs. year, bar graphs comparing pre- and post- 2014 growth rates, and box plots illustrating wage distribution and variability across states.

Table 1 shows that Maryland has the lowest mean physician wage (\$163,245) among the six states, with low wage variability (SD = \$13,255). Additionally, Maryland experienced negative wage growth both before and after 2014, suggesting that the global budget system may be associated with a decline in physician wage growth.

Table 1: Key Summary Statistics

State	Mean Wage	SD Wage	Pre-2014 Growth	Post-2014 Growth
Delaware	188545.4	16530.50	0.48041813	-0.8250265
Maryland	163245.1	13255.11	-0.07045697	-0.2866989
New Jersey	180830.1	11039.42	2.00997262	-1.9218399
Vermont	178259.4	18483.77	0.42880014	3.5414074
Virginia	174439.8	19989.24	-0.15332445	-1.6301732
West Virginia	185126.5	15533.46	1.41227630	1.464266

*Note: SD = Standard Deviation. Growth represents wage growth over time.*

## Results

Figure 1 simplifies comparisons by grouping states into three categories, Maryland, Vermont, and others (average of Delaware, New Jersey, Virginia, and West Virginia). Maryland exhibits a steadier and slower wage growth rate over the entire period. However, after the implementation of the global budget system in 2014, the growth rate appears to flatten, which suggests a stabilizing effect on wage growth. In contrast, the other states, which also operate under a FFS system, also display more dynamic wage growth than Maryland with some variation year to year.

Focusing more closely on Maryland and Vermont highlights the potential impacts a global budget system may have on Vermont once it is implemented. Both states appear to exhibit the same upward trend prior to 2014. However, after the implementation of the global budget system in Maryland, its wages began to flatten, while Vermont's wages continue to rise at a steeper rate. As Vermont prepares to implement a global budgeting system through the AHEAD Model in 2026, this comparison provides a baseline to assess how physician wages might change. If Vermont follows a similar pattern to Maryland, it may experience greater wage stability but reduced growth.

Figure 2 provides a different view of the global budget system by emphasizing the decline in physician wage growth relative to the FFS states. Before 2014, Maryland experienced a slightly negative growth rate, but showed an even more negative trend post- 2014, which reinforces the idea that wage growth slows when the global budget system is implemented. Vermont on the other hand showed positive wage growth both before and after 2014, with higher post- 2014 growth. New Jersey, Virginia, and Delaware all show negative trends, highlighting that growth under the FFS system is not always positive.

Figure 1: Physician Real Wages Over Time per State

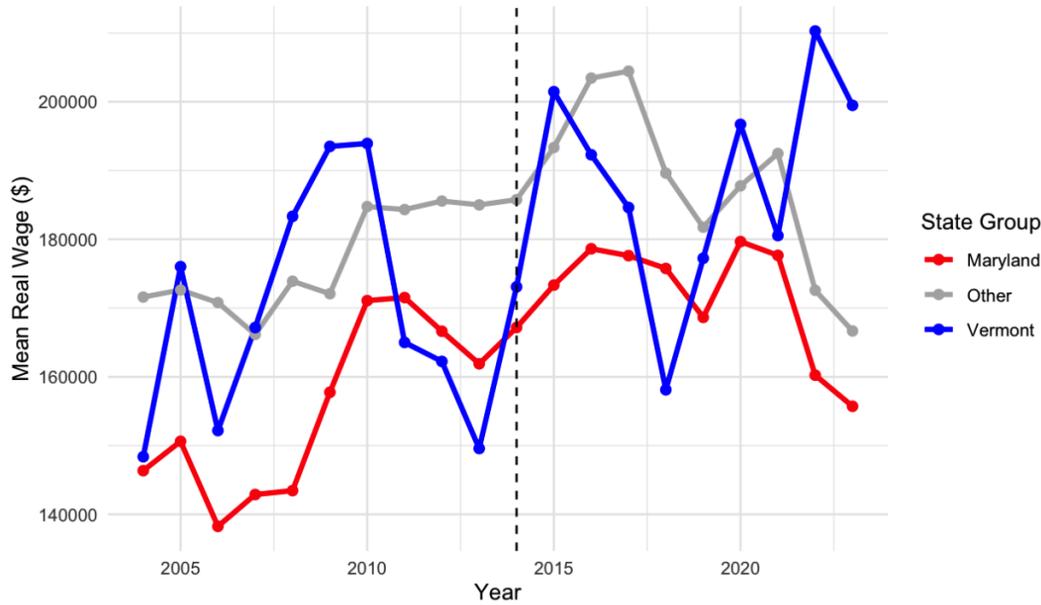


Figure 2: Wage Growth Rate by State Before and After 2014

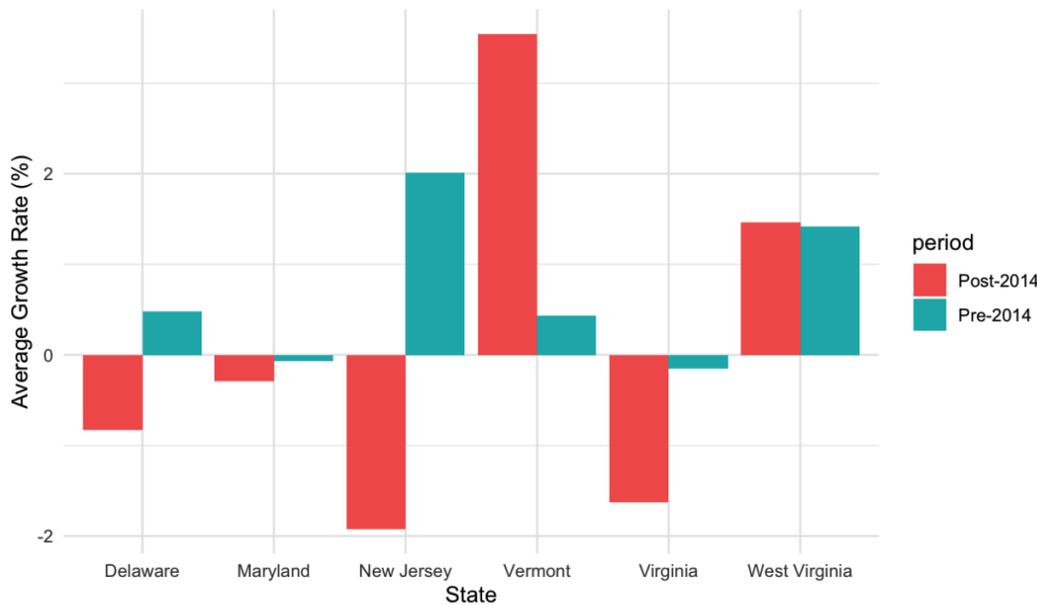
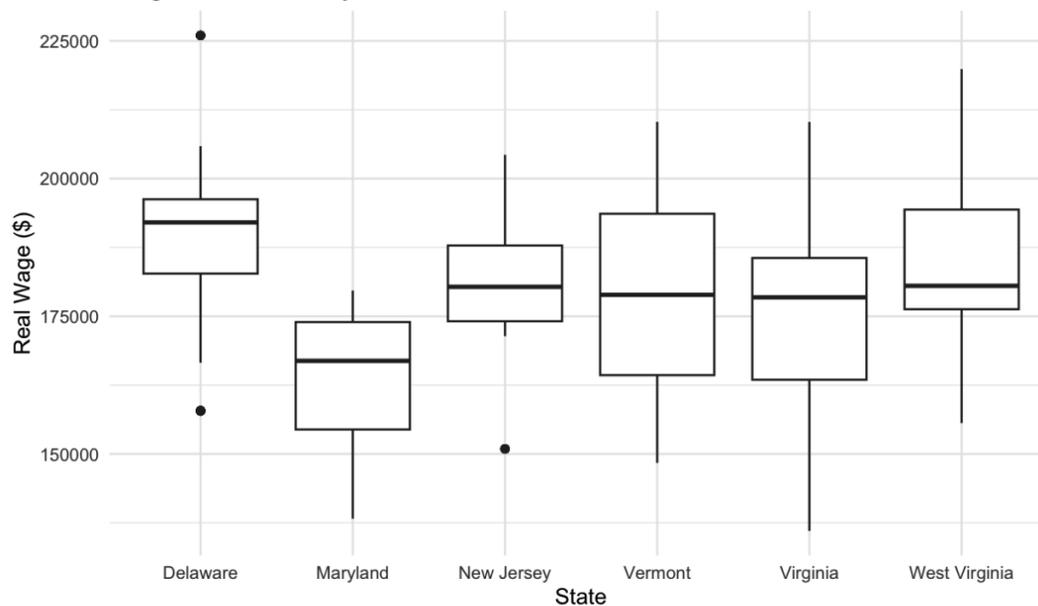


Figure 3 compares wages across each state. Maryland’s median wage is lower than FFS states at about \$165,000, and its interquartile range is narrower, and has fewer outliers lying between \$155,000 to about \$175,000. This narrow range suggests lower variability and greater wage consistency among physicians operating under Maryland’s global budgeting system. In contrast, states using the FFS system like Vermont, West Virginia, and Virginia exhibit higher interquartile ranges, and thus higher wage variability.

## Conclusion

This study investigates the impact of Maryland’s global budgeting system on physician wage growth in comparison to FFS states. By analyzing real wage data from 2004 to 2023, our findings demonstrate a clear difference between states using FFS systems and Maryland’s fixed-budget approach. Across all visualizations, Maryland consistently shows slower, more stable wage growth, reduced variability, and fewer wage outliers relative to its neighboring FFS states. These patterns align with our hypothesis that global budgeting leads to more stable physician wages because of the reduced MRPL. In contrast, FFS states such as Vermont and Virginia show more dynamic wage growth post-2014, with wider interquartile ranges and greater fluctuations in physician pay. This variation highlights how FFS models continue to financially reward additional service,

Figure 3: Wage Distribution by State Post-2014



which potentially drives higher earnings, but with greater variability and less predictability.

The case of Maryland vs. Vermont offers particularly valuable insight as Vermont prepares to implement its own global budgeting model in 2026. While Vermont currently benefits from rapid wage growth under FFS, our results suggest that adopting a global budgeting system may stabilize earnings at the cost of reducing wage growth. This trade-off poses important considerations for policymakers aiming to balance cost containment with the need to attract and retain physician talent.

Ultimately, this study contributes to the ongoing dialogue about payment reform by providing empirical evidence that global budgeting can reshape labor market dynamics in healthcare. While the model promotes cost containment and efficiency, its long-term success will depend on whether states can maintain a competitive and sustainable physician workforce under more constrained financial conditions. Future research should explore how such systems affect not just wages, but also physician behavior, access to care, and overall healthcare quality.

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# Socioeconomic Factors Associated with Maternal Health in Togo: A Quantitative Literature Review

Binayek Tiwari, Elizabeth Odife

Improved maternal health is essential to the economic prosperity of any nation; as a study published by the Commonwealth Fund found, maternal morbidity can cost up to \$32.3 billion dollars (Tikkanen, Zephyrin, & Schneider, 2021), and that is only accounting for the U.S. The ramifications for developing countries could be substantially higher, given the differences in economic progress. Maternal health remains a critical issue in many low- and middle-income countries, but a country of particular interest would be Togo, located in Sub-Saharan Africa. A report published by the United Nations Development Programme in 2015 found that Togo was consistently rated with low human development, resulting in a Gini coefficient of 46% in 2013 and a maternal mortality ratio of 450 to 100,000 (United Nations Development Programme, 2015). Furthermore, as efforts to achieve the Millennium Development Goals published by the United Nations persist, Togo remains in a critical state of despair due to economic inequities. Despite improvements in maternal healthcare access, disparities still persist due to various socioeconomic factors. This paper reviews the existing literature on maternal health in Togo and examines the role of key socioeconomic determinants. Three major factors identified for this paper are: maternal education, geographical and regional disparities, and wealth inequality. Using indicators such as concentration indices, the human opportunity index (HOI), and logistic regression models from prior research, we assess how these factors shape healthcare accessibility. The reviewed studies indicate a strong economic bias in healthcare access, with economic status contributing 75.66% to inequalities in facility-based deliveries (Atake, 2020) and maternal education increasing the likelihood of adequate antenatal care (ANC) visits by 73% (Kota, Chomienne, Geneau, & Yaya, 2023). Moreover, regional disparities contribute to significant variations in skilled birth attendance and antenatal care coverage (Sanoussi, 2017). These findings highlight the urgent need for targeted policy interventions to enhance healthcare accessibility in marginalized communities.

## Introduction

In September of 2000, the United Nations (UN) published its Millennium Development Goals (MDG), an initiative meant to encourage political leaders to attain higher levels of human development. A particular focus was on MDG number 5, whose aim was to improve maternal health care, often assessed through antenatal care visitation (ANC) and the prominence of skilled birth attendants (SBA) (Millennium Development Goals Report: United Nations, 2015). Despite Togo's efforts to achieve said goals via the International Health Partnership and related initiatives (IHP+), a Human Development Report by the UN in 2015 found disheartening results, with Togo having a Human Development Index (HDI) of 0.484. Moreover, despite a 45% decline in the maternal mortality ratio worldwide from 1990, 86% of maternal deaths were concentrated in sub-Saharan African countries and Southern Asian countries (The Millennium Development Goals Report: United Nations, 2015). A particularly disconcerting finding was that less than 20% of sub-Saharan African countries had nationally representative data (with Togo as a part of that demographic), which increases the difficulty in research abilities to ascertain the progress made. Togo, like many sub-Saharan African nations, faces persistent disparities in maternal healthcare access. Maternal mortality remains high, largely due to the uneven distribution of healthcare resources and socioeconomic inequalities. According to (Atake, 2020), despite a 19.2% decline in maternal mortality between 1998 and 2013, access to essential maternal health services remains disproportionately skewed toward wealthier, educated, and urban populations, highlighting an increasing need to properly assess research findings on this topic.

This study reviews three critical socioeconomic determinants affecting maternal healthcare utilization in Togo: geographical & regional disparities, household wealth & economic status, and maternal education. Geographical & regional disparities explain the impact of healthcare infrastructure and rural-urban differences. Household wealth & economic status discuss financial constraints as a barrier to accessing maternal healthcare. Maternal education discusses the role of educational attainment in influencing health-seeking behaviors. Using quantitative models such as concentration indices, HOI, and logistic regression analyses from previous studies, we examine the statistical relationship between these factors and maternal healthcare utilization. This approach allows for a comprehensive assessment of the inequalities affecting maternal health in Togo.

## Methods

We examined 7 papers related to socioeconomic contributions to maternal health disparities in Togo, Africa, with our objective being to identify the three prominent determinants of those health disparities. Our sources were gathered utilizing various databases, including Google Scholar, PubMed, and the Kelvin Smith Library catalog, with our search words including "socioeconomic factors", "maternal health", "Togo", and "health disparities", all to find the most crucial reports to aid our research. We excluded peer-reviewed papers that generalized findings to all of sub-Saharan Africa or reported solely on infant mortality rates. Moreover, studies that failed to account for confounding variables such as age or marital status were excluded. To assess the risk of bias, all studies were evaluated using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for

Cross-Sectional Studies (Institute, 2017) and the JBI Critical Appraisal Checklist for Qualitative Research (Institute, 2017). The cross-sectional studies' scores were evaluated from 1-8, and the qualitative research scores were evaluated from 1-10, all of which are located in Table 1.

## Socioeconomic Factors

### Maternal Education and Health-Seeking Behavior

Access to maternal healthcare is often shaped by socioeconomic and geographic disparities. Women living in rural or low-income settings frequently face barriers such as limited availability of health facilities, transportation difficulties, and financial constraints. These challenges are further compounded by lower levels of education, which can reduce awareness of the importance of maternal services and hinder autonomous decision-making. Women with higher levels of education are more likely to recognize the importance of maternal health services, adhere to recommended ANC visits, and seek professional assistance during childbirth (Kota et al., 2023).

To analyze how education influences maternal healthcare utilization, this paper examines the findings of Kota, Chomienne, Geneaum, and Yaya (2023), whose logistic regression analysis provides a clear quantitative framework for evaluating key predictors such as education level. This study was selected because it offers robust, data-driven insight into maternal health behavior in low-resource settings—directly aligning with the focus on how socioeconomic factors impact health service use. A logistic regression model is a statistical method used to determine the probability of an event occurring based on various influencing factors. In this context, it helps estimate how likely a woman is to attend antenatal care (ANC) visits or deliver in a health facility based on factors like education, income, or geographic location. Furthermore, the odds ratio (OR) is a measure of association that tells us how much more (or less) likely an event is to happen in one group compared to another. If OR is greater than 1, the event is more likely in the first group. If OR is less than 1, the event is more likely in the first group. If OR equals 1, there is no difference between the groups. The confidence interval (CI) represents the range within which the true effect is likely to fall, given the data. It tells us how precise the odds ratio estimate is.

A logistic regression analysis conducted by Kota, Chomienne, Geneaum, and Yaya found that women with secondary or higher education were 73% more likely to attend four or more ANC visits than those with no formal education (Kota et al., 2023). This is represented by an odds ratio of 1.73, meaning the odds of attending ANC are 1.73 times higher for educated women. The confidence interval (CI) for the 1.73 OR in the same study is 1.42–2.12. This means that the true odds of attending ANC could be anywhere between 1.42 times and 2.12 times higher for educated women. The result is statistically significant, suggesting that education may have an impact on ANC attendance. Logistic regression uses a mathematical function (the logit function) to model the relationship between independent variables (like education, income, or rural vs. urban residence) and a binary outcome (such as attending ANC visits: Yes/No).

The odds ratio is derived from this regression equation:

$$P(Y = 1) = \frac{e^{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n}}{1 + e^{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n}}$$

where:

- $x_1, x_2, \dots, x_n$  are the factors (such as education, income, and region),
- $\beta_1, \beta_2, \dots, \beta_n$  are the estimated coefficients, which determine the impact of each factor on the likelihood of attending ANC.

The odds ratio is calculated by exponentiating the coefficient  $OR = e^\beta$ . This approach is effective for estimating causal effects in observational data, provided that key assumptions—such as correct model specification—are met. While logistic regression cannot establish causality in the strictest experimental sense (due to the absence of randomization), it offers a robust approximation of causal relationships when used carefully, especially in public health research where randomized controlled trials are often impractical.

### Geographical and Regional Disparities

Regional disparities significantly influence maternal healthcare access in Togo. One widely cited measure to assess such inequalities is the *Human Opportunity Index* (HOI), which evaluates how equitably access to essential services—such as healthcare—is distributed among population groups. The HOI is a statistical tool used to measure how fairly access to essential services is distributed among different population groups. It helps determine whether circumstances beyond a person's control (such as place of birth, income, or education) influence their chances of receiving essential healthcare services. In the context of maternal healthcare in Togo, HOI helps assess the inequality in access to services like antenatal care (ANC), skilled birth attendance, and facility-based deliveries.

HOI is computed using the formula:

$$HOI = p \times (1 - D),$$

where:

- $p$  is the average coverage rate of the service (e.g., the percentage of women receiving skilled birth attendance),

- $D$  is the Dissimilarity Index, which measures how unequally access to the service is distributed across different groups. A higher  $D$  indicates greater inequality.

This framework is particularly effective because it integrates both the extent of service coverage and the inequality of its distribution, offering a more holistic view than simple averages. However, one limitation is that the HOI aggregates data across large population groups, which may mask micro-level disparities, such as those between ethnic minorities or within remote rural areas. Despite this, it remains a powerful tool for identifying structural inequality, especially in public health systems where average coverage may appear adequate but conceal deep regional divides.

A study conducted by Sanoussi in 2017 found that women in rural areas face significantly higher barriers to accessing maternal healthcare services due to factors such as distance to healthcare facilities, lack of skilled healthcare workers, and shortage of emergency obstetric care (Sanoussi, 2017). A third of Togolese women live more than five kilometers away from a health center, making access difficult. Moreover, midwives and trained medical personnel are concentrated in urban areas, leaving rural women reliant on traditional birth attendants. Many rural health centers lack the equipment and personnel to handle complications such as obstructed labor or postpartum hemorrhage (Sanoussi, 2017). A higher HOI means more equitable access to maternal healthcare across different geographic locations, while a low HOI in rural areas confirms that healthcare access is heavily influenced by location. The same paper analyzed data from the 1998 and 2013 Togo Demographic and Health Surveys (Anipah et al., 2014) to evaluate inequality in maternal healthcare access over time.

The key HOI results for skilled birth attendance and antenatal care coverage were (Sanoussi, 2017):

- HOI for Skilled Birth Attendance in Urban Areas (2013): 78%
- HOI for Skilled Birth Attendance in Rural Areas (2013): 42%
- HOI for Four or More Antenatal Care Visits in Urban Areas: 72%
- HOI for Four or More Antenatal Care Visits in Rural Areas: 35%

This urban-rural gap of over 30 percentage points demonstrates a significant inequality in maternal healthcare access based on geographic location.

## Wealth Inequality

The rise in income inequality across the globe has substantial ramifications for any country, but for Togo, the consequences are exacerbated due to its contribution to poor maternal health outcomes. Income inequality was denoted as the primary determinant of maternal healthcare utilization amongst the three variables, and such findings can be attributed to its inadvertent connection with both. A paper published in 2020 by Atake drew upon the Concentration Index to determine the effects of income inequality on maternal health utilization. The concentration index works in tandem with the concentration curve as its function is to assess the distributional deviation from perfect equality. The general formula for the concentration index is:

$$CI = 1 - 2 \times \int_0^1 C(p) dp.$$

In other words,

$$CI = 2 \times (\text{Area between the concentration curve and the equality line}).$$

The following conditions apply:

- If  $CI = 0$ , perfect equality exists.
- If  $CI > 0$ , inequality favors the rich.
- If  $CI < 0$ , inequality favors the poor.

Atake found that 43% of women in poor households received four antenatal care visits in comparison to 78.5% of women in wealthy households. In addition to this, there was a general decline in inequality in antenatal care visits, decreasing from a ratio of  $CI = 0.142$  in 1998 to  $CI = 0.129$  in 2013; yet their values remain above 0, which still points towards the non-wealthy facing the brunt of this inequality gap. Moreover, his findings were supported by the data accumulated in other studies, with authors reporting that wealthy women were 3.7x more likely to have a skilled attendant at birth (SBA) (Mati, Adegoke, Asalu, & Salihu, 2018), 23% more likely to receive post-natal care (McCarthy, Braganza, & Fiori, 2017), and that even a slight increase in the wealth index led to an 8% increase in the probability of receiving prenatal care (Johnson, Issifou, & Homevoh, 2013).

Upon further inspection, it was noted that two studies within our analysis examined health insurance coverage and its contributive efforts to reduce maternal health utilization inequality. This is important to mention as one study found that 6% of wealthy women had health insurance coverage in comparison to 1% of non-wealthy women, with insured women being 3x more likely to have their birth attended by an SBA (Mati et al., 2018). These findings are imperative to take into consideration, as it is noted that women with higher tax brackets have greater access to health insurance. This is of particular importance due to individual reports from women in Sagbado claiming that their lack of “financial autonomy prevents [them] from accessing necessary health services such as contraceptives” (Emmel, 2018). Furthermore, the inability to afford health insurance to cover their health services generates another health barrier, as women have reported their inability to “raise the initial 10,000 CFA [for a caesarian section] to receive care in time for their birth” (Emmel, 2018). From the information provided, it is clear that a woman’s financial status plays a critical role in her ability to access the help required for a safe delivery.

## Summary of Papers

The majority of the studies (4 out of the 7) reported income as the primary determinant of health accessibility disparities for mothers, whilst 2 out of the 7 reported education as the primary determinant. In total, however, all 7 cited income, education, and regional differences as the most prominent variables influencing maternal health services, whilst other exploratory variables, including religion and age, were rated lower. However, there were discrepancies in the data among the studies reviewed, primarily due to the intensity of the research conducted at the individual level. Over 30% of the studies utilized the Demographic & Health Surveys published in 1998 and 2013 by The DHS Programme (Anipah et al., 1998) (Anipah et al., 2014), yet their results varied. In particular, there was a consensus amongst the researchers that rural women were substantially less likely to receive timely antenatal care (ANC) and deliver at a health facility, with only 37% cited as living within 3 kilometers of a functional health facility (McCarthy et al., 2017). However, one study claimed that rural women were more likely to receive timely ANC care in comparison to urban women (Kota et al., 2023), which shocked us, given that the cross-sectional study accounted for more exploratory variables, such as prior parity and household size. It posed the question as to whether or not the findings should be considered more accurate given the author's in-depth analysis, or if they should be treated as an anomaly.

We found conflicting evidence; however, another paper utilizing data from the 1998 and 2013 DHS Programme found that accessibility to antenatal inequalities increased from 5.9% to 12.7%, and access to quality care inequalities also increased from 27.7% to 28.6% (Sanoussi, 2017). Meanwhile, only one study accounted for post-natal check-ups, citing that only 11% received a check-up from a health professional, compared to 23% who received a post-natal check-up from friends and family (Mati et al., 2018). Consequently, there were many doubts about the validity of our findings given the discrepancies amongst researchers despite accessing the same data. Upon further inspection, the difference lies in their methods and parameters for maternal health, with some citing that quality is derived from the number of antenatal care visits (Atake, 2020), whilst others cite that it is derived from facility-based deliveries (McCarthy et al., 2017). We understood that our findings are limited due to the lack of information related to Togo, as verified by the MDG report in 2015, and crises such as the HIV epidemic and the COVID-19 pandemic affecting the research gathered. However, the evidence presented is relevant nonetheless, as all papers find similar results in that the primary determinants of this inaccessibility are income, regional differences, and educational disparities.

## Limitations

Despite the intensive analysis conducted by various researchers, there are shortcomings to our analysis. In particular, the majority of the studies utilized information gathered from the 1998 and 2013 Demographic and Health Survey, generating a decade gap in research and posing a critical issue in verifying the validity of these findings in the present day. Furthermore, as asserted earlier, there are discrepancies amongst the results, given their different methodologies and criteria, which creates another flaw in our analysis. To compensate for this, further research must be conducted within the present day to determine the quality of maternal health within Togo and if the inequality gap has widened or narrowed over the years.

## Conclusion

This review of maternal healthcare access in Togo highlights significant socioeconomic disparities affecting the utilization of essential services such as antenatal care (ANC), skilled birth attendance, and facility-based deliveries. The analysis of existing literature identified three primary determinants—maternal education, household economic status, and geographical disparities—as key contributors to unequal access to maternal healthcare services. First geographical differences negatively affect women's access to critical maternal health care, which highlights the unequal distribution of maternal healthcare services across Togo. Policy changes should primarily focus on expanding the number of healthcare facilities across the regions in Togo, as these findings underscore the urgent need for investment in rural healthcare infrastructure, increased deployment of skilled midwives, and improved transportation networks to ensure timely maternal care.

Furthermore, income is a critical component of the accessibility of health care, as wealth directly affects a woman's educational attainment and her ability to live in urban areas whilst affording rising healthcare expenses. Despite efforts by the Togolese government to reduce healthcare costs, most notably with their creation of the Wezou program in 2021 that would provide 4 prenatal consultations and healthcare coverage, there are still disparities present within the region that are a byproduct of societal factors such as lack of female autonomy that exacerbate these devastating circumstances. To fully account for the complications of motherhood and health services for Togolese women, more research has to be conducted on the various regions in Togo, and policy initiatives must include efforts to improve educational attainment rates for women and occupational prospects for their autonomy.

Lastly, maternal education plays a crucial role in shaping health-seeking behavior. Given this information, there should be increased incentives to improve educational attainment rates for women in Togo as a means to mitigate the effects of poor maternal health. There is no denying that increasing accessibility to educational opportunities will require an extensive amount of funding and changes to the infrastructure of Togo. However, to improve the prosperity of Togolese mothers, the Togolese government must persist in its efforts to overcome these socioeconomic barriers and create a new era of prosperity.

# Appendix

JBI Critical Appraisal Scores		
Study	Author	Score
1	Atake, E.	8/8
2	Emmel, C.	10/10
3	Johnson, A., & Homevoh, E.	8/8
4	Kota, K.	8/8
5	Mati, K., Adegoke, K. K., Michael-Asalu, A., & Salihu, H. M.	8/8
6	McCarthy, K. J., Braganza, S., Fiori, K., Gbeleou, C., Kpakpo, V., Lopez, A., Schechter, J., Singham Goodwin, A., & Jones, H. E	8/8
7	Sanoussi, Y.	8/8

Figure 1: JBI Critical Appraisal Scores

Study	Authors	Publication Year	Time Frame Study	Main Analytic Techniques
1	Atake, E.	2020	1996 - 2013	Concentration Curve, Concentration Index, Multivariate logistic regression
2	Emmel, C.	2018	2018	Participatory Survey
3	Johnson, A., & Homevoh, E.	2013	2006	Descriptive analytics & econometric analysis
4	Kota, K.	2023	2013	Bivariate and multivariate analysis
5	Mati, K., Adegoke, K. K., Michael Asalu, A., & Salihu, H. M.	2018	2013-2014	Multivariate analysis
6	McCarthy, K. J., Braganza, S., Fiori, K., Gbeleou, C., Kpakpo, V., Lopez, A., Schechter, J., Singham Goodwin, A., & Jones, H. E	2017	2014	Bivariate and multivariable logistic regression
7	Sanoussi, Y.	2017	1996 - 2013	Human Opportunity Index & Disparity Index

Figure 2: Table of Authors

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# Medicaid Work Requirements and Hospital Readmissions: A Difference-in-Differences Analysis in Arkansas

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In recent years, several US states have implemented work requirements for Medicaid eligibility to increase employment in low-income populations. Arkansas was the first state to fully implement such a policy in 2018, resulting in the disenrollment of 18,000 individuals before it was blocked in mid-2019. With states like Ohio now seeking to enact a similar policy, there is growing concern about the potential negative health consequences. This paper evaluates the nature of these consequences by analyzing the effects of the policy on excess readmission ratios (ERR), a key hospital performance metric created and used by the Center for Medicare and Medicaid Services (CMS). Using ERR data from 2014 to 2024, we leveraged a Difference in Differences (DiD) regression framework to compare ERR performance between Arkansas and three control states. However, the effects we observed were small in magnitude and statistically insignificant. These findings suggest that work requirements may affect healthcare quality despite the limited effects observed in our analysis.

## Introduction

Since 2010, Medicaid work requirement policy has become increasingly popular among Republican states, including Ohio. As of 2025, Arkansas is the first and only state to have fully implemented Medicaid work requirements. During its brief rollout, starting in June 2018, it was reported that approximately 18,000 individuals lost Medicaid coverage before a federal judge blocked this policy in March 2019 (Skinner, 2024). Ohio received approval for similar work requirements in 2019 under the Trump administration, but implementation was paused due to the COVID-19 pandemic. Before Ohio republicans could resume their pursuit of the policy, the Biden Administration revoked the approval in 2021. Now, under the new Trump administration, Ohio has resubmitted a proposal to the Centers for Medicare and Medicaid Services (CMS) to implement work requirements (Kasler, 2025).

As this proposal re-emerges, it is important to understand the effects this policy may have on the health outcomes of Ohio's Medicaid population as it risks revoking coverage, disrupting access to necessary care for vulnerable groups. Currently, eligibility for Ohio Medicaid is determined by an individual's income relative to the Federal Poverty Level (FPL). Following Medicaid expansion under the Affordable Care Act in 2014, non-elderly adults between the ages of 19 and 64 with incomes up to 138% of the FPL also became eligible (McGee, Akah, & Wiseloge, 2025). Under the work requirements proposal, these non-elderly adults would have to meet certain conditions in order to remain eligible for Medicaid. One such condition requires individuals to work or engage in community service for a minimum of 20 hours a week to retain Medicaid coverage. While the proponents of this policy believe that the requirements would help reduce federal spending, boost employment, and help individuals become more independent, evidence shows that many Medicaid recipients are already working part-time or face significant barriers to stable employment (Garfield, Rudowitz, Musumeci, & Damico, 2018). Proponents of the policy also claim that there is a connection between employment and better health. However, insufficient literature casts doubt on whether this connection is actually significant.

Given that insurance coverage plays a key role in readmission rates (Bailey, Weiss, Barrett, & Jiang, 2019), we will theoretically predict that a population shift from Medicaid to uninsured coverage should cause the ERR to increase (Wier, 2011). Because of this, we will interpret an increase in ERR as an indication that the distribution of Medicaid and uninsured individuals has changed. Therefore, our hypothesis will be one-tailed to capture the expected shift in ERR.

$H_0$ : The Arkansas implementation of Medicaid work requirements has a negative or neutral impact on expected readmission ratio (ERR) outcomes.

$H_1$ : The Arkansas implementation of Medicaid work requirements has a positive impact on expected readmission ratio (ERR) outcomes.

## Literature Review

Much of the existing literature on Medicaid work requirements and Medicaid expansion has focused on the consequences that coverage loss has on healthcare access and affordability. Evidence from Sommers, Chen, Blendon, Orav, and Epstein (2020) highlights how Arkansas's 2018 implementation resulted in widespread disenrollment and adverse health-related behaviors. Through a series of random digit dialing telephone surveys in 2016, 2018, and 2019 of low-income adults, they found that among those who were affected, 50% reported serious problems with medical debt, 56% had delayed care due to costs, and 64% delayed taking medications (Sommers et al., 2020). Along the same lines, Garfield et al. (2018) and Katch, Wagner, and Aron-Dine (2018) argue that coverage disruptions disproportionately affect already vulnerable populations, like individuals with mental illness, chronic conditions, or fluctuating work hours. These vulnerable populations already face barriers to entering the workforce and are predisposed to worse health outcomes, so the loss of coverage would likely exacerbate this effect. In addition, Jung and Shrestha (2024) simulate the effects of Medicaid work requirements and find that although there

is a slight rise in labor force participation, Medicaid disenrollment is primarily concentrated among high-risk, low-income individuals. They suggest that the administrative costs and coverage losses outweigh any marginal gains from employment.

Instead of looking at healthcare accessibility, we have decided to examine healthcare quality by utilizing Expected Readmission Ratios (ERR) to estimate the direct health effects of the policy in Arkansas. ERR is a metric developed by the CMS that is often used to assess how well hospitals manage acute conditions and ensure appropriate follow-up care. Although Zuckerman, Sheingold, Orav, Ruhter, and Epstein (2016) does not directly examine insurance loss, their study supports the use of ERR as a valid quality indicator because it demonstrates that policy interventions can have an impact on ERR. While there are few studies that have relied on ERR to examine the effects of Medicaid work requirements, we were able to create a framework for our analysis by utilizing ERR outcomes in Arkansas to offer a new perspective on the medical impacts of this policy. This not only reinforces concerns about coverage loss but also provides more precise insight into how such policy changes may undermine healthcare quality. Since Ohio is proposing the implementation of work requirements, we aim to understand whether such policies are likely to fulfill their intended goals or instead, lead to worse health outcomes for those most in need.

## Data

This analysis uses emergency room Expected Readmission Ratios (ERR) from the publicly available Center for Medicare and Medicaid Services (CMS) database to evaluate the effects of Medicaid coverage loss on healthcare quality. ERR reflects the ratio of predicted to expected readmission rates for medical conditions requiring immediate attention. The CMS uses ERR rates in every state as a performance metric to assess a hospital's ability to treat acute medical conditions, determining that hospital's reimbursement. ERR is particularly sensitive to certain conditions such as heart failure and pneumonia, which are highly inelastic to price changes, unlike elective procedures like joint replacements. ERR tends to increase when a larger proportion of the population lacks insurance, making it a fitting measure of differences in outcomes between insured and uninsured populations (Bailey et al., 2019). While there are some concerns regarding the variability of ERR, these issues are discussed further in the limitations section. The control states, Mississippi, Missouri, and Oklahoma were selected by two criteria: 1. A control state must be similar to the treated state in terms of its population's healthcare consumption patterns. 2. A control state should not have a partial intervention of the same type as the treated state. Partial intervention states like Georgia are particularly poor candidates for control states because they would confound estimates of the treatment effect and bias it towards zero.

Our final data set, derived from the raw CMS data set, consists of 6,632 observations distributed across 280 hospitals and three of the six ERR conditions. We are using a selected set of ERR conditions for each hospital in the treatment state and in the control states. We excluded three conditions: Hip and Knee Replacement (THA), Chronic Obstructive Pulmonary Disease (COPD), and Coronary Artery Bypass Graft (CAPG) because they were not consistently present in the pretreatment years. We used the following conditions: Heart Failure (HF), Pneumonia, and Acute Myocardial Infarction (AMI). Each observation is at the hospital-condition level. The sample is also restricted between the years 2014 to 2024, giving us four years before the policy implementation to support a robust testing of the parallel trends assumption, and four years after to evaluate both immediate and longer-term effects. The year 2023 was excluded because it did not report Pneumonia.

## Methodology

To estimate the impact of the policy on Arkansas ERR rates, we chose to employ a few variations on the difference-in-differences (DiD) framework. This allows us to assess whether a treatment effect exists, when it emerges, and evaluate the parallel trends assumption. The DiD framework assumes that in the absence of the treatment, treated and controlled hospitals within states should experience parallel trends in ERR outcomes. We can test this by evaluating the magnitude and significance of the difference between Arkansas and control before treatment.

We based our analysis on the generic DiD framework, using a regression model to estimate the effects of the average treatment effect on ERR. The canonical DiD regression is given by the equation:

$$Y_{it} = \beta_0 + \beta_1 \cdot \text{Post}_t + \beta_2 \cdot \text{Treatment}_i + \beta_3 \cdot (\text{Post}_t \times \text{Treatment}_i) + \varepsilon_{it}$$

We modified the basic specification to include year indicators, interactions between treatment status and each year, and condition-fixed effects. This specification is given by the following equation:

$$\text{Outcome}_{itc} = \beta_0 + \sum_{t \neq 2017} \beta_t \text{Year}_{t,it} + \gamma \text{Intervention}_i + \sum_{t \neq 2017} \delta_t (\text{Year}_{t,it} \times \text{Intervention}_i) + \sum_c \theta_c \text{Cond}_c + \varepsilon_{itc}$$

Where:

- $\text{Outcome}_{itc}$ : the ERR for hospital  $i$ , in year  $t$ , for condition  $c$ .
- $\text{Intervention}_i$ : a dummy equal to 1 if hospital  $i$  is in Arkansas.
- $\text{Year}_{t,it}$ : a set of dummies for each year from 2014 to 2024

- $\text{Year}_{t,it} \times \text{Intervention}_i$ : the DiD interaction terms for each year  $k$ .
- $\delta_k$ : the dynamic treatment effect over time (main coefficient of interest).
- $\text{Cond}_c$ : the dummy for diagnostic condition (AMI, HF, or PN).
- $\varepsilon_{itc}$ : clustered error term at the hospital level (PROV).

Several key treatment-related variables were generated. *Intervention* (1 if ARK, 0 otherwise) indicates the policy receiving group (ARK). *Post* (1 for years  $\geq 2017$  and 0 otherwise) denotes the pre and post-treatment periods that represent the implementation of the 2018 policy. *rel\_year\_shifted* indicates all years with respect to their distance from the baseline year 2017 so that the first year 2014 corresponds with one and the baseline year corresponds with five. *Cond\_id* is a cleaned and standardized representation of the three selected ERR conditions, which is used as a categorical variable to generate the dummy variables. All standard errors are clustered at the hospital level to account for repeated observations of the same provider (hospital) over time. A year control variable like *i.year* was not used because the *ib2017year* variable already controls for year effects. We also conducted a robustness check by modifying the first specification to group the pre and post-years together to estimate the aggregated effects on the years before and after the policy implementation.

## Results

We used the regression specification given above to estimate the impacts of the Arkansas policy implementation on ERR outcomes. We had two goals in mind for this analysis: first, to validate the parallel trends assumption; second, to determine the magnitude and significance of the post-treatment effects of the intervention policy on Arkansas. The results from this regression are displayed in Figure 1 and Table 1 below.

The joint F-test for significance across all 21 interaction terms yields  $(21, 289) = 1.55$  with a p-value of  $(p = 0.0598)$ . This indicates a marginal joint significance at the 10% level, suggesting that the treatment had a potentially nonrandom effect on ERR outcomes. However, the low R-squared (0.0139) and adjusted R-squared (0.0108) indicate that the explained variance in ERR is limited.

To test the parallel trends assumption, we look at the pre-treatment coefficients (years 2014 through 2017). These interactions range from -0.0074 to 0.0008 and are statistically insignificant ( $p = 0.529$  to  $0.883$ ), indicating no relevant difference between Arkansas and the control states before the 2018 intervention, confirming the parallel trends assumption. Additionally, we visually confirmed this result by observing Figure 1. This supports the validity of the DiD strategy to test our hypothesis.

The coefficients of the post-treatment interaction terms (years 2018-2024) are consistently negative after the policy, indicating that the ERR outcomes consistently decreased relative to the control states. The largest effects occur in 2022 (-0.0155,  $p=0.137$ ) and 2024 (-0.0143,  $p=0.12$ ). However, none of these coefficients are statistically significant as their p-values exceed the predetermined 0.05 alpha level. We confirmed these results with a robustness check using a grouped-year regression where all pre and post-years were collapsed into one binary indicator, see table 2. This supports the parallel trends assumption by showing that the interaction term for the pre-policy period was small (-0.0017) and insignificant ( $p=0.456$ ). We also confirmed that the post-intervention coefficient was small (0.0049) and insignificant ( $p=0.528$ ). Both analyses show that the drop in the post-treatment year of the treated group is small, negative, insignificant, and imprecise.

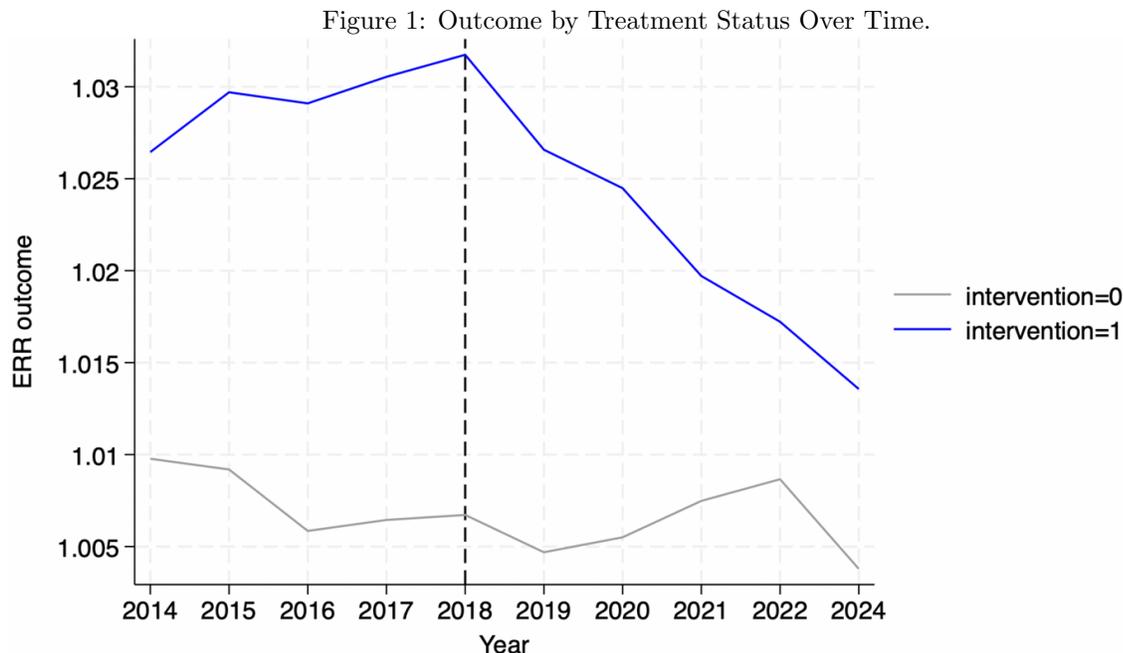


Figure 21

displays predicted ERR in Arkansas vs. control states (MO, OK, MS) from 2014–2024.

Table 1: Event Study Regression Results (Excluding t-values)

Outcome	Coefficient	Std. Err.	P >  t
<b>year</b>			
2014	0.0033275	0.0042993	0.440
2015	0.0027443	0.0038018	0.471
2016	-0.0005981	0.0024771	0.809
2018	0.0002726	0.0025209	0.914
2019	-0.0017578	0.0026941	0.515
2020	-0.0009446	0.0030405	0.756
2021	0.0010364	0.0031083	0.739
2022	0.0022149	0.0029928	0.460
2024	-0.0026578	0.0032799	0.418
<b>intervention</b>			
1	0.0240932	0.0091345	0.009
<b>year x intervention</b>			
2014	-0.0074185	0.0114768	0.519
2015	-0.0035844	0.0104676	0.732
2016	-0.0008461	0.00573	0.883
2018	0.0009251	0.0053246	0.862
2019	-0.0022048	0.007542	0.770
2020	-0.0051107	0.0088851	0.566
2021	-0.0118655	0.0099435	0.234
2022	-0.0155323	0.0104159	0.137
2024	-0.0143167	0.009109	0.120
<b>condition</b>			
HF	0.0050948	0.0028262	0.072
PN	0.0013424	0.0028004	0.632
<b>_cons</b>	1.004178	0.0033659	0.000

Table 2 displays regression output for our DiD models.

Table 2: Grouped-Year Regression Results

Variable	Coefficient	Std. Err.	P >  t
<b>post</b>			
1	-0.0016972	0.0022758	0.456
<b>intervention</b>			
1	0.0210892	0.0086651	0.016
<b>post x intervention</b>			
1 1	-0.0049823	0.0078931	0.528
<b>condition</b>			
HF	0.0050614	0.0028027	0.072
PN	0.0012921	0.0027927	0.644
<b>_cons</b>	1.005588	0.0036617	0.000

## Conclusion

Based on our theoretical expectations, we hypothesized that the ERR for Arkansas would increase after the implementation of the work requirements policy. However, our difference in differences (DiD) analysis found that Arkansas' ERR consistently decreased relative to the control states. While these findings were small and statistically insignificant, they still suggest an

effect opposite to our expectations. Therefore, we fail to reject the null hypothesis that the Arkansas implementation of Medicaid work requirements has a negative or neutral impact on expected readmission ratio (ERR) outcomes.

A possible explanation for our results is that the implementation period of the policy (2018-2019) was too short for a trend to emerge. Another possibility is that the effects of the COVID-19 pandemic, which emerged in 2019, positively influenced the ERR data, confounding our results. This “COVID effect” is also exacerbated by the small size of the impacted group, 18,000 individuals lost Medicaid coverage (Skinner, 2024). This is relatively small compared to the 1.2 million individuals estimated to be on Medicaid in Arkansas.

The short duration of the policy implementation, between 2018 and 2019, likely limited our ability to detect a significant effect in ERR. Additionally, the onset of the COVID-19 pandemic introduced potential confounding factors, particularly for delayed effects after 2019. Finally, due to the statistical insignificance and small magnitude of the observed effects, it remains unclear whether the slight decrease in Arkansas ERR reflects an improvement, a deterioration in Medicaid coverage, or simply random variation.

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# The Effects of Telehealth Utilization by Demographics of Medicaid Beneficiaries in the Mid-West

Athena Mandal, Allison Su, Naomi Moneme

The COVID-19 pandemic catalyzed the rise of a new domain of healthcare service—telehealth—particularly for individuals with limited access to in-person medical services. A growing proportion of patients have turned to telehealth services for chronic disease management and acute health concerns, highlighting new potentials for expanding virtual care beyond its traditional assistance with behavioural and mental health. Although expansion of telehealth in recent years continues to show potential in bridging equity gaps, systemic disparities remain across different groups. This study examines telehealth usage among Medicaid beneficiaries in Ohio, Indiana and Michigan during 2020-24 with a focus on sex and race. On modelling the relations between these demographic factors as a function of time, we found a consistent trend that women were the primary users of telehealth across all three states. Racial demographic analysis revealed that Black and African American Medicaid beneficiaries were the dominant user group, with notable utilization rates also observed among American Indians. Notably, racial trends across the three states are not as consistent as the results obtained from the gender demographics. Through this analysis of demographics, we hope to facilitate a better understanding of how telehealth is impacting different demographics, highlighting patterns that can help improve the accessibility and effectiveness of telehealth for underserved populations.

## Introduction

Telehealth is a transformative approach to healthcare that utilizes technology to receive medical care remotely and increases overall health literacy (Corbett, 2020). As of 2024, at least 51.5 percent of patients have had at least one telehealth visit, which is higher than the amount of times that they would be able to see a physician without access to telehealth (Cao, 2024). Telehealth helps eliminate the barriers associated with in-person healthcare and enables underserved populations to access healthcare. The National Institute of Health (NIH), research shows that telehealth approval rates among users range from 93 percent to 94 percent. Post-Pandemic Telehealth has more potential to service and expand its capabilities into different sectors such as women’s health, acute care, and chronic care management. With continued advancements in technology and increased acceptance among patients and providers, telehealth has the potential to become a cornerstone of healthcare delivery, improving health outcomes across diverse populations and reducing disparities.

## Literature Review

There is a vast amount of literature that illustrates the effectiveness of telehealth broken down by demographics. According to the Centers for Disease Control (CDC), health outcomes are differentiated by respective demographic factors and disparities are still evident in the quality of care. Access to options like telehealth is more difficult in rural areas, especially for people of color (POC). Access to digital devices and the internet are crucial for accessing telehealth services. Black patients are less likely to be seen by a specialist and receive appropriate care. According to Spatial Risk Systems, 16 percent of black households do not have access to any type of device while 23 percent do not have access to the internet. This, coupled with the fact that those with low English proficiency are less likely to use telehealth, contributes to the existing disparities. However, the most significant driver when it comes to disparities in the usage of telemedicine comes down to the geographic area that they live in. Urban areas are more likely to have a high concentration of POC so these reports where there are large urban areas will report POC are utilizing telehealth. While, POC in states that are more rural are less likely to report high telehealth usage (Park, 2023). This means that for racial groups we may not see a clear indicator of which racial group is utilizing telemedicine. The usage of telehealth is rather weighed more heavily on how large their urban area is and the geographical concentration of their racial groups. Telehealth right now is better at serving women in the virtual care space, showing that women are about 60 percent likely to use telehealth at least once (Hayhurst, 2022). Female physicians are more likely to provide telehealth services by 2022, 66 percent of female physicians said that they had at least one telehealth appointment (Hayhurst, 2022). This may be due to the fact that female physicians are seen as more “accommodating” to their patients compared to male physicians (Hayhurst, 2022). This can also be attributed to the growth of telehealth utilization in maternal health services. A study done in Cleveland (OH) found that 90 percent of women had access to telehealth during their pregnancy and 53 percent of that same group indicated satisfaction with the service (Craighead, 2022). Hence, for our study, we expect women to be accessing telehealth more frequently than their male counterparts across the three states. Overall, our research hopes to identify and draw correlations for demographic groups benefitted from the expansion of telehealth in the Midwest, aiming to highlight how the benefits of virtual care can be maximized.

## Data and Methods

We utilized R to visualize the effects of telehealth expansion and utilization rates among Medicaid Beneficiaries in Ohio, Michigan and Indiana. All data is obtained from Centers for Medicare and Medicaid Services (CMS). The dataset pertaining to this project is available for public use and provides demographic details on Medicaid and Medicare beneficiaries across the 50 states using telehealth during 2020-24. To understand the impact of telehealth across various demographics dimensions, we examined telehealth usage trends by sex and race in three geographically adjacent states in the Midwest—Ohio, Michigan and Indiana. We generated line plots to observe changes in utilization patterns across the demographic groups and identify potential disparities. To account for differences in population sizes across demographic groups, the data points were expressed as the proportion of Medicaid beneficiaries who used telehealth services, divided by the total number of individuals in the respective demographic group within the state. This research aims to provide a data-driven understanding of how telehealth adoption has affected an underserved population of users eligible for Medicaid, thus offering insights into the long-term potential of telehealth in managing public health.

## Results

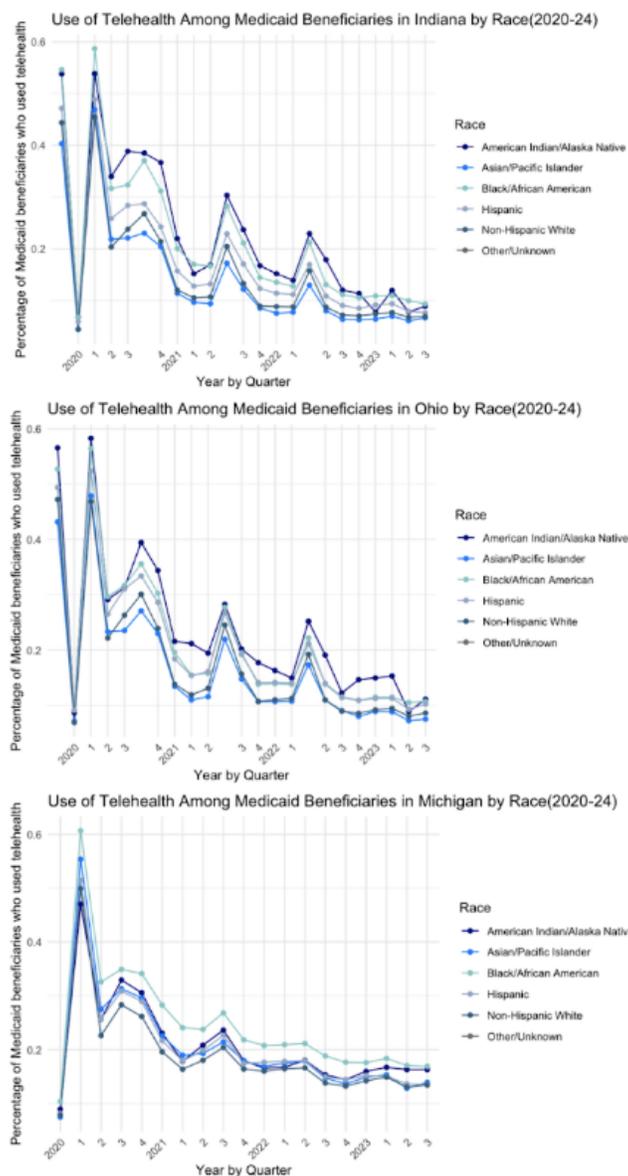


Figure 1: Use of Telehealth Services among Medicaid Beneficiaries in Indiana (top), Ohio (middle) and Michigan (bottom) by racial groups during 2022-24.

Figure 1 illustrates the distribution of Medicaid beneficiaries utilizing telehealth services, segmented by racial groups. There was close competition between Black/African Americans and American Indian/Alaskan Native populations, with both racial groups showing significant usage rates in Indiana and Ohio. Although Black and African Americans formed the largest user group in Michigan, telehealth was more popular among Asians and Pacific Islanders in Michigan than it was in Ohio and Indiana for the same group.

All racial groups exhibit similar sharp declines in telehealth utilization after 2021, reflecting a decrease in the market demand for telehealth services as the impact of the COVID-19 pandemic diminished. Despite this, Black and African American populations continued to peak at significantly higher proportions even when other racial groups were on the decline. In Ohio, American Indians and Alaskan Natives showed usage rates comparable to Black/African Americans, occasionally surpassing by unremarkable proportions. Despite the ambiguous racial trends, Blacks and African Americans were deemed to be the largest user group given their higher frequency of telehealth visits even when the effects of Covid-19 pandemic diminished.

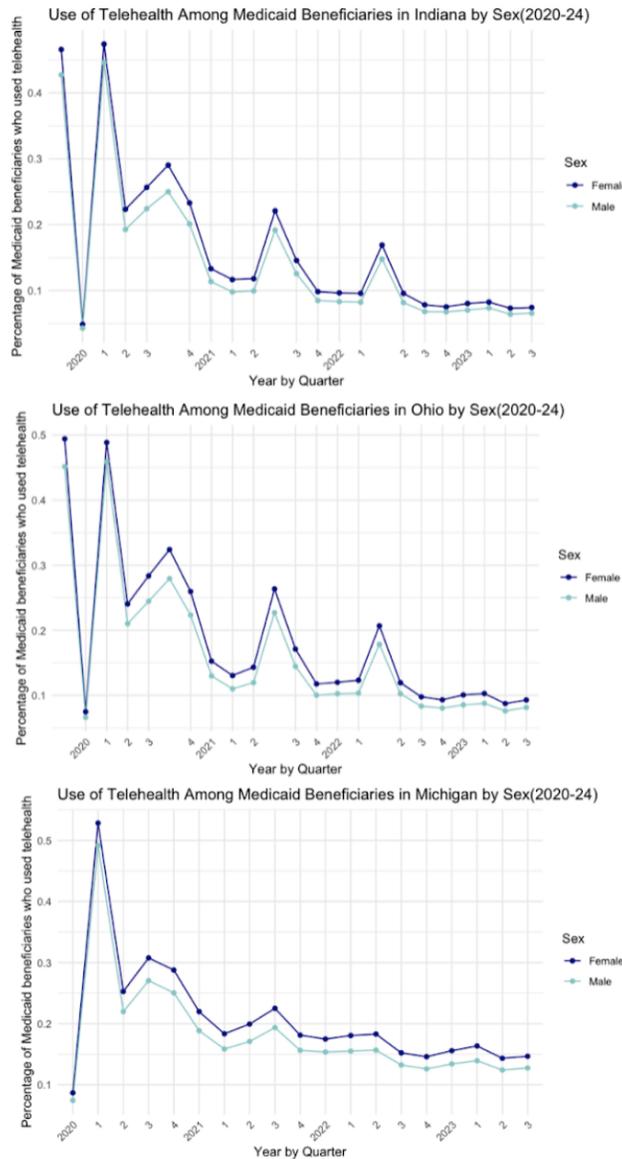


Figure 2: Use of Telehealth Services among Medicaid Beneficiaries in Indiana (top), Ohio (middle) and Michigan (bottom) by sex during 2022-24.

Figure 2 illustrates the usage of telehealth services among males and females eligible for Medicaid benefits in Indiana, Ohio, and Michigan during 2020-24. Notably, women have always averaged above their male counterparts in terms of telehealth usage, despite an overall decline in the popularity of telehealth services similar to what was seen in Figure 1.

An interesting point to note is that all visualizations pertaining to the racial and gender groups show synchronized peaks and troughs in telehealth usage, indicating that external systemic factors relating to the Covid-19 pandemic waves influenced telehealth usage. This helps explain the demand shocks observed in our study.

## Conclusion

The results from the analysis of telehealth utilization among Medicaid beneficiaries in the Midwest (2020-24) demonstrate an interaction of socioeconomic factors and policies pertaining to COVID-19. Contrary to the hypothesis that Black and African Americans are less likely to use telehealth given lack of access to internet and digital devices, they emerged as the dominant user of telehealth. Given the economic vulnerability of the group, the marginal utility associated with telehealth visits is high. Telehealth helps adjust for the barriers associated with in-person visits through lower opportunity costs in terms of time, money and efforts. Our study demonstrates that alongside Blacks/African Americans, American Indians and Native Alaskans show high telehealth usage. This proves that telehealth was substantially more beneficial for traditionally underserved racial groups by helping overcome supply-side constraints and providing them with alternative options for regulating their health.

The role of telehealth in reducing transaction costs and opportunity costs is most evident amongst women. This disparity may be attributed to women's disproportionate burden of childcare duties, which could restrict the time they have to engage in specialty telemedicine care. Possibly due to their roles as caregivers, women are more likely to view virtual care as an increasingly convenient option.

Overall, our study shows that telehealth was specifically beneficial for traditionally marginalized groups—women and socioeconomically disadvantaged racial groups. However, the decline of usage shows that these gains were not sustainable, inducing the need for incentives to encourage permanent usage of telehealth. By harnessing the potential of telehealth services through a long-term solution, healthcare delivery can be significantly improved in marginalized populations.

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# Constructing a Hospital Quality Index

Sidharth Jindal, Fiona Arado, Manav Bhandary, Marissa Dewey

In this article we provide a theoretical framework for constructing a hospital quality index. We provide a comprehensive literature review outlining the different aspects of a hospital's 'quality'. We then propose using Principal Component Analysis to uncover the underlying latent distribution of these indices.

## Introduction

Hospital quality varies greatly across regions, prompting efforts to measure and compare performance using standardized metrics. Several countries have established quantitative frameworks to determine whether hospitals are up to acceptable standards, incorporating measures such as healthcare expenditure, surgical mortality rates, general capacity, and patient outcomes. Ideally, such indices should prioritize patient outcomes over hospital inputs like staffing and equipment. In this paper, we propose constructing an index of Ohio and the broader Midwest region by integrating multiple indicators to provide the most comprehensive index possible with the available data. Developing such an index is essential for policymakers seeking to identify and understand the qualities that improve hospital performance. A well-designed index can reveal disparities across regions, highlight the best practices, and inform targeted interventions aimed at improving patient care. Systemically comparing crucial performance indicators such as mortality rates and patient satisfaction can allow policymakers to make data-driven decisions that improve the efficiency and overall quality of healthcare delivery.

## Literature Review

Several measures of hospital quality and different indicators and methodology approaches have been proposed. The first, "A New Approach for Constructing a Health Care Index including the Subjective Level," argues for the combination of both macro and micro level data. Jaworek (2022), highlights how current healthcare indices operate on a macro scale, failing to take into account any tangible benefits provided for citizens.

To address this limitation, Jaworek incorporates surveys and self-reported data for health-care recipients as a subjective-level indicator. The surveys focus on two main sections: a self-assessment of health and an assessment of confidence in their healthcare system. Responses are recorded on scales, with the self-assessment's levels being [excellent, very good, good, fair, poor, can't choose], and the confidence level being (none, very little, some, a great deal, complete confidence). Additional demographic information is also noted, such as education, sex, age, and sport (activity level). Jaworek then pairs this individual-level, subjective data with macro-level indicators, specifically expenditure on the government, households, and private insurance companies, among other spenders. The macro expenditure indicators are weighted according to subjective relevance and then assessed.

The indicators in this index have some relative strengths and weaknesses in applicability. The survey can be used as a patient satisfaction indicator, which would be good because it can show how hospital-goers assess their experience. Additionally, since the satisfaction survey is paired with a self-reported health survey, we can see if there is a correlation between increased health and patient satisfaction, which could help to validate the indicator. Using expenditure as an indicator is more difficult, since there is not always a correlation between spending more money and having better results. This does not necessarily preclude its use, but is certainly something to be wary of when constructing our index.

Another factor of hospital quality to consider is accessibility. In healthcare, accessibility refers to how easily healthcare services can be used from a given location. Accessibility is broken into two pieces – spatial factors, which is determined by an individual's physical location, and nonspatial factors, which is determined by demographic factors. Blanco et al.'s "Measuring Access to Health Services: Constructing a Multidimensional Index" discusses and synthesizes measures for both of these factors.

For measuring spatial access indicators, two models in literature are discussed – a gravity-based model and a two-step floating catchment area (2SFCA) model. The gravity-based model depicts supply-demand interactions (i.e. healthcare providers and the population) in different areas. In the construction of the location indicator, the model takes in parameters of population, capacity of the healthcare provider, travel distance, travel friction, the number of locations, and the number of physicians. The 2SFCA method calculates the accessibility at a location  $i$  by summing over all physician locations within a threshold travel time and calculating a physician-to-population ratio within this catchment area. The location indicator would be good to incorporate into the spatial access indicator because of its ability to take into account multiple different factors of a location's accessibility. As long as a reasonable and accurate catchment area—how wide the location indicator spans—is established, this could be a good indicator within our attempts to capture a hospital's accessibility.

Non-spatial factors—such as racial demographic and socioeconomic status—are also important, as they can affect how accessible healthcare is to a certain group of people. It is often very difficult to synthesize this into an index because there are so many variables that fall under this category (e.g. age, number of children, income, homeownership). However, certain methods can simplify this problem, such as principal component analysis (PCA), which is discussed further in this paper. Factoring both these spatial and non-spatial aspects will be important in ensuring that the indicator accurately encompasses

the degree to which hospitals are accessible to a large variety of people, and should aid in the external validity of this index's procedure.

An additional hospital quality index—from AHQR Quality Indicators—we reviewed focused on indicators related to the quality of inpatient hospital care, a medical treatment that requires a patient to stay in the hospital for at least one night. The Inpatient Quality Indicators track hospital performance over time by summarizing multiple indicators to help detect differences in healthcare quality and improve healthcare decisions. These measures are helpful because they can be utilized by consumers who want to select higher quality hospitals, hospitals that want to improve the quality, and policymakers who want to know which areas to prioritize. The two main composite measures are the Inpatient Quality Indicators (IQI) 90 (measures mortality rates for selected inpatient procedures) and the IQI 91 (measures mortality rates for selected inpatient conditions). The composites combine individual mortality indicators into a weighted average, which involves calculating the risk-adjusted rate, the reliability-adjusted ratio, and applying the component weights. The weights are distributed based on how common the procedure or condition is. The biggest strength of this index is that it offers a broad assessment of hospital performance by combining multiple indicators, making it easier to compare hospitals and trends over time. Furthermore, the usage of risk-adjusted rates makes the results more statistically sound because it does not unfairly penalize hospitals that treat sicker patients. Some of its setbacks are that important details could be missed out on because the index aggregates multiple composite scores. Additionally, although hospitals can view their composite score, the measures do not provide guidance on how to improve in specific problem areas, making it difficult to take direct action.

The final relevant index focuses on hospital death rates adjusted for severity. In “A Proposed Hospital Care Index,” Roemer et al. (1968) found the crude death rate—the most commonly used indicator at the time—was not the best indicator of a hospital's quality, due to an uneven distribution of the severity of cases. Using data from a selection of southern Californian hospital's Annual Reports and death certificates, the authors created a new index that took the crude death rate of each hospital and controlled for a variety of factors to get an indicator of overall hospital quality.

The ideal measure would be case severity, but that is difficult to measure, so proxies are used. The study looked at age of death and socio-economic status (SES) by way of the proportion of non-white patients, and types of cases, specifically cancer and accidents. The occupancy-corrected length of stay would be a good comprehensive indicator, but could be difficult to apply broadly to our index because it requires data on the number of beds and length of stay. Also taken into account was the technological advancement of the hospitals, which was comprised of a simple weighting of different components of technical adequacy. Higher rates of technological advancement are correlated with, and were found to be the best single indicator of, higher crude death rates. The authors do a series of regressions to come up with an index, but acknowledge that it does not have a very high external validity.

One of the most obvious issues is their quantification of socio-economic status. As previously mentioned, they simply used the status of being non-white as an indicator of lower socio-economic status, which is problematic for our index. We would instead take into account household income (as applicable), race, gender, and other simple indicators as a means of correction for socio-economic status. Some of the regressions and the equations were oversimplified due to a lack of easily accessible data, but we can certainly incorporate some aspects of this proposed index into our construction.

## Methodology

In literature review, we outlined several indicators that are related to a hospital's ‘quality’. Our goal is to create an index of quality to serve as a comparison between hospitals, so we require a method for synthesizing the several factors of consideration into a single number. This index should maximize the variance between different hospitals and use indicators such as average length of stay, post-operative complications, and patient satisfaction. Principal Component Analysis (PCA) helps identify which factors contribute most to differences across institutions. In this section we will first provide a theoretical overview of PCA, and then explain its application in the context of constructing our Hospital Quality Index.

Principal component analysis is a feature-dimensionality reduction technique that aims to explain variance in the data, and we will now briefly illustrate how this is computed. Suppose we have  $n$  indicators of interest and  $m$  hospitals. We can represent this information in a  $n \times m$  matrix,  $\mathbf{X}$ . The first step in calculating the PCA is normalizing  $\mathbf{X}$  by centering each indicator about its mean and dividing by its standard error, yielding  $\tilde{\mathbf{X}}$ . This makes it possible to compare variances between indicators with different units, such as length of patient stay and inpatient quality. We then compute the covariance matrix of  $\tilde{\mathbf{X}}$ , which is  $\mathbf{R} = \tilde{\mathbf{X}}\tilde{\mathbf{X}}^T$ , which is an  $n \times n$  matrix. This prepares us to determine which directions have the most variance. So, we compute the singular value decomposition (SVD) of  $\mathbf{R}$ , which is  $\mathbf{R} = \mathbf{U}\mathbf{\Lambda}\mathbf{U}^T$ , where  $\mathbf{\Lambda}$  is a diagonal matrix with diagonal entries  $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_n \geq 0$ . The first  $k \leq n$  of these will be nonzero, so we have  $\lambda_1 \geq \dots \geq \lambda_k > 0$ . These values are the eigenvalues of the covariance matrix, with corresponding eigenvectors  $\mathbf{e}_1, \dots, \mathbf{e}_k$ . These eigenvectors are the principal components of  $\mathbf{X}$ , and the size of their eigenvalue indicates how much variance that principal direction exhibits. For a visualization of how the data has been transformed through this process, see Figure 1. We now must decide how many principal directions to keep. A common rule of thumb is to choose the number of principal components,  $n_{PC}$ , that explain 95% of the variance. That is, since the explained variance of principal component  $i$  is  $\lambda_i / \sum_{j=1}^n \lambda_j$ , we choose the smallest  $n_{PC}$  such that

$$0.95 \leq \frac{\sum_{j=1}^{n_{PC}} \lambda_j}{\sum_{j=1}^n \lambda_j}.$$

With this theoretical framework in mind, we now interpret PCA in our context – constructing a hospital quality index. We discussed the indicators of interest in the literature review section, and will gather data from the Cleveland Clinic Foundation,

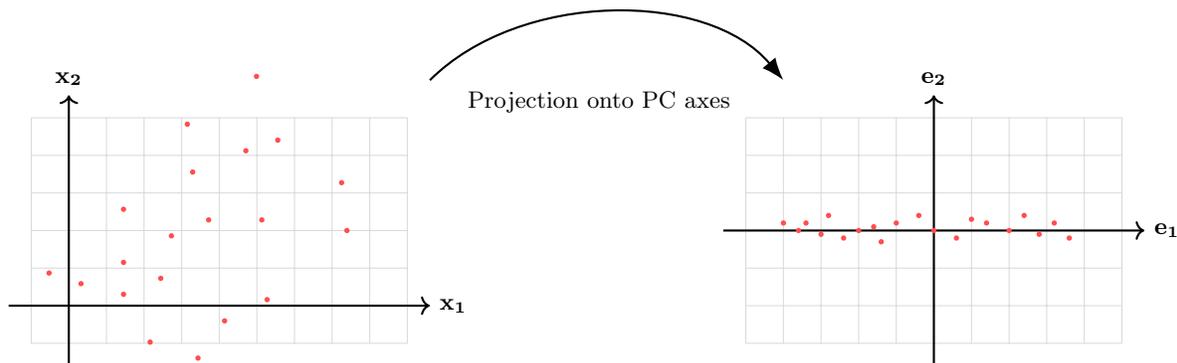


Figure 1: Visualization of PCA.

University Hospitals, and MetroHealth. To evaluate average length of stay and post-operative complications, we plan to select a standard set of surgical procedures performed at every hospital. This ensures the indicators are not sensitive to differences in surgery complexity, expertise and, to some degree, controls for case severity. With this data, we compute the PCA and choose the first  $n_{PC}$  principal components that explain 95% of the observed variance. This gives us a vector of indices, but we desire a single number for our index. So, the final step in this process is choosing weights on each of these principal components to output a single number. These weights are determined base on our sample, and are part of the next steps of this project.

## Next Steps

This semester we focused on developing a theoretical framework for creating a hospital quality index. In the future, we hope to implement this index in the context of several Cleveland hospitals. In particular, we plan on gathering data from the Cleveland Clinic Foundation, University Hospitals, and MetroHealth and using our index to compare these. The data we collect will be vital in determining the weights on each of the principal components.

## Conclusion

Constructing a thorough hospital quality index for Ohio and the Midwest is a necessary step toward improving healthcare outcomes and policy decisions. By implementing objective performance metrics such as length of stay, post-operative complications, and patient satisfaction with broader measures of accessibility and resource capacity, this index can provide a comprehensive view of hospital performance across different populations. Our proposed methodology, which combines established statistical techniques like Principal Component Analysis with data from a range of hospital systems and public databases, aims to capture the most meaningful variation in healthcare quality. Ultimately, this work will provide policymakers, healthcare providers, and patients with a powerful tool to identify disparities, benchmark performance, and drive data-informed improvements in hospital care across the region.

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# Regional Analysis

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# EdChoice Impact: Academic Performance Shifts

Eve Butovska

Ohio's EdChoice Program provides scholarships for families to enroll their children in private schools. One of the ways to qualify is to be assigned to a public school on the designated schools list—identified annually based on performance and Title I status, which reflects the share of low-income students. The schools eligible in 2025–2026 differ from those in 2024–2025. This article analyzes the academic performance improvements that EdChoice provides to the schools in Ohio, using schools who remained on the designated list over both years. It compares their achievement changes with the schools that were not consistently on the list. The goal of this article is to determine whether the EdChoice meets one of its intended objectives: improving academic performance in struggling schools.

## Introduction

This paper investigates the educational consequences for schools on Ohio's EdChoice designated list. Using every school in Ohio that has been consistently reporting their Performance Index Scores (PIS) over the 2021–2024 school years, we analyze the improvement in PIS for each school, dividing them into two categories: schools that have been on the EdChoice designated list for both 2024–2025 and 2025–2026, consistently scoring lower 20% academically, and those that have been on the list for only one year or never.

The EdChoice list designation is highly based on Performance Index Scores, so this article seeks to understand the trends in those scores during and before the designation years. Although the program's list of schools is updated annually based on recent performance, I assume some consistency in the composition of low-performing schools over time. Schools on both the 2024–2025 and 2025–2026 lists are likely to have been eligible in previous years due to persistent underperformance. However, the absence of official historical designation records limits direct confirmation.

## Literature Review

Many research papers feature the EdChoice voucher program. Dufault's study of Catholic school principals found no significant administrative struggles caused by it but highlighted secondary effects like staffing needs. These findings suggest that schools must adapt their operations to meet program demands, even after exiting the designated EdChoice list.

Carr previously found that voucher-based competition under EdChoice marginally improved traditional public school performance. However, results were heterogeneous across schools and often dependent on the scale of voucher uptake. This reinforces the need to explore academic outcomes at the student level and institutional patterns of improvement or stagnation.

Additional literature points to the difficulty of isolating EdChoice effects from broader socioeconomic factors. Urban schools tend to be overrepresented on the EdChoice list and often face more severe resource constraints, suggesting the need for targeted policy solutions beyond simple designation and choice-based mechanisms.

## Methodology

The eligibility of the EdChoice program is based on performance criteria and demographic factors. To appear on the 2024–2025 Designated EdChoice List, a school had to be ranked the lowest 20% in the Performance Index Rankings for the 2022–2023 and 2023–2024 academic years and operated by a school district for which the average percentage of Title 1 formula is 20% or greater in the last three school years. To appear on the 2025–2026 Designated EdChoice list, a school can perform in the lowest 20% in Performance Index Rankings for at least two of the 2021–2022, 2022–2023, and 2023–2024 academic years.

Data for this analysis were collected from EdChoice reports from the Ohio Department of Education and Workforce for the 2024–2025 and 2025–2026 school years and the academic performance of given schools. A limitation of this data set is that Ohio does not require testing score reporting for all schools. As a result, many EdChoice-eligible schools do not report standardized test data. This study includes only schools with consistent test score reporting for four years, which introduces selection bias.

# Results

The data compares the performance of Common Schools, those on Ohio’s EdChoice designated list, and Other Schools that are not on the list. The first two line graphs illustrate trends in Performance Index Score percentiles over four academic years, while the histograms provide an overview of the score distributions for both groups.

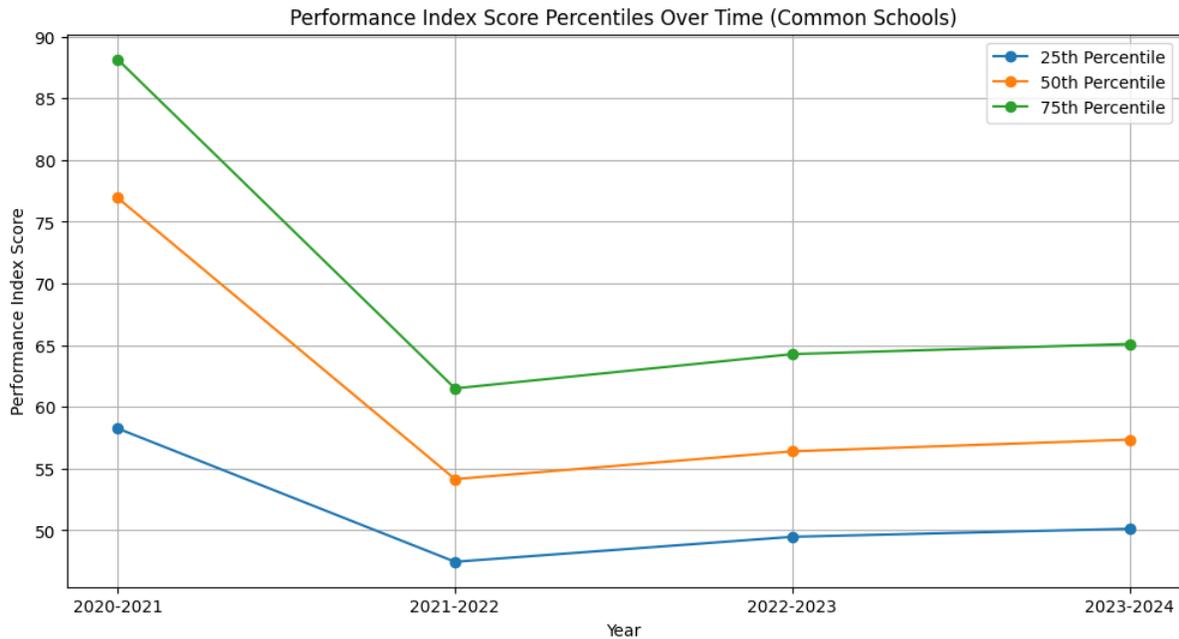


Figure 1: Performance Index Scores in 2020-2024 academic years among EdChoice schools.

In the case of EdChoice schools, the 75th percentile experienced a sharp decline from 2020-2021 to 2021-2022, dropping from 90 to 60, followed by a slow but steady recovery over the subsequent years. A similar pattern is evident for the 50th percentile, which fell from 75 to approximately 55 during the same period and then gradually improved. This trend highlights a systemic challenge for these schools, as even their highest-performing students have faced significant setbacks, and the recovery has been slow.

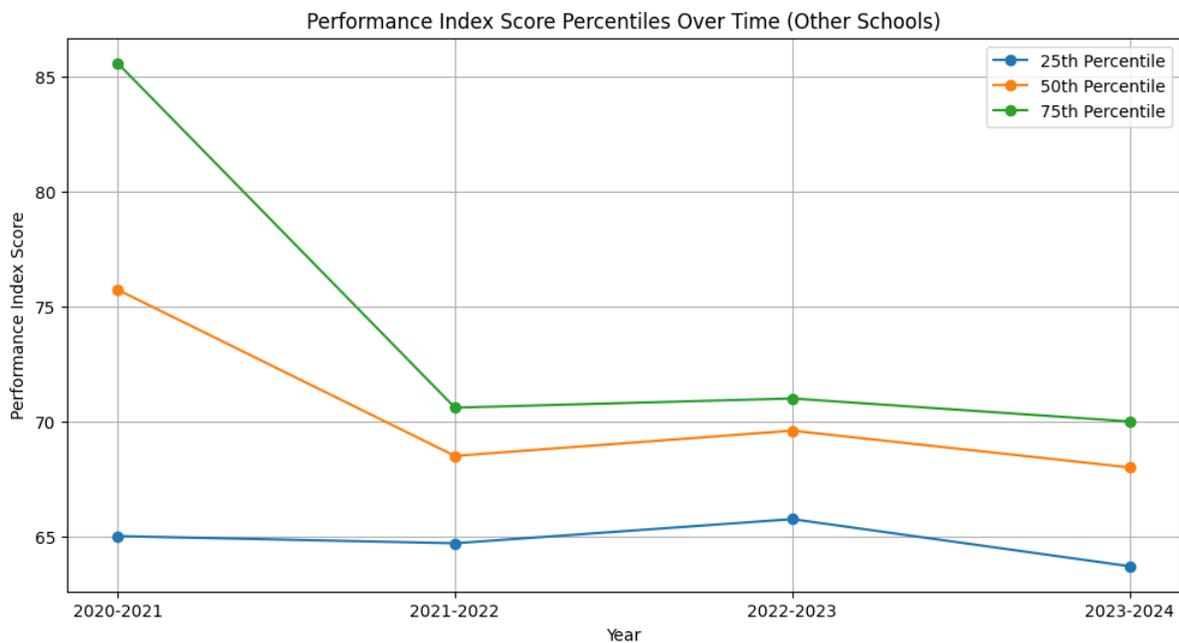


Figure 2: Performance Index Scores in 2020-2024 academic years among non-EdChoice schools.

In contrast, non-EdChoice showed a different pattern. While the performance also dropped sharply between 2020-2021 and 2021-2022, the subsequent years did not show a recovery. Instead, the performance plateaued before declining slightly by 2023-2024. The 25th percentile for Other Schools demonstrated a modest decline over the four years, with no signs of recovery, reflecting stagnation among lower-performing students.

The histograms reinforce the performance gap between the two groups.

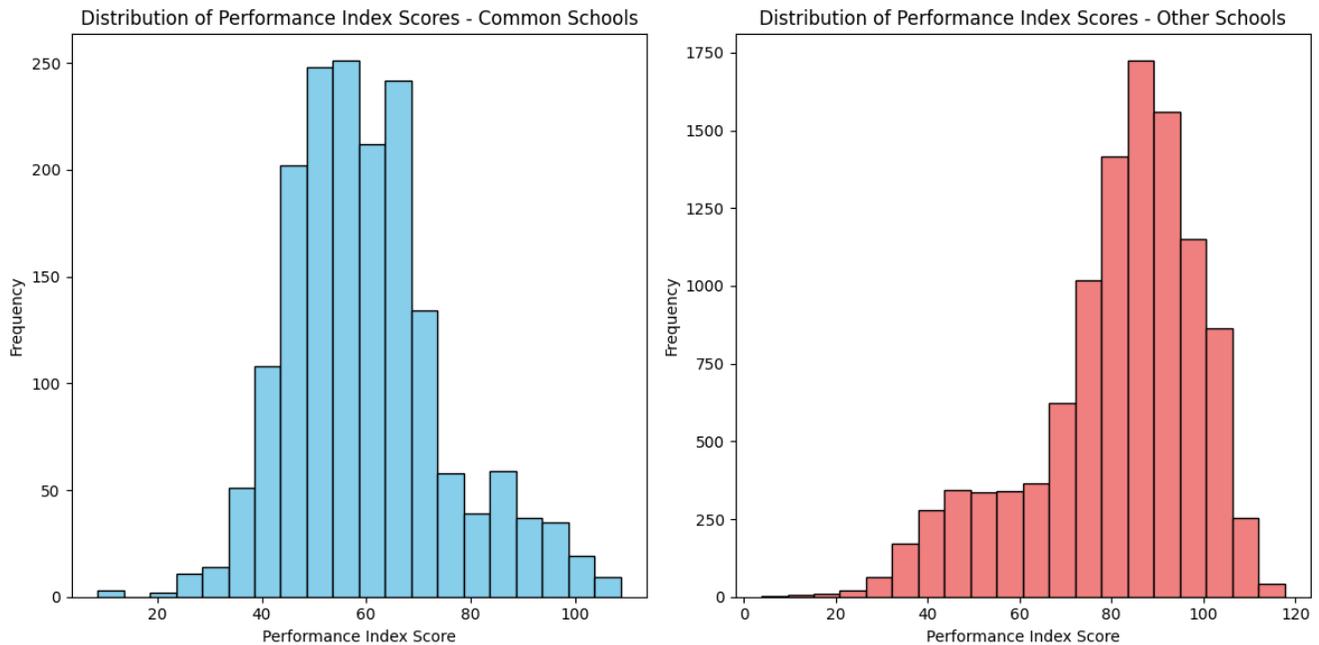


Figure 3: Performance Index Scores distributions.

The distribution of scores for EdChoice schools is roughly normal, with most scores concentrated in the 50–70 range. The tails suggest fewer outliers, indicating a narrow performance range. In contrast, the distribution for non-EdChoice schools is slightly skewed to the left, with a peak in the 70–90 range. This distribution highlights a higher average performance for schools not on the designated list.

## Conclusion

These findings reveal a clear disparity between the two groups. EdChoice schools consistently underperform compared to their counterparts. The underperformance is most pronounced at the higher percentiles, where the gap is stark, but it is evident across all levels. While they have shown some signs of recovery after a significant decline in 2021-2022, their progress has been slow and insufficient to close the gap with the other schools that have demonstrated greater stability and higher overall performance.

Several probable causes can be inferred from this pattern. EdChoice schools may face deep-rooted challenges such as high student mobility or external socioeconomic pressures that are not adequately addressed by this model. Additionally, the potential loss of students through the voucher program may cause difficulties for these public schools. Without structural support and targeted interventions beyond the designation, these schools may struggle to reverse negative trends, suggesting the need for more holistic policy responses.

Another consideration is that schools remaining on the EdChoice list may experience a concentration of high-need students, which can intensify academic challenges while straining existing resources. Moreover, the EdChoice designation may unintentionally stigmatize schools, affecting staff morale and parent perceptions, which compounds retention and performance challenges.

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# Does Supply and Demand still Hold in Ohio's Housing Market?

Eamon Lee

## Introduction

Ohio's housing market is among the most affordable in the country, with prices trailing those in many other states. Within the state, though, there exist significant discrepancies in housing affordability at the county level. These local differences became even more pronounced during the pandemic, as house prices soared to unprecedented levels. While assessing the root causes behind the crisis, I explore both from the buyers' and sellers' perspective by exploring the dynamics between supply and demand within the housing market.

## Data and Findings

Typically, metropolitan areas are thought to have higher housing prices than the state average, leading to the assumption of an urban-rural divide in housing prices and affordability. In Ohio, however, this disparity is not as obvious.

Figure 1 shows the current housing affordability situation in Ohio based on the housing affordability index created utilizing 2023 data from the American Community Survey (ACS). The index is created by dividing the median home prices by the median household income; a higher value means less affordable, vice versa.

Franklin County stands out on the map, shaded bright yellow near the center of Ohio. Home to Columbus—the state's most populated city—it has a housing affordability index of 3.6. This means that a median-priced home costs 3.6 times the median household income. If an average household saves 20% of its annual income, it will require 18 years to purchase a house outright in Franklin County without considering inflation and other factors. Yet, apart from Franklin County, it remains challenging to locate the other major metropolitan areas—Cleveland in Cuyahoga County and Cincinnati in Hamilton County—simply by observing the affordability index. This finding begs the question: what is driving the affordability index up in Franklin County relative to Ohio's other metropolitan areas in Cuyahoga and Hamilton counties?

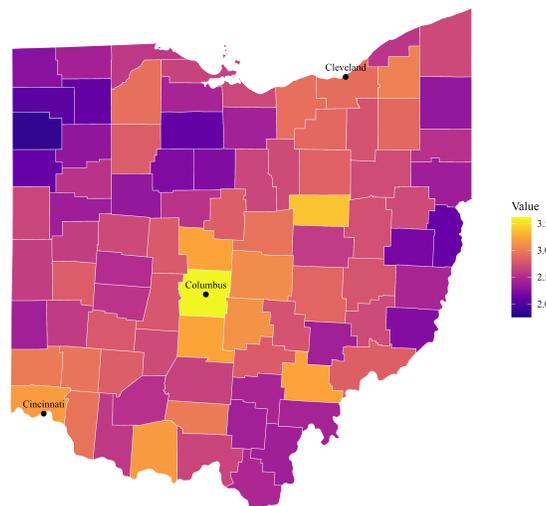


Figure 1: Map Illustrating the Housing Affordability Index in all 88 Counties in Ohio  
Data Source: American Community Survey Data 2023

Figure 2 shows trends over time in Cuyahoga County (Cleveland) and Franklin County (Columbus) over time, breaking down of the affordability index into its two components: median home value and household income. During the 2010s and before the pandemic, the median household value and income for both Cuyahoga and Franklin counties remained relatively stable. However, during the pandemic, both counties' median home values increased. Ultimately, the growth in median home

values outpaces the increase in wages. In addition, the pandemic saw a rapid rise in housing prices within Franklin County than in Cuyahoga County. This suggests that Franklin County’s high affordability index (unaffordable) is driven by rising home values, not falling income.

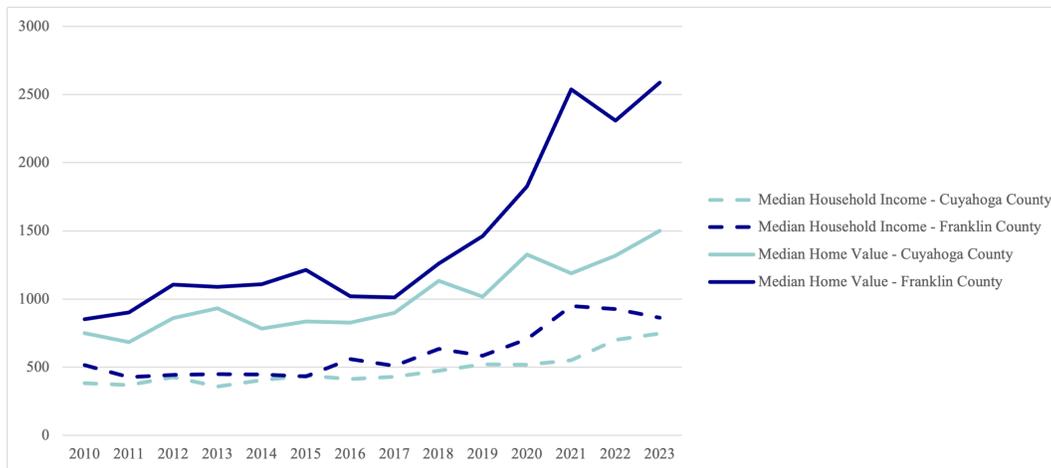


Figure 2: Median Home Value and Household Income in Cuyahoga and Franklin County  
Data Source: American Community Survey Data 2009-2023

Apart from understanding the simple increase in prices, it is worthwhile examining the theory behind the supply and demand within Ohio’s housing market. Investigating whether the basic model of supply and demand holds within the housing market in Ohio, Figure 3 graphs the affordability index against housing units per population for every Ohio County in each year from 2018-2023. Housing units are the supply, while population is a proxy for housing demand. Each dot on the graph represents a county in a specific year, with outliers removed using the Z-score method. (A threshold of 3 is applied, meaning that data points with a Z-score larger than 3 or smaller than -3 were omitted.) A negative correlation is observed throughout the 6 years covered; as the number of housing units per population in a county increases, the county becomes more affordable. This suggests that the law of supply and demand applies: a higher housing supply relative to housing demand is related to lower prices. The graph points to a straightforward takeaway: increasing the supply of housing is key to easing affordability pressures.

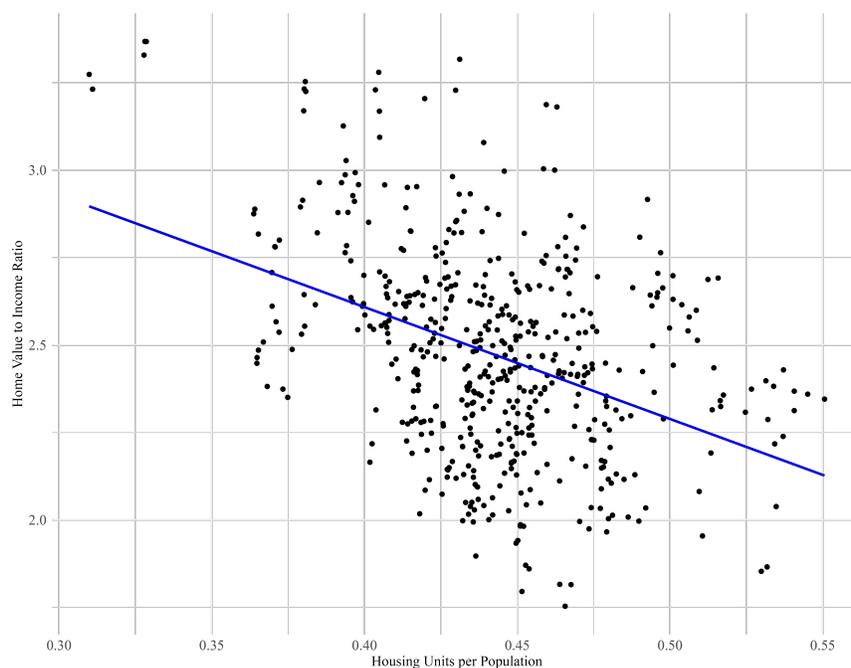


Figure 3: Correlation between Affordability Index and Housing Units to Total Population  
Data Source: American Community Survey Data 2018-2023

Upon a close examination of the population change (demand) with the change in housing units (supply) of the same period (2018 to 2023), there exists a strong positive correlation between the two variables shown in Figure 4 (one data point represents one county over the 5-year time period). This suggests that the increase in new housing has in fact been keeping up with the change in demand across Ohio, assuming population size is a reasonable proxy for demand. To some extent, this seems to contradict the growing housing affordability crisis.

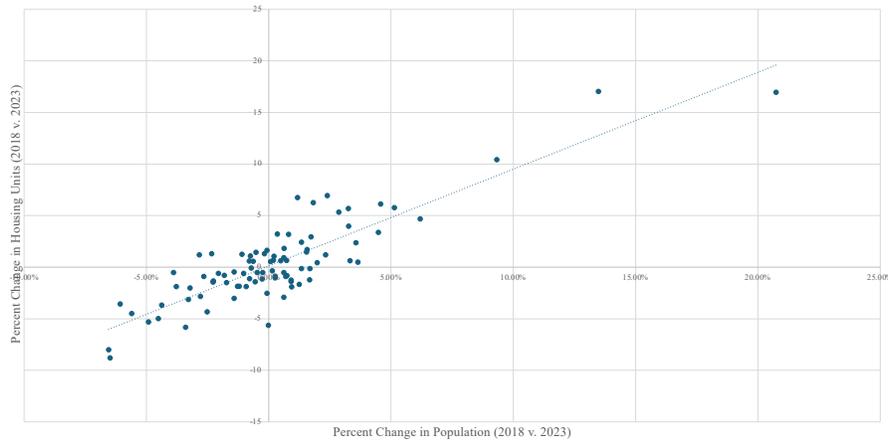


Figure 4: Change in Housing Units and Population between 2018 and 2023  
 Data Source: American Community Survey Data 2018-2023

From the data, two potential explanations can be used to explain the mismatch between Figure 3 and Figure 4. From the perspective of demand, the Ohio’s housing market may involve a certain number of external buyers or speculators who do not reside in the state, causing the population data to understate the demand in the market. On the other hand, relating the findings to the supply side, the difference could be caused by how newly completed housing units do not cater to buyers within the affordable market. These factors collectively contribute to the growing housing affordability crisis.

## Conclusion

The supply and demand model provides a preliminary explanation of Ohio’s housing market, but it is insufficient in fully illustrating the affordability crisis. By further understanding the unique local economic and geographical differences and changes over time, the government could implement regional-specific policies to tackle the crisis.



# The Impact of Tariff Policies on Ohio’s Manufacturing Sector: A Historical Analysis

Calais Michaelsson

## Introduction

Tariffs have historically played an important role in U.S. fiscal policy, serving as a powerful tool for the government to protect domestic industry while simultaneously generating revenue (Taussig, 1923). Over the past several decades, the Rust Belt region, particularly the state of Ohio, has experienced a significant decline in its manufacturing industries (Kahn, 1999). Given the potential for tariffs to act as tools for protecting domestic industries while also reducing manufacturing exports through retaliatory tariffs, this research investigates the impact of major tariff policies on Ohio’s manufacturing sector. These major tariff policies include both free trade agreements, which aim to reduce tariffs and other trade barriers, and steel and aluminum tariffs, which have a particularly significant impact on manufacturing.

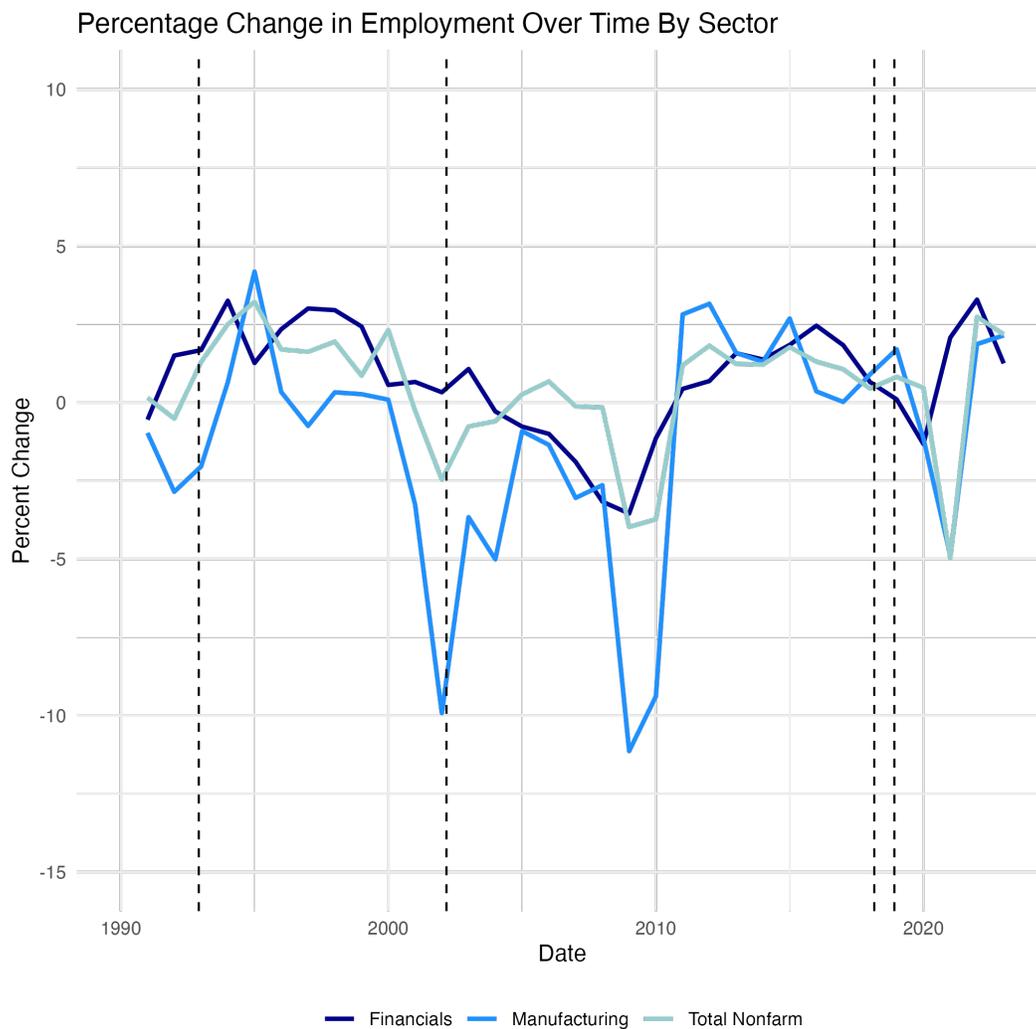


Figure 1: Shows the percent changes in employment in the financial and manufacturing sectors along with total employment. Data encompasses the state of Ohio from 1990 to 2024. Additional lines have been included for implementation of important tariff policies. From left to right, vertical dashed lines represent: NAFTA (1992-12-01), Bush steel tariffs (2002-03-05), Trump steel tariffs (2018-03-01), and USMCA (2018-11-30). Source: BLS via FRED

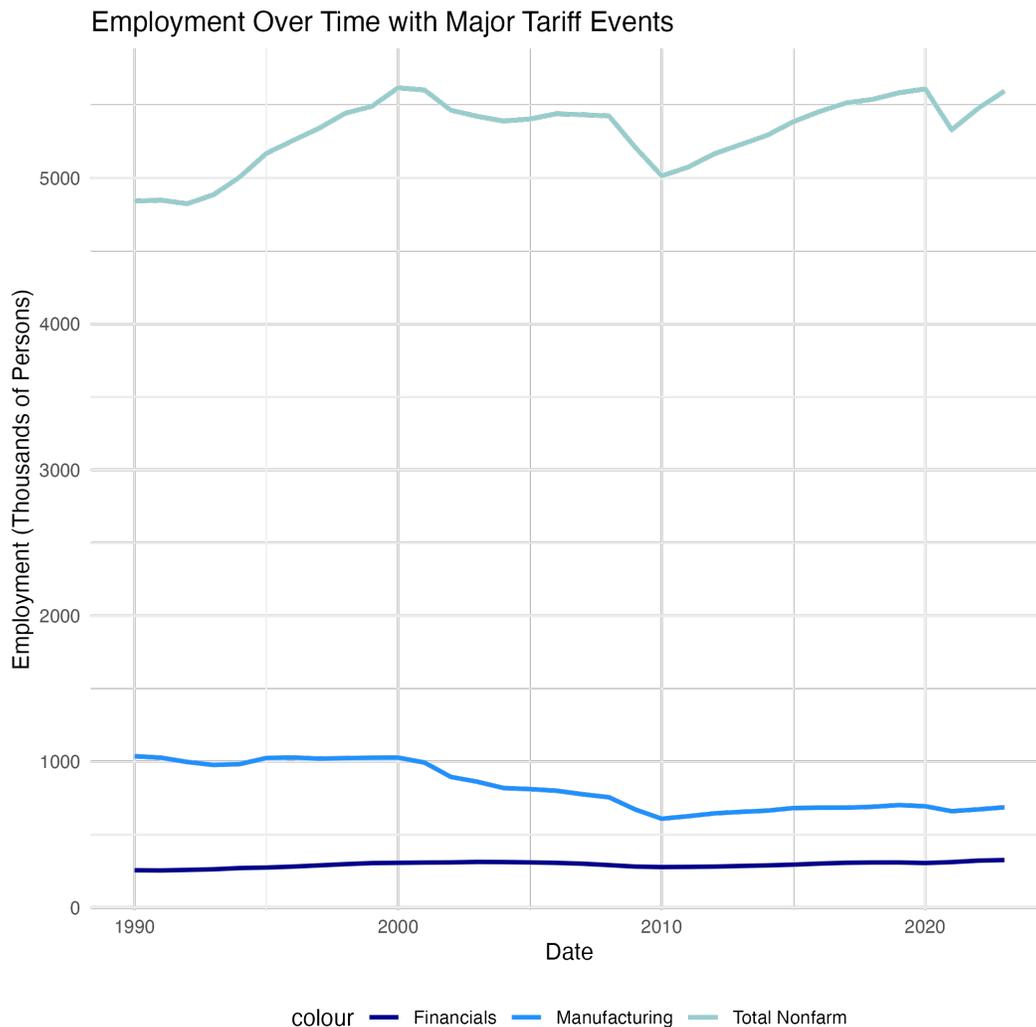


Figure 2: Shows the total changes in employment in the financial and manufacturing sectors along with total employment. Data encompasses the state of Ohio from 1990 to 2024. Additional lines have been included for implementation of important tariff policies. From left to right, vertical dashed lines represent: NAFTA (1992-12-01), Bush steel tariffs (2002-03-05), Trump steel tariffs (2018-03-01), and USMCA (2018-11-30). Source: BLS via FRED

## Analysis

Following the signing of the North American Free Trade Agreement (NAFTA) in 1992, there was a significant increase in total nonfarm employment in Ohio (see Figure 2). From 1992 to 2000, nonfarm employment increased by 794,500. However, despite NAFTA's promise to boost domestic production, manufacturing jobs increased by only 29,600 over the same period. This raises questions about the actual effectiveness of NAFTA in improving the U.S. manufacturing sector.

Between 2000 and 2002, manufacturing saw a significant decrease in employment, with a 14.44% drop and a total employment reduction of 132,100. A potentially significant contributor to this decline was President Bush's steel tariffs, implemented in response to struggling domestic steel producers. These tariffs ranged from 8% to 30% on steel imports from most countries.

The Trump administration's steel and aluminum tariffs took effect in January 2018, shortly before the signing of the United States-Mexico-Canada Agreement (USMCA) in November 2018 (Trump, 2018). Determining the impact of these policies is challenging due to their close proximity. The tariffs were a protectionist measure, while the USMCA was a free trade agreement. Data shows an increase of 71,200 in total nonfarm jobs and an increase of 3,600 in manufacturing jobs. Additionally, a large drop in employment occurred in 2021, likely due to the COVID-19 pandemic (see Figure 2) (Gould & Kassa, 2021).

## Conclusion

By examining the impact of previous tariff-related policies, we can draw inferences on how to best shape tariff policy to benefit Ohio's manufacturing industry. For one, the data above draws into question the actual effectiveness of NAFTA in improving the U.S. manufacturing sector. It appears that NAFTA did result in a significant increase in employment but this did not hold true for the manufacturing sector. Looking at NAFTA's successor, the USMCA, we see that this trade deal did not lead to meaningful increases in Ohio's manufacturing employment.

Looking directly at tariffs, the steady decrease in manufacturing employment following Bush's steel and aluminum tariffs may imply that they had a negative impact on manufacturing, possibly as a result of retaliatory tariffs from trading partners. However, it does not appear that this pattern repeated during Trump's 2018 tariffs. We can infer that while tariffs can negatively affect manufacturing, they do not necessarily have to.

However, it is important to recognize that this analysis is limited due to its lack of econometric analysis. As a result, more research, especially into the results of Trump's 2024 tariffs, would further clarify the relationship between tariff policy and Ohio manufacturing. We can nonetheless gain valuable insights into shaping policy based on this analysis. In conclusion, while the impact of tariff policies on Ohio's manufacturing sector has been complex and multifaceted, the findings suggest that carefully crafted tariffs, when strategically implemented, can protect domestic industries without causing detrimental effects, highlighting the need for a nuanced approach to trade policy.

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# Geospatial Dynamics of Post-Pandemic Job Shifts, RTA Ridership, and Unemployment In Cuyahoga County

Noah Leibowitz

From the years leading up to the Covid-19 Pandemic through 2022, Cuyahoga County has seen a shift in the distribution of jobs. While certain suburban areas saw slight growth in jobs, urban job growth prevailed during the recovery from the pandemic. Interestingly though, RTA ridership numbers have been on the decline and have not fully recovered to pre-pandemic levels. The net shift of jobs toward the urban core, coupled with an overall decline in suburban jobs, highlights a growing disconnect between the movement of individuals and the movement of jobs. While unemployment numbers have returned to pre-pandemic levels, job access disparities have contributed to this disconnect.

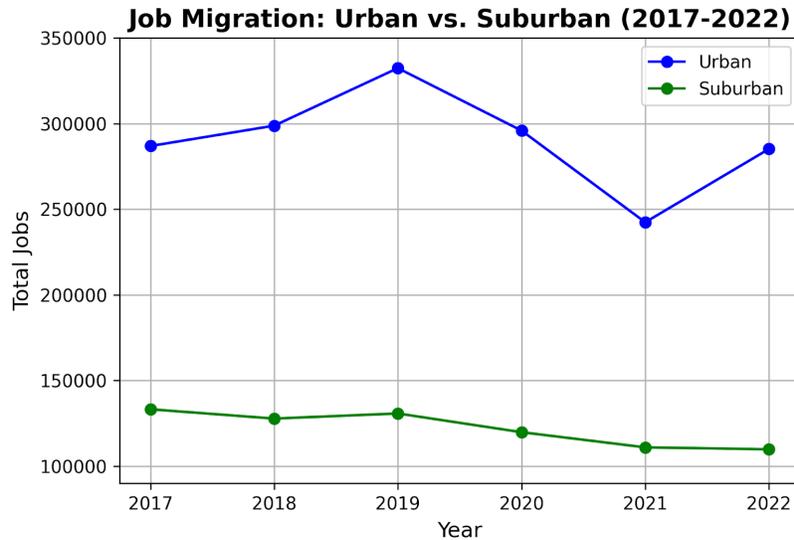


Figure 1: Total Job Counts Between 2017 and 2022 in Urban and Suburban Areas Across Cuyahoga County (US Census Bureau Longitudinal Employer-Household Dynamics Origin-Destination Employment Statistics)

## Job Growth in Cuyahoga County (2017-2022)

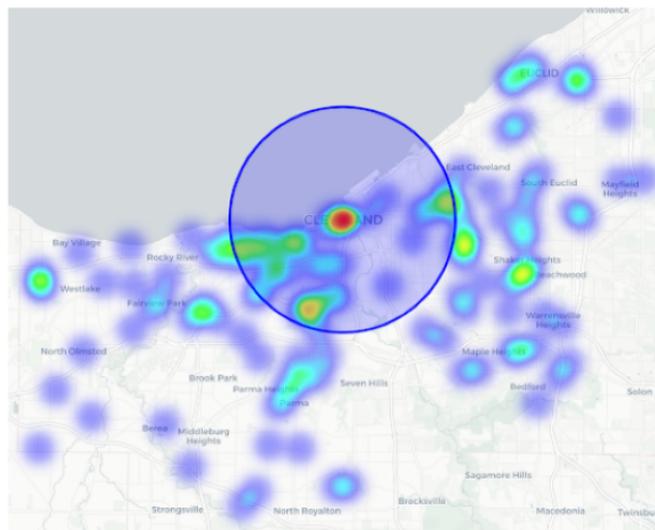


Figure 2: Total Job Raw Growth Rates Across Cuyahoga County (US Census Bureau LODES)

Figure 1 demonstrates how the distribution of jobs in suburban and urban areas in Cuyahoga County has changed over time, using geospatial data at the block level from the US Census Bureau. I define urban areas as being within an 8 kilometer radius of downtown Cleveland; everything outside of that circle is defined as suburban. While suburban job counts didn't experience as sharp a decline as urban job counts during the pandemic, they have yet to increase. In contrast, urban job counts have rebounded almost to pre-pandemic levels indicating that post-pandemic, the job access gap has increased and the total number of jobs have declined. Overall, this suggests a growing concern of a mismatch between where jobs are located and where workers live.

Figure 2 illustrates the growth rate in total jobs across the county from 2017 to 2022, using the same dataset from the US Census Bureau. Certain suburban blocks have experienced slight increases, though job counts across all suburban areas have decreased. Furthermore, the majority of job growth occurred in the urban core of Cleveland. At the same time, population flows have generally trended towards suburbs and away from urban cores. Thus, the finding that total urban job counts have increased and total suburban job counts have decreased could suggest a spatial mismatch between the flow of individuals and the location of jobs. While some sectors experienced a dynamic shift towards suburban areas, the effects were not strong enough to offset the rebound in urban job counts between 2021 and 2022.

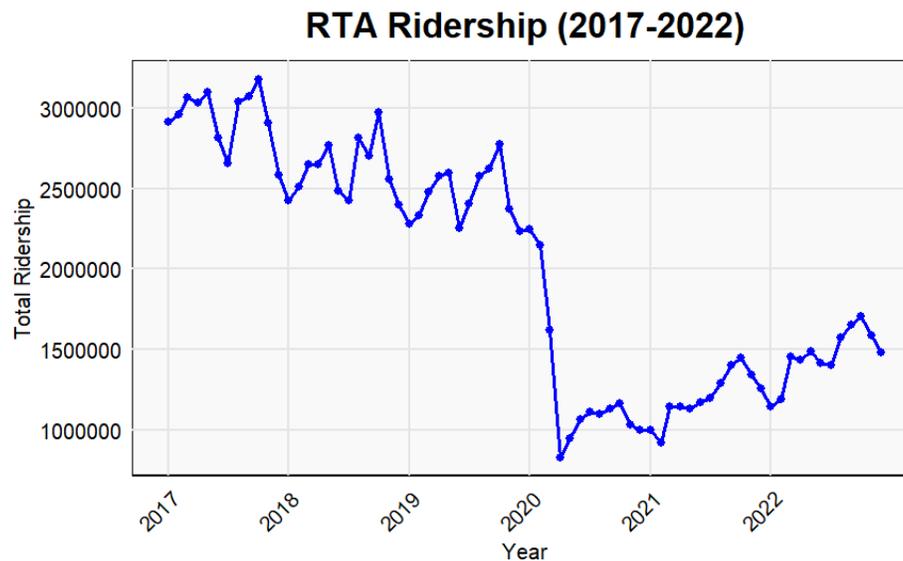


Figure 3: Cleveland Rapid Transit Authority (RTA) Total Ridership (United States Department of Transportation)

Figure 3 demonstrates how Cleveland's Rapid Transit Authority (RTA) total ridership has changed over time. While there was a sharp decline in ridership in 2020 due to the onset of the pandemic, there was a steady decline between 2017 and 2020 as well. Furthermore, while ridership has improved since the pandemic, the numbers are significantly lower than they were before the pandemic. The overall decline in ridership patterns can be related to the fact that many who live in the suburbs have to commute by car into downtown where they work. The job disparities created across the county have made it difficult for those seeking employment near where they live. If one lives in a suburban area and commutes to the city for work, they are still more likely to use their own personal vehicle. The slight recovery in ridership post-pandemic is in line with the urban recovery in jobs as shown in Figure 1.

Overall, an increased spatial mismatch between residences and workplaces, along with decreased public transportation ridership, continues to hinder access to opportunities within residents' immediate surroundings

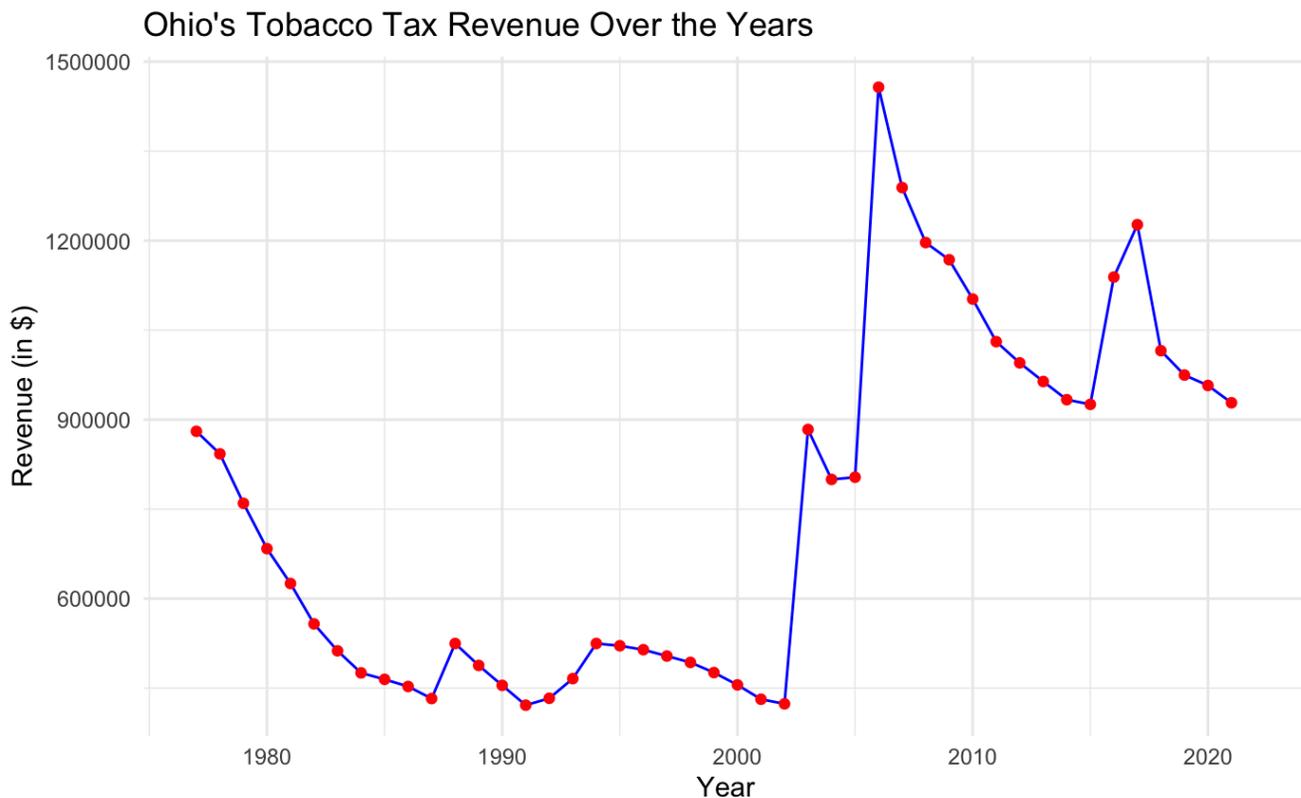
Considering these trends, policymakers should prioritize expanding public transportation infrastructure to improve commuter access to downtown jobs. This approach would both improve public transportation access and further boost job access, reducing the gap between where one lives and one is employed. Moreover, investing in an expansion to public transportation can have external benefits that contribute to long-run growth across the county.

# Governor DeWine's Tobacco Tax Proposal: Can Sin Taxes Guarantee a Future for a Child Tax Credit?

Siya Motwani

On February 3, 2025, Ohio Governor Mike DeWine introduced the 2026-2027 executive budget, in which he proposed a \$1.50 increase in cigarette taxes, from \$1.60 to \$3.10 per pack. The Governor's office estimates this increase would raise revenue from \$706.3 million in fiscal year 2025 to \$1.11 billion in fiscal year 2026, with a significant portion of the revenue going toward a refundable \$1000 child tax credit (DeWine & Murnieks, 2024). A child tax credit is a tax benefit designed to provide financial support to families with children. Under this proposal, families with children under age 6 could reduce what they owe in state taxes by up to \$1000 per child each year. The goal of this is to alleviate financial burdens for low- and middle-income families in the state (State of Ohio, 2025).

Ohio has seen several such tobacco tax hikes throughout its history, most notably in 2002 when the cigarette tax increased by 31 cents, from 24 to 55 cents per pack, followed by a substantial hike in 2005 when the tax more than doubled with a 70-cent increase to \$1.25, and again in 2015 when it rose by 35 cents, reaching \$1.60 per pack (Ohio Department of Taxation, 2025). The graph below depicts the revenue Ohio has generated through these tobacco taxes over the years.



As can be seen, the graph depicts notable spikes in Ohio's tax revenue, particularly in 2002, 2005, and 2015, which align with the tax hikes mentioned.

After the 2005 tax increase, there was a sharp rise in revenue, from about \$800 million to \$1.46 billion, reflecting the immediate impact of the tax change. However, following this was a gradual decline in revenue, suggesting that cigarette sales had reduced or there was increased tax avoidance. A similar trend can be seen after the 2015 increase, with a short-term revenue boost from around \$925 million to \$1.14 billion before a gradual decrease.

The proposed \$1.50 increase in 2026 is expected to generate a substantial revenue boost, similar to previous hikes. However, based on historical trends, it is important to note that after an initial surge in revenue, there may be a decline, as smoking rates drop or tax avoidance increases. This potential drop in revenue raises concerns about the long-term sustainability of funding the proposed child tax credit, which relies heavily on cigarette tax revenue. The effectiveness of the tax, therefore, ultimately depends on the state's primary objective. If the goal is to reduce smoking, the policy may be successful and lead to a positive public health outcome. However, if the aim is to provide stable, long-term funding for the child tax credit, relying solely on cigarette tax revenue may not be sustainable. As cigarette sales continue to fall, Ohio could face funding gaps, making it important to consider alternative or additional revenue sources.

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# How Cleveland's Winters Shape Its Economy

Michelle Gantumur

## Introduction

Cleveland experiences a continental climate with four seasons with intense cold, snowy winters, and hot, humid summers. Located on the "Snow Belt" next to Lake Erie, the city is subject to lake-effect snow, particularly on its eastern side, where snowfall can be significantly higher than in western neighborhoods (Smith, 2025). Lake-effect snow is the primary driver of Cleveland's winter weather intensity, occurring when cold air masses move across the relatively warmer waters of Lake Erie, picking up moisture that then falls as snow when reaching land.

Given its regular exposure to inclement winter weather, the city has developed systems to maintain economic functionality throughout the season. In this article, I seek to explore the question: has the Cleveland economy truly adapted to the city's harsh winter conditions?

## Adapting to Harsh Winters

Cleveland has made significant strides in adapting to its challenging winter climate, particularly the lake-effect snow from its proximity to Lake Erie. The city has implemented comprehensive snow and winter response plans, incorporating new technologies and equipment to enhance snow removal and emergency response capabilities. These measures aim to maintain economic functionality during winter weather emergencies (Winter and Snow Plan, n.d.). Severe winter weather events impose substantial costs on the regional economy. A study commissioned by the American Highway Users Alliance found that snow-related road closures cost Ohio approximately 300 million dollars per day in both direct and indirect costs (Safe Winter Roads, 2020). This underscores the significant economic stakes of winter storms.

Among everyone, hourly workers suffer the most during winter weather shutdowns, accounting for almost two-thirds of direct economic losses (Safe Winter Roads, 2020). When businesses close or reduce hours due to snow events, these workers often lose income that cannot be recovered. This disproportionate impact on hourly workers creates a ripple effect through the economy, as reduced consumer spending affects businesses beyond the immediate storm period.

Business operations face multiple challenges during severe winter weather, such as delayed opening times, reduced parking availability due to snow accumulation, increased property maintenance costs, and potential liability issues related to snow and ice hazards (Schill, 2019)

Even when storms only cause short-term closures, the aggregate economic effects can be substantial. One hour of downtime might not seem significant, but when multiplied across many businesses, costs quickly accumulate for property owners, employers, and employees (Schill, 2019).

Severe winter weather significantly disrupts Cleveland's transportation systems. Heavy snowfall can lead to road closures, create hazardous driving conditions, and disrupt commutes. Freezing rain can coat roads in ice, making them extremely dangerous. These conditions require substantial expenditures on snowplows and road salt, which become increasingly costly during prolonged or intense storms. Airports also experience delays and cancellations due to snow accumulation on runways, aircraft icing problems, and reduced visibility. These transportation disruptions translate into lost productivity, decreased tourism, and increased operational costs for businesses that depend on timely shipments and travel.

## Data and Findings

To investigate the question of how snowfall might affect the Cleveland economy, I gather data on two metrics: monthly snowfall in Parma, a Cleveland suburb, and quarterly sales tax revenue for the state of Ohio, both from 2010 to 2024. I aggregate snowfall by quarter and compare these metrics for quarter 1 (January, February, and March), the snowiest quarter.

In Figure 1, I observe a negative correlation between winter snowfall amounts in Cleveland and sales tax revenues in Ohio. This correlation is marginally significant with a p-value of 0.08. reveals an important economic relationship. This correlation coefficient suggests a moderate inverse relationship: as snowfall increases, sales tax revenues tend to decrease. Under the assumption that quarterly snowfall year-to-year is pretty random, this is evidence to suggest that snowier winters do have a negative effect on the Ohio economy.

### Correlation between Q1 Snowfall and Sales Tax Revenue

January-March only - Correlation: -0.4905

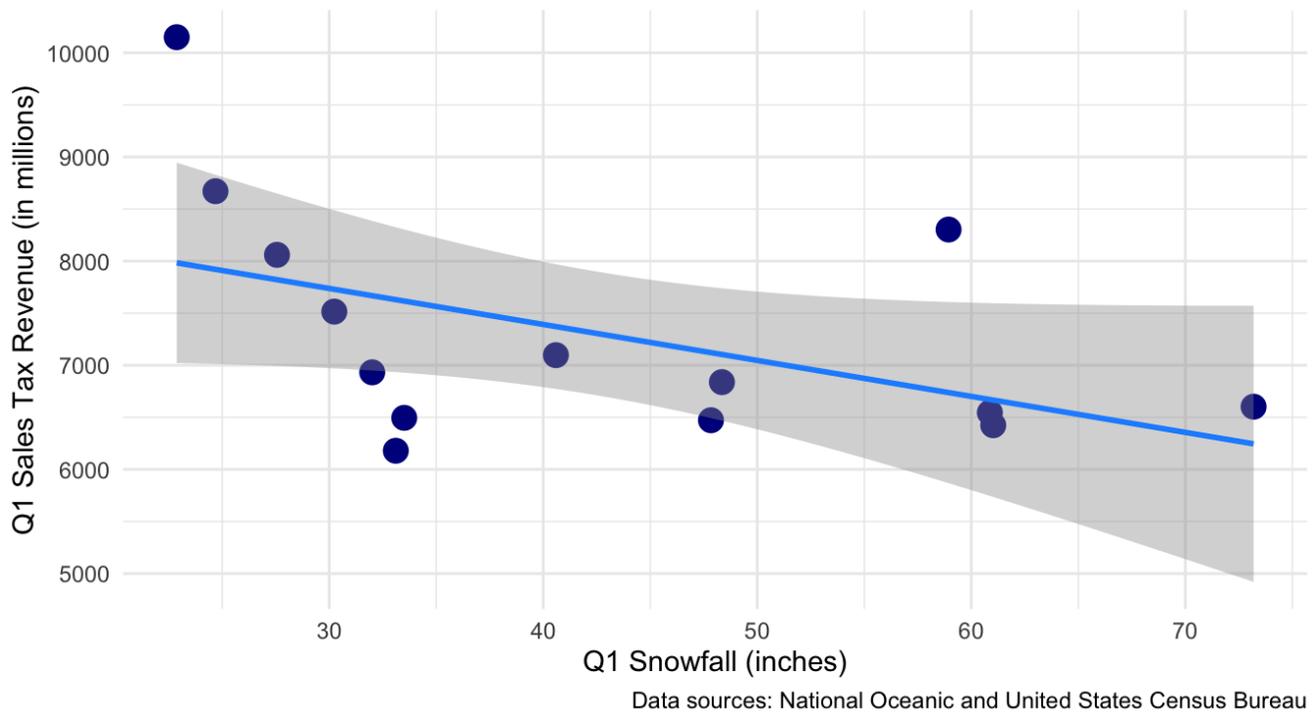


Figure 1: Snowfall and Sales Tax Revenue Relationship Scatterplot

### Q1 Snowfall and Sales Tax Revenue Over Time

January-March only

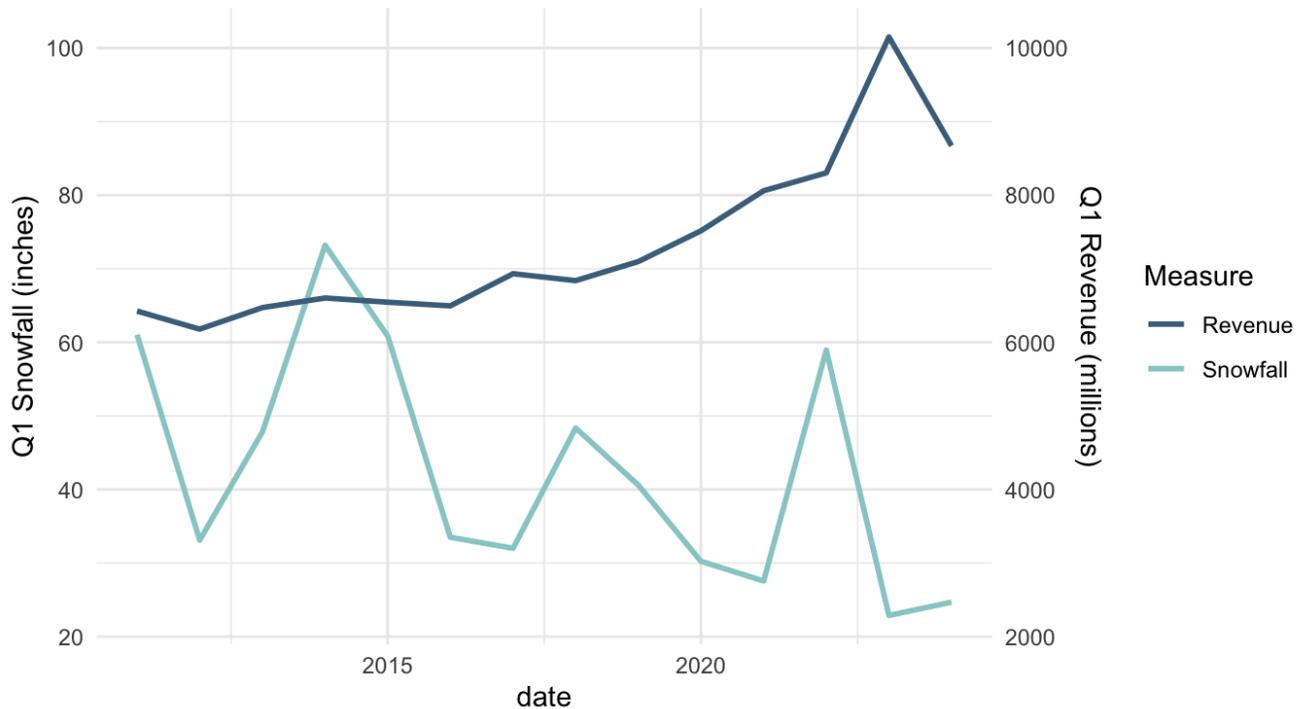


Figure 2: Snowfall and Sales Tax Revenue Over Time

Figure 2 shows sales tax revenue and snowfall for quarter 1 over time. There exists significant year-to-year variation in snowfall amounts, lending more credibility to the theory of a real relationship between snowfall and tax revenue.

## Conclusion

These findings suggest that Cleveland's harsh winter conditions, particularly heavy snowfall, can have tangible economic consequences, potentially depressing statewide sales activity. While the city makes significant efforts to mitigate winter weather disruptions, the data indicates that severe winters may still hinder economic performance. Continued investment in winter resilience strategies may be essential to protecting both local livelihoods and broader economic stability.

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# Outreach

 *Kyoto, Japan*



# Efficiency or Excess?: How School District Spending Shapes Educational Achievement

Elijah Davis, Daniel Chase, Aanchal Nair

This study investigates how the allocation of public school spending across different types of educational expenditures such as instruction, administration, and student support affect academic performance in Ohio school districts. We use district-level expenditure and achievement data from the 2024 fiscal year to create a regression model with interaction terms and explore how the effectiveness of spending varies based on poverty levels. Our results depict that though instructional spending has an overall positive correlation with performance outcomes, its impact decreases in high-poverty districts. Administrative spending especially when paired with higher poverty rates is negatively correlated with student outcomes. Therefore it is important to focus not only on how much districts spend but how and where resources are allocated across schools. Our analysis highlights the need for equity focused investment and contributes to growing literature on improving student achievement through educational finance.

## Introduction

Education funding plays a critical role in shaping student academic success, however funding allocation remains a subject of debate. This study investigates how different types of expenditures in public education affect academic performance in Ohio school districts. Through analyzing spending patterns and student achievement metrics, this study adds to the ongoing discussions regarding efficient resource distribution in order to maximize limited financial resources in diverse socioeconomic contexts.

## Hypothesis

As this study examines the impact of different public school expenditures in Ohio school districts measured through Performance Index Scores, we propose the following hypotheses. We hypothesize that instructional and pupil support spending have a significant positive relationship with school performance outcomes whereas expenditures for administration may have a neutral association. This is based on the premise that investments to educational resources will directly contribute to improved student achievement. The null hypothesis is that there is no significant relationship between expenditures in per-pupil expenditures like instructional, pupil support, staff support, administrative, or school performance outcomes. This can be due to multicollinearity where high correlations among spending variables could make it difficult to isolate the causal relationship of expenditure categories as individual effects are unclear. There may also be omitted variable bias as other key factors such as teacher quality and parental involvement are not directly accounted for.

## Literature Review

Cohen-Zada, Gradstein, and Reuven (2013) investigate how public school administrators allocate students into classrooms based on socioeconomic background using a compensatory allocation model. Their findings claim that school administrators manipulate class-size rules to ensure weaker students benefit from more individualized instruction. These findings suggest that student experiences and learning outcomes are shaped by the resource allocation decisions at the administrative level rather than solely funding availability. To counterbalance inequalities in student preparedness, school leaders adjust class sizes and distribute students strategically. Thus, this study emphasizes that resource distribution is not merely a function of funding availability. Instead, it is the culmination of administrative discretion and strategic decision-making. Building on Cohen-Zada et al. (2013), our research widens the focus from classroom allocation decisions to district-wide expenditure patterns. We are examining how additional spending categories (than the ones used in their model) affect student performance across school districts in Ohio.

Luca and Hinshaw (2013) examine how different categories of school expenditures can impact student achievement in Ohio. Focusing on variables that represent the distribution of funds across instructional, administrative, pupil support, and operational costs, they found that higher instructional spending is positively correlated with academic performance, while increasing administrative expenditures showed little to no benefit, implying that funds allocated to non-instructional functions may not be directly contributing to student success. This is a critical distinction in education financial allocation, as it suggests that student outcomes may be enhanced through redirecting funds from administrative overhead to direct instructional spending. Additionally, they found that teacher salaries and availability of classroom resources had the greatest benefit for student achievement output. Our study extends Luca and Hinshaw (2013) by expanding the analysis to assess how expenditure distribution can affect student achievement in different district contexts. To do so, we differentiate the impact of expenditure allocation across district types, specifically comparing high-poverty and low-poverty districts. Using this approach allows us to determine whether the effectiveness of different spending categories varies based on the socioeconomic status of

the given district. We aim to gain insight into whether increased funding for instruction benefits all districts equally or if the impact is more pronounced in schools with less resources allocated to them.

## Theoretical Model

The theoretical model asserts that financial allocations for districts have a significant relationship on district performance. Schools that prioritize instructional spending, such as staff support and pupil support, often see better outcomes due to improving teacher quality and engagement. Conversely, excess spending on administrative costs or other non-instructional expenses may act as a detriment to student performance by diverting funds from direct educational improvements. Since well-funded districts are better equipped to invest in improved facilities, materials, and technology than poorly-funded districts, our model aims to control overall funding via enrollment numbers. Ultimately, we hope to uncover that effective allocation strategies allow districts to maximize student achievement and overall school performance.

## Data and Methodology

The analysis focuses on all public school districts in Ohio during the 2024 fiscal year, utilizing the Expenditure Flow Model (EFM) dataset. The dataset includes key financial indicators, such as operating expenditures, instruction, pupil support, staff support, administration, and operations support. Additionally, we incorporate expenditure per-pupil metrics (EPP) calculations to normalize spending across districts of varying sizes. The District Achievement Ratings dataset includes performance index scores, which is a measure of student performance in a state-issued test. Relevant data, along with enrollment data and poverty rates, were sourced from the Ohio Department of Education and Workforce. To assess the relationship between financial expenditures and school performance outcomes, we will employ an empirical model examining the impact of different spending categories on school success metrics such as standardized test scores and graduation rates. The core regression model is specified as:

where  $P$  represents a school or district's performance metric (measured by performance index scores). We hypothesize that higher instructional and pupil support expenditures positively correlate with performance outcomes, whereas excessive administrative expenditures may have mixed effects.

## Findings

We model district expenditures as a share of total per-pupil spending across instructional, administrative, pupil support, and staff support categories, using operating costs as the reference point. The model explains 55.4% of the variation in Performance Index Scores, and the results underscore that spending distribution, not just spending levels, has meaningful implications for student achievement. Although instructional spending share shows a positive relationship with performance (coefficient = 41.58,  $p = 0.15$ ), the effect is not statistically significant on its own. More notably, the effectiveness of spending varies significantly by poverty level. Interaction terms reveal that in high-poverty districts, increased spending on instruction, administration, pupil support, and staff support is less effective, and in some cases associated with lower performance, relative to operating expenditures. These results support and extend Luca and Hinshaw's findings by showing that not only does instructional spending generally outperform administrative expenditures, but that the context in which funds are deployed matters substantially. In particular, high-poverty districts may benefit more from foundational operational investments than from increases in support services or instructional spending alone.

## Regression Results (Baseline: Operating Spending Share)

Variable	Coefficient (Std. Error)
Constant	86.11*** (0.33)
Administration Spending Share	-70.07* (36.96)
Pupil Support Spending Share	-8.28 (38.64)
Staff Support Spending Share	-19.21 (37.87)
Instruction Spending Share	41.58 (29.02)
Disadvantaged Student Percentage	-0.29*** (0.01)
Admin Share $\times$ Poverty Rate	-7.49*** (1.59)
Pupil Share $\times$ Poverty Rate	-6.20*** (1.63)
Staff Share $\times$ Poverty Rate	-9.39*** (1.72)
Instruction Share $\times$ Poverty Rate	-5.87*** (1.24)
Total Enrollment	-0.00018* (0.00009)
$R^2$	0.554
Adjusted $R^2$	0.547
Observations	660

*Note:* Standard errors in parentheses.

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

## Conclusions

Our preliminary findings suggest that increased instructional spending may improve student achievement, while higher administrative expenditures may have a small but negative effect. If future econometric analysis finds that these trends hold, policymakers should consider prioritizing direct educational investments to maximize students' success. This includes allocating funding for teacher salaries and classroom resources. Additionally, the strong impact of being economically disadvantaged on performance highlights a necessity for targeted funding in lower-income districts. To refine and more accurately measure these relationships, we will look to address multicollinearity and incorporating additional variables in our regression model.

Our findings highlight the crucial role of spending allocation over spending volume in shaping academic outcomes across Ohio school districts. Though our model explains a substantial 55.4% of the variation in performance index scores as shown in the R-squared value for cross-sectional educational data, it's important to examine how different categories of expenditures interact with socioeconomic context. The results emphasize that economically disadvantaged students exhibit the strongest and most statistically significant negative relationship with student performance and highlights that poverty is a structural barrier to educational success. Additionally, the consistently negative and significant interaction terms between poverty and all spending categories suggest that even well meaning investments may be less effective in high poverty contexts.

Administrative spending appears especially inefficient, with its interaction with poverty showing a strong and negative effect. This lines up with past research (like Luca & Hinshaw, 2013), which argues that too much spending on administration can hurt student outcomes—especially in districts that are already under financial strain. Instructional spending shows a positive coefficient, which aligns with our theoretical expectations and past studies. Its interaction with poverty is strongly negative which emphasizes that returns to instruction spending depend on its context. This suggests that to improve performance, instructional investments should have supportive conditions like food security, stable housing, and engaging caregivers. We also need to keep in mind the possibility of multicollinearity affecting our results. To address this, we are planning to check for it using variance inflation factors (VIFs) and may explore other modeling approaches or ways to simplify the variables in future analysis. In conclusion, districts should reconsider disproportionately high administrative expenditures and focus instead on strategic, equity-informed investments in direct student support—especially in disadvantaged communities. Resources should be directed toward more support for students, and future policy should focus on not just how much is spent,

but by where and how that money flows within the system.

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# Balancing Government Regulation and Free Markets: An Economic Analysis

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## Introduction

The debate over government regulation versus free-market policies has intensified since 2016, emerging as a central topic of discussion within American economic and political discourse. The key goal of evaluating the various perspectives that lie in such arguments is to identify the extent to which government intervention is necessary to ensure economic stability, fairness, and growth. Striking a balance between market freedom and regulation is crucial to a nation's economy; excessive government regulation can inhibit innovation and efficiency, while insufficient regulation has the potential to lead to market failures, income inequality, and financial instability (Stiglitz, 2017). This paper employs positive economic analysis to examine the diverse perspectives that shape regulatory policy, assess historical economic data, and propose a regulatory framework that fosters both economic growth and social welfare.

## The Role of Government Regulation in the Economy

Government regulation encompasses policies aimed at mitigating market inefficiencies, safeguarding consumer interests, and promoting national economic stability. Generally, this includes antitrust laws, labor protections, environmental standards, and financial oversight. Advocates for stricter regulations argue that regulation can assist in preventing market failures while also protecting public welfare. Contrastingly, opponents claim that excessive regulation exerts undue stress and costs for businesses, undermines the natural competitiveness of the market, and stifles economic progress.

## Policy Choices

To better understand how different regulatory models have influenced the U.S. economy, it is helpful to examine historical trends of regulation across several decades along with their impact. Table 1 presents key periods of regulatory policy aside from corresponding economic factors, such as gross domestic product (GDP) growth rate and employment rate. The table primarily displays three overarching policy descriptors in terms of regulation: deregulation, moderate regulation, and increased regulation. Across the decades of 1980 through 2020, periods of deregulation or moderate regulation, like the 1980s and 1990s, generally saw a higher GDP growth rate (3.5% and 3.9%, respectively) in comparison to periods with increased regulation, like the 2000s and 2010s (2.5% and 2.3%, respectively). Unemployment rate, on the other hand, seemed to vary independently of regulatory trends.

Table 1: Regulatory Trends and Their Economic Impacts in the United States

Period	Regulatory Trend	GDP Growth Rate	Unemployment Rate	Key Policies
1980s	Deregulation	3.5%	7.3%	Reagan-era deregulation
1990s	Moderate Regulation	3.9%	4.2%	Financial deregulation, NAFTA
2000s		2.5%	5.5%	Sarbanes-Oxley Act
2010s	Increased Regulation	2.3%	4.0%	Dodd-Frank Act, ACA
2020s	Mixed Approach	Varies (COVID-19)	Varies	COVID-19 relief

*Note.* This table provides an overview of historical periods that can provide insight into tendencies and economic effects of regulatory trends over time. While this table may suggest a potential correlational relationship amongst regulatory trends and their outcomes, it does not establish a direct causation among such factors

There are several policy frameworks that currently exist to balance government intervention and free-market principles, affecting the regulatory trends presented in each decade. First, deregulation is defined by reducing government oversight in corporations to benefit and stimulate natural competition and business innovation (Friedman, 2002). However, this also contains included risks, such as reduced consumer protections. A prime example of

deregulation is the Airline Deregulation Act of 1978, which undid strict protocol set by the Civil Aeronautics Board (CAB), which controlled airline fares, routes, and mergers (Walker, n.d.). Proponents advocated that the act would result in greater efficiency and flexibility to improve their route and even strengthen leverage when dealing with labor unions. After deregulation, airlines had the liberty to adjust their pricing as per market demand, leading to the significant decrease of airfare pricing. While the consumer benefited significantly on a financial standpoint, they also experienced a decline in service quality as some airlines struggled with certain tradeoffs of competition, reducing expenditures in areas such as staffing, maintenance, and amenities (Walker, n.d.).

Targeted regulation, contrastingly to deregulation, serves to address selected areas on specific market failures and bureaucratic inefficiencies. For instance, environmental standards limiting carbon emissions would overall impact two types of market failures as far as the environmental viewpoint of welfare economics is concerned: externalities, which is the failure of firms to consider the impact of their production on others, assuming the harm of carbon emissions on the environment, public health, or overall society; and information asymmetry, which is the inability of firms to make sound, informed decisions due to lack of information on other options or risks, such as knowledge of how such emissions will impact the environmental, public health, or overall society (US EPA, 2014). Rather than imposing broad, rigid mandates, targeted regulation on environmental impacts would utilize market-based mechanisms to encourage compliance with environmental standards. For example, cap-and-trade programs limit overall pollution levels but allow businesses to trade emissions permits, promoting cost-effective reduction (US EPA, 2016). Similarly, pollution taxes create financial incentives for firms to reduce harmful emissions, while subsidies support companies that adopt environmentally friendly practices. These policies ensure that regulation addresses environmental harm without stifling economic growth or innovation by focusing on where regulation is needed the most while still stimulating improvement.

Secondly, broad regulations expand government oversight, preventing corporate malpractices, safeguarding public health, and promoting income equity. The Dodd-Frank Wall Street Reform and Consumer Protection Act (2010) was enacted in response to the 2008 financial crisis. It introduced comprehensive financial regulations, such as creating the Consumer Financial Protection Bureau (CFPB) and mandating stress tests for banks, aimed at reducing the risk of another crisis, enhancing consumer protection, and augmenting transparency in financial markets. Research from the Mercatus Center indicates that from 1997 to 2010, the least regulated industries experienced a 63% growth in output per person, whereas the most regulated industries saw only a 33% increase (*Regulation and Productivity* | Mercatus Center, 2014). This disparity underscores the potential overregulation has in stifling productivity and innovation. Additionally, studies have found that a 10% increase in federal regulation correlates with a 0.5% rise in income inequality, suggesting that regulatory burdens can disproportionately affect lower-income populations (*Regulation and Income Inequality in the United States* | Mercatus Center, 2020).

## Recommendations

Keeping the various benefits and risks of each regulatory model into consideration, this paper supports the use of a regulatory hybrid model that integrates targeted regulation with market-driven solutions ensures a balanced approach. By blending the flexibility of market solutions with the oversight of regulation, this model can enhance the efficiency of economic systems and protect public welfare.

One key component of the hybrid approach is the use of regulatory impact assessments. Before implementing new regulations, governments should conduct cost-benefit analyses to evaluate the potential economic impacts that certain regulatory approaches may have. This practice aligns with long-standing administrative law principles, which allow courts to judicially review agencies to avoid actions deemed as “arbitrary and capricious” under the Administrative Procedure Act (Barczewski, 2024). Historically, under the *Chevron* deference (established in *Chevron U.S.A., Inc. v. NRDC*, 1984), courts automatically deferred ambiguous statutes to reasonable agency interpretations, enhancing flexibility and agency autonomy. *Chevron*, however, was recently overturned in 2024 in *Loper Bright Enterprises v. Raimondo*, increasing the role of the judiciary system in interpreting technical statutes (Barczewski, 2024). Now that aspects like cost-benefit analysis are subject to independent judicial interpretation, rather than simply being deferred for “reasonability,” agencies may be obligated to justify their analyses more rigorously. Overall, the process of cost-benefit analysis helps ensure that the benefits of regulation outweigh the costs, promoting policies that are both effective and efficient. The Organisation for Economic Co-operation and Development (OECD) in 2018 highlighted the importance of these assessments as they guide policymakers in designing regulations that achieve desired outcomes without unnecessarily burdening businesses or consumers.

Another essential element of the hybrid model is the implementation of sector-specific policies. Regulations should be tailored to industries that are most susceptible to market failures, such as finance, healthcare, and environmental protection. According to Arrow, different sectors require unique approaches to regulation, since market failures are different across various industries (Arrow, 1970). For example, the financial and capital markets often require stringent oversight to prevent systemic risk, where the failure of one institution or aspect of the market

can lead to a negative domino effect on the rest of the economy—like how the collapse of Lehman Brothers, one of the largest investment banks in the U.S., contributed to the 2008 financial crisis, later effectuating the Dodd-Frank Wall Street Act and the move for stronger oversight (Labonte, 2018). On the other hand, industries like healthcare generally merit regulations that ensure equitable access to services in order to benefit the consumer. By customizing regulations to the needs of each industry, policymakers can address specific challenges while minimizing unnecessary regulatory burdens on other sectors.

Finally, a periodic review mechanism can ensure that regulations do not remain static, yet evolve in response to changing economic conditions. The World Bank advocates for establishing dynamic systems that regularly evaluate the effectiveness of regulations and adapt them to new circumstances. This approach ensures that outdated or ineffective regulations can be reformed or repealed, promoting innovation and economic flexibility. By continuously assessing the performance of regulations, policymakers can maintain a regulatory environment that supports sustainable economic growth while addressing emerging challenges (Manjul, Wheeler, & Singh, n.d.).

## Evaluation of Policy Effectiveness and Conclusion

It is necessary that the effectiveness of this policy be reevaluated regularly in constantly-shifting economic conditions. This model can primarily be evaluated quantitatively with general key indicators of economic soundness: namely, GDP growth rate and unemployment rate, as utilized in the evaluation of past regulatory models in Table 1, but also additional metrics such as business investment trends, income distribution metrics, and inflation and consumer price stability, to name a few. For instance, a declining GDP could call for a reevaluation of policy, possibly indicating that certain aspects of regulation may be impacting the economy negatively (Blanchard & Johnson, 2012) and a decreasing unemployment rate would suggest that policies stimulate job creation. Business investment trends would ensure that investors are confident in the market, which could be considered as an indicator of strong economic health and a positive outlook for future growth. Analyzing income distribution metrics, as well as inflation and consumer price stability, would ensure both social and economic sustainability for the consumer. A rising number of corporate bankruptcies—reminiscent of Lehman Brothers in 2008—might begin to signal underlying vulnerabilities in the financial system and indicate the possibility of systemic risk (Labonte, 2018), potentially prompting a reconsideration of existing regulatory frameworks or targeted policies. Decreased consumer spending can also be a critical economic indicator, which could signal a loss in confidence in the economy, lower demand for goods and services, and reduced business profits (Blanchard & Johnson, 2012).

With the proposition that various sectors require different, tailored approaches in regards to regulation also comes the suggestion that these sectors will necessitate industry-specific metrics to be utilized for evaluation. Stress tests, for example, are mostly utilized for assessing banks, and can include various economic indicators such as the assessments of length of bond holdings, the strength of their capital reserves to evaluate whether or not the bank can continue lending effectively during a period of reduced economic activity and thus gauging the bank's overall health. In other sectors, it may be beneficial to examine the overall economic effect of regulatory choices along with identifying whether or not the goals of such choices were met; for example, in the case of environmentally-driven regulations, this could include monitoring outcome-specific metrics, such as the reduction of carbon emissions in tons, as well as financial outcomes, like cost per unit of pollution abated and cost of compliance, especially in cost-benefit analyses (Manjul et al., n.d.). Evaluating some of the broader metrics on individualized sectors, such as consumer spending and business investment trends, may provide a more specific snapshot into how tailored regulations are affecting each of these industries. Different sectors have different economic indicators, and identifying these indicators may result in a more robust analysis of consequences.

Overall, the ongoing debate over government regulation versus free-market policies requires a nuanced, hybrid approach, recognizing that both regulation and deregulation have their benefits and drawbacks. Therefore, a balanced regulatory framework analyzing various aspects of the market and economy can better shape future policy by assessing needs and reevaluating effects upon the economy. By continually assessing policy outcomes, regulators can adapt to evolving economic landscapes, ensuring a resilient and prosperous future.

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# Inflation in a Post-Pandemic Economy

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## Introduction

In recent years, inflation has surged in the U.S. economy, adversely affecting essential industries and households. This paper will provide an examination as to what caused this escalation in worldwide prices. Although central banks worldwide have attempted to curb inflation through an assortment of monetary policy tools, the high prices have triggered extensive debate on whether we are facing a temporary surge or a lasting change towards higher prices. As one of the pressing issues that the average American experiences daily and merely, it has become a significant aspect in political campaigns. The 2024 Trump presidential bid attacked the Biden-Harris administration for the prolonged period of high prices in groceries, energy, and real estate. With the heightened importance of inflation reduction and its effect on millions of American households, this paper explores the prominent causes of inflation, the effects it has on households and firms, and the possible viable solutions and policy changes aimed at mitigating the price inflation.

Among other major causes, the COVID-19 pandemic’s detrimental effects can be pointed to as the prominent reason why prices have seen substantial elevation in the past few years. The global crisis brought about a standstill adversely affecting businesses, leading to millions of job losses, and a decline in gross domestic product (GDP), as seen in Figure 1. Specifically, the pandemic led to the decrease of consumption and investment in the economy, with an 8.2% and 16.2% decrease, respectively, at the start of Q2 in 2020.

### GDP and Components of GDP Percent Change

Data interpreted from U.S. Bureau of Economic Analysis

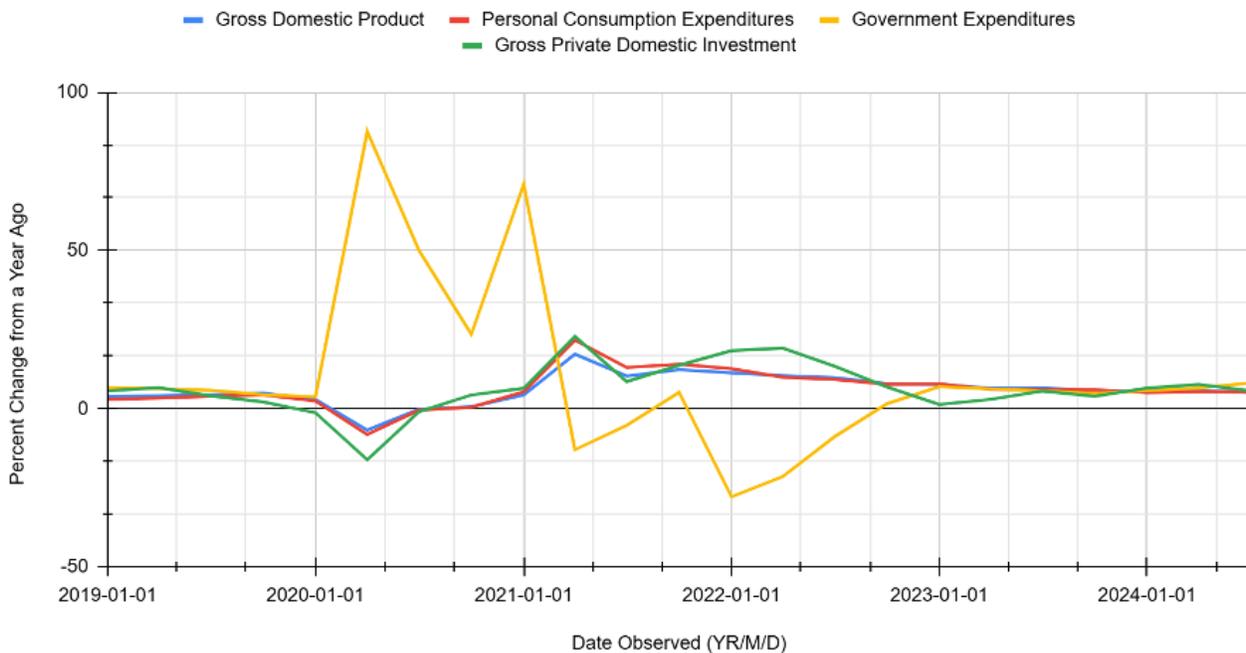


Figure 1: GDP and Components of GDP Percent Change

In response, action was taken by the U.S. government by introducing stimulus initiatives, like the CARES Act, to provide funds to individuals and businesses with the intention of maintaining stability amid the downturn period. The CARES Act sent out three rounds of direct relief payments. These Economic Impact Payments came to be known as stimulus checks through which households received \$1200 per adult and \$500 per qualifying child under age 17 (US Department of the Treasury.) These actions can be seen in Figure 1, as government spending increased

by 87.6% at the start of Q2 of 2020 and 70.9% from the previous year. Despite the government's efforts to offset the effects of the pandemic, gross domestic product still fell by 8.2% at the start of Q2 in 2020. Nevertheless, when businesses reopened, individuals rushed to purchase products and services they had refrained from or could not acquire during the pandemic phase resulting in demand-driven rises in the costs of goods and services as consumer supply availability remained limited. As an effect of the pandemic, supply chains that tie the world's economies together were broken and disrupted by the sudden shutdown of the world, as the transportation of manufactured goods and raw materials were minimized.

## *Housing*

The housing market has come to be one of the many markets to be hit the hardest by inflationary pressures. In the past decade, housing prices have been on an upward trajectory, as seen in figure 2. COVID-19 and the 2024 Presidential Election have shed light on these longer-term trends.

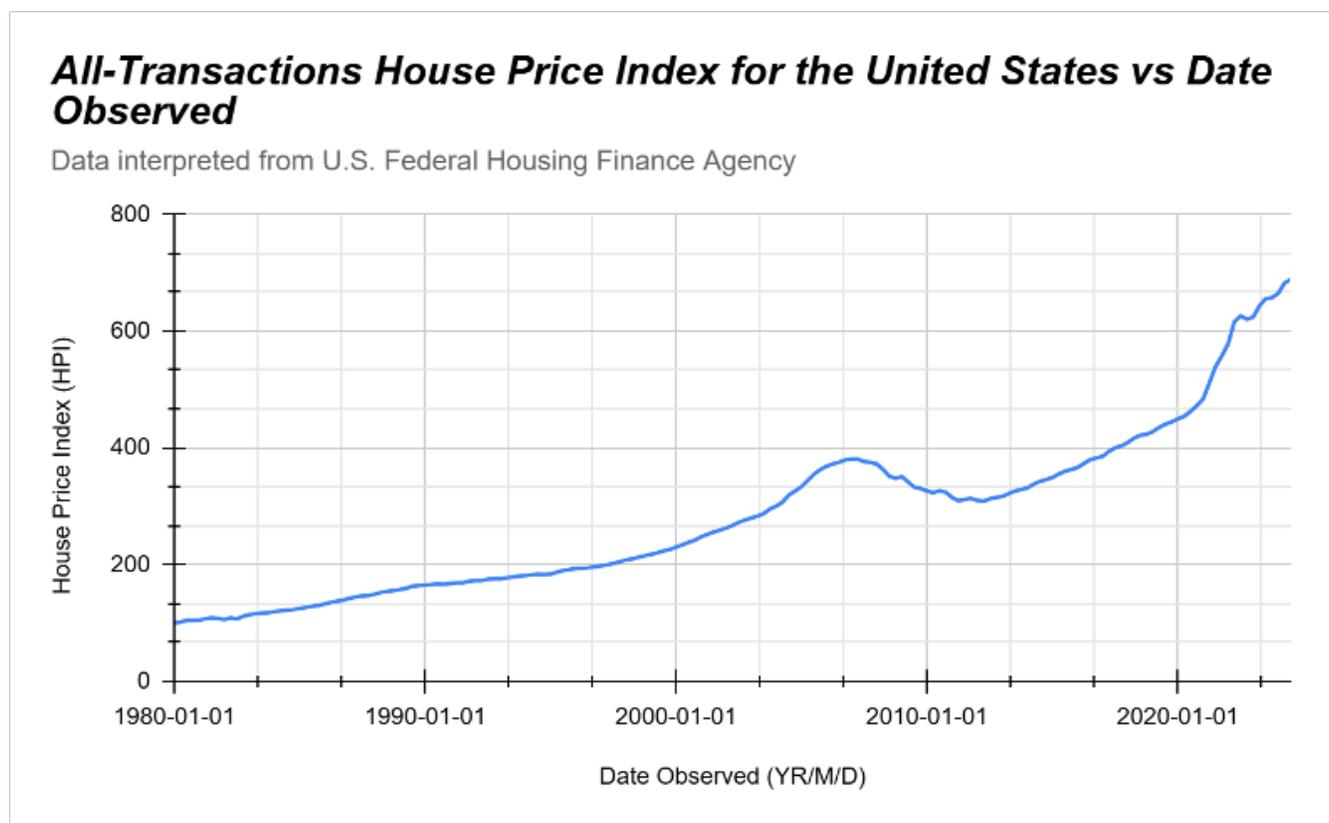


Figure 2: All-Transaction House Price Index for the United States vs Date Observed

A common misconception with the steady increase in prices is that real estate private equity firms are the sole cause for the rise in prices for housing. However, the root of the problem has to do with the amount of land available to build shelter and the number of buyers. Ultimately, the number of homes available for sale in the United States is low, with McLaughlin reporting that there are 953,452 thousand homes actively listed for sale, making it hard for younger generations to buy their first homes. The amount of land continues to diminish as time goes on, while the number of houses being built cannot properly keep up with the increasing demand for shelter in the U.S., subsequently increasing the price of houses. Because of this, consumers blame the investment corporations for "stealing" homes away from them, even though it is not the case. Although inflation proves to be cooling as time comes, the prices remain at record-high levels, making the affordability and accessibility of shelter more difficult. This serves to be a prominent area of concern as much discourse of how to handle and remedy the housing market continues to be debated.

## Commodities

Apart from housing, commodities that the average American needs have seen their own surge in prices throughout the country. The disruption of global supply chains following the pandemic and international conflicts have detrimentally affected markets around the globe. Specifically, the food industry had seen unprecedented levels of prices. With the "mixture of labor shortages tied to the pandemic, ongoing supply chain disruptions, droughts..." (Washington Post) and other causes, groceries have become exceedingly high, frustrating American consumers. Leading back to US politics, the republican party attacks the Biden and Harris administration for these increased prices. Much can be said about the circumstance and situation the administration was thrown into from the start, but it is understandable for many Americans to blame the government for the increased prices they experience daily, another commodity being gas for vehicles. The increase in gas prices can be attributed to four specific factors, among many others: workforce shortages, global conflicts in Eastern-Europe, rebounding from the initial phases of the pandemic, and the upcoming election with the varied policy uncertainty that it comes with (api.org). These increases in prices of daily commodities are what burden consumers the most, in the sense that there is a tangible effect on their personal lives.

## Policy

The Federal Reserve has cut interest rates for the first time since the beginning of the pandemic, they lowered the federal funds rate by half a percentage point, following the strategy of avoiding any volatile hikes in interest rates to ensure the "soft-landing" of the US economy (Bankrates.com). This has already proved to ease inflation, so the Federal Reserve should continue with their strategy of slowly lowering the interest rates. In addition, investing in the supply chain aspect of the economy will be an integral part of fighting the uncertainty inflation can bring. One action the government could take is to diversify the inputs that are heavily reliant on one specific region or country, another being investing in domestic industrial capabilities. Reducing our dependence on volatile international markets and economies can mitigate the long-term effects of inflation by addressing the supply chain bottlenecks that plague the US economy.

To specifically address the ongoing issues with the housing and energy market, the government must take much more precise action to remedy the calamitous effects inflation had on each respective market. To address the influx in prices in the housing and energy markets, the government could give companies across the country tax incentives to those that adopt a permanent or hybrid remote working model. Cities like New York City, Chicago, Los Angeles, Atlanta, etc. can benefit from such incentives, as much of their population is made up of people who need to live close to their work location without the option to work remotely. These people primarily move into these cities just to commute to their job much easier. Although this is logical, it drives up the prices of housing in these cities to extreme levels. During and following the pandemic, remote work became much more prevalent, as COVID inhibited people's ability to commute to work, therefore not being too out of the ordinary. With this incentive, people would be more likely to not move into these cities with high housing prices as remote working becomes more common. An incentive like this reduces the pressure on high-demand urban areas, like these cities, and would stabilize the housing market for these cities. Not only would this allow for the housing market to slowly recover, but it would also decrease the reliance on energy to commute to work. Transportation costs make up a large portion of the consumer total expenditure data collected from the US Bureau of Labor Statistics in 2023.

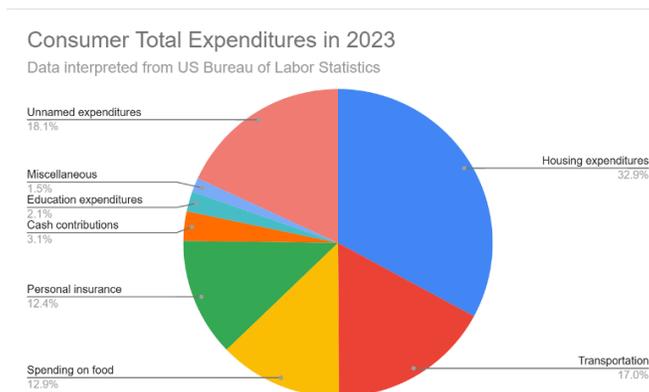


Figure 3: Consumer Total Expenditures in 2023

Without the increased need for energy to fuel their transportation, the cost of transportation would decrease immensely, consequently lowering the demand for energy, like gas.

The overall goal of U.S. economic policy going forward should be to lower inflation rates and consumer prices while maintaining steady economic growth, which can be seen through a tangible increase in GDP. However, measuring the overall inflation of the economy would be ineffectual in tracking the efficiency of the recommendations stated previously, as the housing market has a much higher CPI than any other market, as seen in Figure 4.

*Consumer Price Index: Shelter vs. All items except Shelter*

Data Interpreted from US Bureau of Labor Statistics

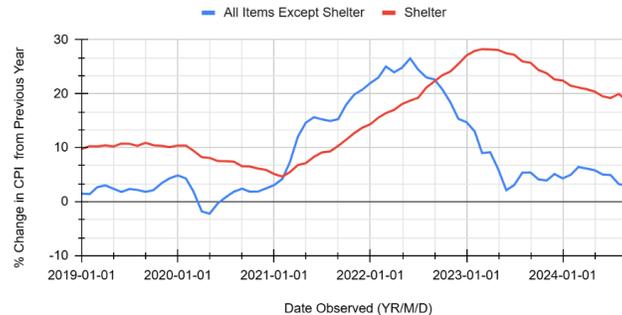


Figure 4: Consumer Total Expenditures in 2023

Because the housing prices are a large factor in the core inflation, the core inflation excluding the shelter will be tracked to measure the effectiveness of lowering the interest rates even further and investing in supply chain strength, while the OER of the housing market will be tracked to measure the cost of shelter to homeowners. Results should be expected in 24-36 months, or longer, as the lag between the enactment of the policy and the policy's impact itself must be considered.

## Conclusion

Inflation poses a tremendous challenge to Americans. To combat inflation, the government must take meticulous steps and careful measures by strategically lowering interest rates, investing in domestic supply chain strength, and stabilizing the housing and energy markets to ease inflation's effect on essential goods and services, looking forward to time of sustainable economic growth.

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# The Impacts of Government Regulation on Economic Health

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## Introduction

The origins of the modern capitalist economic system can be traced back to 16th-18th century Europe. Since then, politics in almost every market economy on the globe have centered around the issue of the extent government regulation should have on this system. Notably, United States politics since 2016 have become increasingly polarized: The first Trump administration cut corporate taxes, deregulated various industries, and attempted to repeal the Affordable Care Act, while Biden reregulated said industries by imposing mandates on emissions, chemicals, and asbestos, first as Vice President and then as President. In general, these directives seem fundamentally opposed to each other. This paper will focus on three facets of the regulatory state brought to light in recent years: environmental policy, health policy, and financial regulation.

## Environmental Policy

The amount of research conducted on the impacts of environmental regulation has increased exponentially due to it drawing much more public attention in recent years. Critics of regulation in this sector typically value a prosperous economy, while advocates are willing to sacrifice some degree of economic health for the protection of the environment. The relationship between regulation and slowed economic growth is confirmed by the impacts of the EPA's recent tailpipe emissions rule. Finalized in March 2024, it aims to cut emissions in half by 2032 compared to 2026 standards for all vehicles. This, although not explicitly mentioned, strongly incentivizes the mass replacement of gasoline-powered cars with electric vehicles (EVs) in order to avoid more than 7 billion tons of carbon emissions over the next three decades. However, the *direct* economic impacts of such a decision are demonstrated in two ways: First, the shockingly large increase to the budget deficit as a result of EV tax breaks. A 2024 study finds that these provisions will end up costing the government \$870 billion through fiscal year 2031, which more than doubles the original estimate of \$400 billion (Committee for a Responsible Federal Budget, 2024). It was initially expected that the \$400 billion increase would have been offset by the benefits of this law, but the overwhelming success of EV tax breaks has enlarged the deficit to a point where government debt issuance has placed upward pressure on interest rates as inflation expectations remained high, increasing borrowing costs and slowing economic growth.

Second, the EPA has projected the increase in EV demand to lead to anywhere from 30%-56% of all vehicles sold in 2032 to be electric (Brady, n.d.). This shift to electric vehicles has already led to immense amounts of lost revenue from gas taxes. A legislative analyst report projects that transportation revenues for California alone will drop \$4.4 billion or 31 percent by 2034, with the projected loss for other states being around 21-30% (Petek, n.d.). Another study takes into account fuel savings, vehicle technology costs, maintenance savings, infrastructure costs, and climate benefits to calculate the net monetary effect of this law to be a \$1.4 trillion net loss (Bonifas & Considine, n.d.). However, this article was associated with the Cato Institute, an organization known for free market thought, which could explain the \$3 trillion discrepancy with the Environmental Protection Agency's (EPA) estimated \$1.6 million net benefit. Regardless, the EPA's estimate seems to overstate the benefit of the law.

Category	EPA Est. (Billions of USD)	Cato Est. (Billions of USD)
Pre-Tax Fuel Savings	+890	-139
Vehicle Technology Costs	-280	-1,228
Maintenance Savings	+410	+72
Climate Benefits	+330	+22
Infrastructure Costs	-120	-330
Net Total	+1,600	-1,407

Despite the negative effect on the economy, environmental regulation has shown significant benefits in the health of constituents. A connection has been found between consistent environmental regulation and healthier citizens (Pei, Chen, Liu, & Hu, 2023). The study, conducted across the provinces of China, used health data obtained from the

Chinese General Social Survey (CGSS) as the dependent variable and compared it to macro-level data on regional environmental regulation levels, which was the independent variable. It utilized a 5-point scale to measure perceived health levels, along with regulation levels. The study found that environmental regulation directly improves public health by promoting environmentally conscious innovations that yield long-term sustainability and reducing pollutant emissions.

Besides this, two specific findings and general trends were revealed from the study. First, that the beneficial impact of environmental regulatory policy generally increases over time, implying that consistent long-term regulatory policy yields a much larger impact on public health than younger ones. Second, that the positive impact of regulation was stronger among better-educated citizens, specifically those with a university degree or higher, who typically lived in high-concentration urban communities. This suggests that government involvement is more advantageous in densely populated areas, a finding that could inform future concerns surrounding public health. However, all things considered, the study found that the positive impacts of environmental regulation outweigh the negatives by a significant margin. While environmental regulation could negatively impact economic health by reducing wages and employment, this is overshadowed by the general benefit on public health.

## Health Policy

In 1976, the United States adopted the Toxic Substances Control Act (TSCA), which regulated the use of asbestos, lead, and other toxic and cancerous substances in consumer products. Despite this, a 2019 study finds that 12% of global chemical production originates from the US, and studies have shown that the chemical industry boasts a higher worker compensation rate than the manufacturing sector average (Belton, n.d.). The fact that these strengths exist alongside TSCA regulation raises the question of whether further regulation would help or hurt the industry.

To answer this question, the study points to chemical innovation trends from 2013-2018. During these years, the EPA changed the price to submit a new chemical application or pre-manufacture notice (PMN) from \$2,500 to \$16,000 for large companies, a 640% increase, and from \$200 to \$2800 for small companies—a 1400% increase. Simultaneously, PMN submissions dropped from 704 in Fiscal Year 2013 to 408 in Fiscal Year 2018, demonstrating an obvious correlation between heightened regulations and stifled innovation (Belton, n.d.). As a result, notice of commencement (NOC) rates dropped from 403 in FY 2013 to 184 in FY 2018. NOCs are required forms submitted by companies after PMNs are approved, and the 60% decline from FY 2013 to FY 2018 again signals reduced innovation output; not only is this an effect of the increased prices, longer review times and stricter regulations also create difficulties in introducing new chemicals. This is corroborated by the change in perceived risk of PMNs from FY 2013 through FY 2018. During the timeframe, each PMN had to receive either a “drop” or “not likely” rating if the risks were deemed insignificant enough by the EPA to immediately enter commerce, a “likely” rating if danger was probable, or an “insufficient information” rating. The same 2016 act that raised PMN submission prices also increased oversight and caution in evaluating new chemicals for market entry: Before the act was passed, “drop” and “not likely” ratings in 3 years averaged between 67%-71%. On the other hand, “drop and “not likely” ratings in the 3 years following the passing of the act were 13%, 8%, and 4% (2-3). This reflects a far stricter risk-assessment framework, significantly delaying market entry for all chemicals.

Efficiency Metric	Before TSCA	After TSCA
PMN Submission Price (Large Companies)	\$2,500	\$16,000
PMN Submission Price (Small Companies)	\$200	\$2,800
PMN Submissions	704 (FY 2013)	408 (FY 2018)
NOC Submissions	403 (FY 2013)	184 (FY 2018)
Low Perceived Risk	69% (avg.)	8.3% (avg.)
Est. Reporting Requirements (Hours)	129,000	11,600,000
Est. Reporting Requirements (USD)	\$10,800,000	\$800,000,000

In considering another side of the story, one notices that the TSCA was passed amidst growing public concerns over the ability of existing regulations to properly ensure safety: while pesticides, drugs, and food additives were regulated, the majority of chemicals were not, and the private sector, up to that point, had failed to come up with an effective way to ensure safety.

While the TSCA and the 2016 Lautenberg amendment enhanced security and reduced risk, they stifle innovation, adversely affecting chemical manufacturers. Particularly, EPA reporting requirements under TSCA were estimated to cost manufacturers over 129,000 hours and \$10.8 million in 2021, but by 2023, the estimated compliance burden had risen dramatically to about 11.6 million hours and more than \$800 million (Amber, n.d.). Additionally, these longer development and approval times lead to a situation in which many chemical products are not approved until they

are obsolete and useless to manufacturing. The new and novel chemical products make up 10-20% of total industry revenue, demonstrating the demand for innovation from other industries and individuals (Belton, n.d.). In 2022, the US chemical industry generated \$614.2 billion dollars in revenue and exported over \$494 billion worth of chemicals. On the other hand, TSCA-regulated products such as asbestos, methylene chloride, heavy metals, and PCBs kill hundreds of thousands of people every year in the US. However, almost all of these deaths can be attributed to existing high-risk products, including the ones previously mentioned, and not new chemicals. In fact, innovation in this realm would increase the creation of safe alternatives to the existing hazardous products the TSCA aims to regulate, and industry leaders have argued that certain regulations create de facto bans on chemistries essential to innovation, erasing the ability to innovate safer alternatives. Therefore, the evidence suggests policymakers must prioritize innovation in order to balance economic competitiveness with risk mitigation in this lucrative industry. As it stands, the TSCA has been mostly successful in ensuring chemical safety, but the evidence suggests that it also results in the United States missing out on potential economic and public health gains.

## Financial Regulation

Financial regulation is similar to health policy in that it focuses on preserving the safety of producers and consumers. However, this type of regulation specifically cares for the financial integrity of consumers. Although some regulations exert costs on producers, they are typically small, manageable, and are offset by the resulting positive developments. This trend can be seen more than 90 years ago in the Securities act of 1933, which mandated transparency on certain information about companies. This prevented stock prices from being overinflated and helped consumer confidence, driving economic growth. Whilst companies were slightly handicapped, the act helped the US economy to recover from the Great Depression. An EU-sponsored study looks at more modern examples of a similar concept, and it finds an overall positive economic impact from consumer protection measures derived from heightened consumer confidence, which leads to more sales, growing companies, and more jobs. For example, the study finds that a rule that restricted the use of chemicals in children's toys resulted in a loss of up to 3000 total jobs. However, it saw a major increase in online product sales for most sellers, resulting in a net economic benefit (Bukowski & Kaczor, 2019). These results are corroborated by the effects of the Directive on Consumer Rights (CRD) that guaranteed online buyers full transparency in their online purchases. It led to increased confidence in online shopping among 37% of consumers; thus, the study finds that for online purchases, 3% of the growth between 2014-2017 can be attributed to the CRD (9). Furthermore, the impacts of regulation are often amplified by the size of the industry; for example, the European Union saw a colossal increase in tourist revenue of €12.6 billion after implementing a regulation that established the simple rights of non-discrimination, assistance to the disabled, and other similar requirements (8-9, 37). To conclude, consumer protection laws are beneficial towards economic growth because they enhance consumer confidence, which amplifies demand and grows the targeted industry. Hence, the evidence suggests that a balanced approach—regulating large industries to maximize economic growth while deregulating smaller industries to facilitate quick initial growth—is the most effective consumer protection strategy.

## Conclusion

The debate over government regulation in the United States reflects broader tensions between economic growth and public welfare. While environmental and health regulations often incur economic costs and can hinder innovation, they also provide significant public health benefits and long-term sustainability. In contrast, financial regulations demonstrate that well-designed consumer protections can stimulate economic activity by boosting public trust. Together, these findings suggest that a nuanced, sector-specific approach that balances innovation, safety, and economic efficiency is essential for crafting effective regulatory policy in a polarized political climate.

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