UNIVERSITY OF SAN FRANCISCO

MASTERS THESIS

Differential Impacts of COVID-19 Policy Enforcement on Food Security Dynamics

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A thesis submitted in fulfillment of the requirements for the degree of Master of Science

in the

College of Arts and Sciences
Department of Economics

May 30, 2024

"If you want to make someone cry, " Bruno said slowly, "you give them an onion to chop. But if you want them to feel sad, you cook them the dish their mother used to cook for them when they were small..."

Anthony Capella, The Food of Love

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Abstract

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Differential Impacts of COVID-19 Policy Enforcement on Food Security Dynamics

by Shiv GARGÉ

The COVID-19 pandemic has exacerbated food insecurity in the United States, disproportionately affecting vulnerable populations. This paper investigates the county-level impact of various COVID-19 policies on food insecurity using data from the U.S. COVID-19 County Policy (UCCP) Database and Feeding America's Map the Meal Gap study. The study employs a Difference-in-Difference (DiD) approach and a Two-Stage Least Squares (2SLS) regression with two political instrumental variables to address potential endogeneity concerns. The DiD estimates did not show significant effects on the rate of change in food insecurity but indicated promising signs for absolute population values. The 2SLS results reveal that policies such as religious restrictions, curfew requirements, and movie theater closings may reduce food insecurity rates but no significant effect on the absolute population value. The effectiveness of these policies in reducing food insecurity depends on factors such as the duration of the policy, the level of support provided, and the specific needs of the affected populations. We further discuss the relevance of absolute population values to rates of change in food insecurity and why the use of the political instruments could be percieved as the long term effects of the political climate and resulting policy decisions This highlights the importance of considering the differential impacts of COVID-19 policies on food security dynamics at the county level. Understanding these nuances can inform targeted interventions and policies to mitigate food insecurity during the next public health crises.

Acknowledgements

I would like to express my deepest gratitude to Prof. Arman Khachiyan for his exceptional guidance and unwavering support throughout this research project. His invaluable insights and direction have been instrumental in shaping the course of this study. I am also immensely grateful to Prof. Jesse Antilia Hughs for his continued mentorship and for reigniting my passion for research. His encouragement and wisdom have been a constant source of inspiration. To my classmates, I extend my heartfelt appreciation for their camaraderie and support throughout this journey. Your presence has made the challenges more manageable and the successes more meaningful. I am honored to have shared this experience with you, and I eagerly await the opportunity to celebrate your future achievements, wherever your paths may lead. Finally, I would like to acknowledge the support of the University of San Francisco and all the faculty at the Department of Economics for providing the guidance, mentorship and resources while fostering an environment conducive to conducting research.

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Chapter 1

Introduction

1.1 Background

The COVID-19 pandemic, caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has triggered a global health crisis of unprecedented scale since its emergence in late 2019. By 2020, the pandemic had spread rapidly across the globe, prompting widespread public health measures such as lockdowns, social distancing, and travel restrictions to mitigate the virus's transmission. These measures, while necessary to control the spread of the virus, have had profound socio-economic repercussions, particularly in exacerbating food insecurity.

Food insecurity, defined as the lack of consistent access to enough food for an active, healthy life, has been a persistent issue worldwide, especially in low- and middle-income countries. However, the pandemic has significantly intensified this problem, disrupting food supply chains, reducing household incomes, and increasing unemployment rates. According to the Food and Agriculture Organization (FAO), the number of people facing food insecurity reached alarming levels during the pandemic, reversing years of progress in the fight against hunger.

The interplay between COVID-19 and food insecurity is complex, involving multiple dimensions of health, economy, and social well-being. The pandemic has not only threatened the availability of food but also its accessibility and affordability. Nutritional quality has also been compromised, as households resort to cheaper, less nutritious food options to cope with reduced incomes. This has significant implications for public health, as poor nutrition can weaken immune systems, making individuals more susceptible to illnesses, including COVID-19.

Moreover, the pandemic has stressed the importance of resilient food systems that can withstand such shocks. Various international organizations and governments have emphasized the need for comprehensive strategies to address food insecurity in the context of COVID-19. These strategies include social protection measures, support for agricultural production, and efforts to maintain open and functional food supply chains. There is also a growing recognition of the importance of local food systems and community-based initiatives in enhancing food security.

1.2 Research Objectives

The primary objective of this study is to investigate the differential impacts of COVID-19 policy enforcement on food security dynamics in U.S. counties. By employing a Difference-in-Difference (DiD) approach and a Two-Stage Least Squares (2SLS) regression with an instrumental variable based on 2020 election results, this research aims to estimate both the short-term and long-term effects of COVID-19 policies on food insecurity rates. The study will examine the relationship between county-level

COVID-19 policies and food insecurity rates using data from the U.S. COVID-19 County Policy (UCCP) Database and Feeding America's Map the Meal Gap. By highlighting the importance of considering both short-term and long-term effects and emphasizing the role of political factors in shaping policy decisions, this study seeks to provide insights on the effectiveness of these policies as a way to identify a optimal vector of policies during such public health crises.

Chapter 2

Literature Review

2.1 Food Security and Insecurity in the United States

2.1.1 Definitions of Food Insecurity

Most agreed-upon definitions stem out of the Food and Agriculture Organization (FAO) of the United Nations, and FAO defines food insecurity as a situation in which all people at all times have no access to good, safe, nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 2007). The definition determines some of the highlighted aspects, such as regular access to food, safety, and nutritional adequacy.

In contrast, the United States Department of Agriculture (USDA) provides definitions that are more elaborative in differentiating low from very low food security: Low food security is depicted as a state of "reduced quality, variety or desirability of diet", with no or little indication of reduced food intake, while very low food security depicts a state of "multiple indications of disrupted eating patterns and reduced food intake" (USDA, 2021). This serves to grade from compromised dietary quality for food insecurity into a significant reduction in food intake.

2.1.2 Academic Frameworks of Food Insecurity

Food insecurity has been elaborated upon by academic literature through its several dimensions, with the major contributions to the same coming from Maxwell and Smith (1992) and Amartya Sen (1981). The comprehensive framework proposed by Maxwell and Smith classifies food insecurity's dimensions along four broad channels: availability, access, utilization, and stability. Availability refers to the physical existence of adequate quantities of food. This dimension emphasizes whether an adequate food supply is available and can meet the needs of a population. It raises concerns over agricultural production, food stocks, imports, and whether that is enough to avert scarcities.

Access is defined as the capacity to derive proper foods by an individual or household in a manner sufficient to the dietary needs. The latter is actually determined by economic factors such as levels of income and food prices as well as social factors which include cultural practices and policy that may affect food distribution. It brings out the economic and social issues that can deny a person maximum access to adequate food even if it is available within the market.

Utilization is a biological proper use of food, facilitated by a diet that can meet the nutritional requirements of an individual; it is the processes of the body that absorb and metabolize ingested nutrients of food, which may be influenced by the status of health, food safety, and hygiene practices. Emphasize utilization as the quality of intake and health factors guaranteeing that the nutrient consumed is effectively used

by the body. The final component is stability, meaning the regular access to food and its utilization over time. This dimension has to do with time and the food security that prevents individuals from remaining affected by food insecurity due to seasonal climatic patterns, economic disruptions, or political instability. Stability implies that food security is not a temporary situation but a durable state of well-being.

Sen (1981) very substantially contributed from the aspect of academic research, so he concentrates on the access of individuals to food through their various entitlements. Entitlements are, in essence, a broad set of various ways through which people receive food, thus, through income, assets, or even social capital. Sen's work shifts the focus from the availability of food to its distribution and equity with regard to access to food resources. It raises the point that, notwithstanding adequacy in food supplies, the inadequacy of food can be exceedingly dominant. Supplies are adequate, but people are deprived of the means to access the resources. Quite the contrary, entitlement, disadvantages, and choices are taken into account in the framework of Sen, but further, this strengthens and highlights the importance of equitable food distribution and the role that societal structures play in ensuring food security.

2.1.3 Prevalence and Trends

Before the onset of the COVID-19 pandemic, food insecurity in the United States was a significant but slowly improving issue. According to data from the United States Department of Agriculture (USDA), food insecurity had been on a gradual decline since the Great Recession of 2007-2009. In 2018, approximately 11.1% of U.S. households were food insecure at some point during the year, compared to a peak of 14.9% in 2011. This decline indicated progress but also highlighted persistent challenges in ensuring all Americans had reliable access to adequate food (Coleman-Jensen et al., 2019).

The prevalence of food insecurity in the United States has varied across different demographic groups and regions. Households with children, single-parent households, and those headed by African Americans or Hispanics have consistently reported higher rates of food insecurity compared to the national average. In 2018, for example, 13.9% of households with children experienced food insecurity, and among households headed by single mothers, the rate was a striking 27.8% (Coleman-Jensen et al., 2019). Racial disparities were also evident, with 21.2% of African American households and 16.2% of Hispanic households facing food insecurity, compared to 8.1% of white non-Hispanic households (Coleman-Jensen et al., 2019).

Geographic disparities further lay open the imbalance in the distribution of food insecurity in the United States. It has been documented that rural areas and other southern states are prone to higher rates of food insecurity compared to the urban centers and other regions. Most of the factors that explain these disparities are in terms of lower average incomes, higher levels of unemployment, and reduced access to social services. For instance, the rates of food insecurity in Mississippi and Louisiana were among the highest in the entire country and yet the numbers of such states were far higher than what the state numbers alone could explain. This indicates a wider problem of socio-economic nature.

Multi-factoral precursors to food insecurity are economic, with vulnerable low-income families placed at another added burden. Even when the economy was bouncing back, and there was a subsequent boost in employment, many families were still experiencing the problems of inadequate wages, underemployment, and

the continuing rise of many of the costs of living, including for housing and healthcare (Nord et al., 2014). Other factors included important features of the safety net, such as the SNAP program, but eligibility and level of benefit of some households were found lacking (Bartfeld & Dunifon, 2006).

2.1.4 Consequences and Causes

Food insecurity creates more issues that are not confined to hunger. For instance, according to researchers, food insecurity is directly associated with poor health—both physical and mental health. Seligman and Schillinger (2010) have already found compelling evidence to the fact that food insecurity is linked to malnutrition and chronic diseases like diabetes and hypertension. In addition, food-insecure individuals are more likely to experience stress, anxiety, and depression as compared to food-secure individuals (Seligman & Schillinger, 2010). These, in one way or another, are bound to affect the quality of life of an individual in future.

Furthermore, food security has often proved to be a reliable predictor of the educational performance of children. Jyoti et al. (2005) established that food-insecure kids tend to perform poorly in schools and often skip school more frequently when compared to food-secure children. Due to this educational lag, their future social mobility may be at stake. Finally, food insecurity affects the future economy greatly. Cook and Poblacion (2016) have already noted that, "The problem of food insecurity is relentless in tacking on healthcare costs and depressing productivity, processes with a negative effect that is mutually powered by one another" (p. 324).

Food security is crippled by the lack of access and mobility. For instance, according to the results that were obtained by Baek (2016) and Ver Ploeg et al. (2015), restricting transportation severely exacerbates food insecurity in underserved areas, and makes it challenging for people to access grocery stores and any other food outlet. Another challenge that drives food insecurity is racial inequality. Structural discrimination is one that raises the rate of food insecurity among communities of color, and this is in convergence with inequalities in education, employment, and healthcare (Odoms-Young & Bruce, 2018; Coleman-Jensen et al., 2022; Feeding America, 2022). This is likely to unravel serious structural challenges in eradicating food insecurity and providing equal access to nutritious diets.

2.2 COVID-19 Pandemic and Policy Responses

2.2.1 Global and U.S. Policy Implementation

The COVID-19 pandemic provoked a wide array of policy responses from many countries, revealing significant diversity in the strategies and effectiveness of these implementations. Globally, measures to combat the virus included various forms of lockdowns, travel restrictions, social distancing mandates, and, in some cases, economic stimulus packages. However, the effectiveness and impacts of these policies varied significantly depending on the quality of each country's healthcare infrastructure, economic stability, and governance.

Most European and Asian countries emphasized that early and aggressive intervention was key to controlling the virus's spread. For example, South Korea and New Zealand managed to control the infection in its earlier stages by rapidly increasing testing and contact tracing capacity and enforcing strict quarantine measures. South Korea exemplifies a country that confronted the pandemic head-on, conducting massive testing promptly with the help of a robust healthcare system

and efficient governmental coordination. Infected individuals were quickly isolated. New Zealand achieved one of the lowest COVID-19 mortality rates globally thanks to stringent lockdowns and clear communication strategies.

In contrast, the United States exhibited a decentralized approach, with significant policy diversity across states. The federal nature of the U.S. system resulted in state governments playing a central role in health policy, leading to a patchwork of policies. Some states adopted stringent measures, while others were more lenient. For instance, New York implemented severe restrictions and mandatory mask-wearing, effectively containing the initial surge of COVID-19 cases. In contrast, restrictions were slower to be implemented in Florida and Texas, resulting in prolonged periods of high transmission rates.

The economic responses also varied widely. In the U.S., the federal government enacted several significant relief packages, including the CARES Act, which provided monetary relief to individuals, expanded unemployment benefits, and offered support to businesses. These measures were crucial in temporarily mitigating the economic impact of the crisis for many Americans. However, logistical challenges and delayed implementation processes diminished the effectiveness of these interventions, such as the distribution of unemployment benefits and Paycheck Protection Program (PPP) loans.

2.2.2 Impact on Food Security

While these general interventions of imposing lockdowns, issuance of social distancing orders, and travel restrictions are key in controlling the spread of the virus, they disrupt food supply chains, reduce household incomes, and increase food prices with an increased intensity of food insecurity among the vulnerable populations.

These were among the first policy actions taken globally. Food value chains were among the first to feel the pinch as smallholder farmers and informal food vendors were highly affected. For instance, Reardon et al. (2020) point out that lockdowns in the early months of the COVID-19 pandemic have resulted in a loss of food supply from the rural markets to the urban markets, and at the same time, contributed to an increase in food losses and the unavailability of fresh products. The closure of local markets and food outlets exacerbated these problems, more so in developing countries where informal markets have a huge share of food distribution.

For instance, economic policies during the pandemics that included closure of businesses and lay-offs resulted in income loss for most households, hence increasing insecurity in access to food. This in turn led to a drop in the purchasing power of most households, making it difficult to access healthier foods. Laborde, Martin, and Vos (2020) pointed out that a recessionary effect caused by the pandemic had since resulted in significant unemployment and reduction of purchasing power, thereby marking the inaccessibility of healthier food. Notably, it was high in low-and middle-income countries with inadequate social safety nets to cushion the economic shocks. Another crucial policy response in the pandemic is the closure of schools, which again has very wide scope starting from discussion on food safety, most importantly, for children who consider this as their main source. Interestingly, Dunn et al. (2020) also noted that the closure of schools disorganized many programs for child nutrition, thus losing a stable source of taking daily nutrition, hence putting into risk not only hunger then but other future effects on health and educational outcomes.

2.3 Theoretical Framework

2.3.1 Socio-Ecological Model

A Socio-Ecological Model (SEM) is useful in understanding the complexity and interlink of factors that influence food security at many differing levels. Oriented from the works of Bronfenbrenner (1979) and McLeroy et al. (1988), the model regards the levels as individual, interpersonal, organizational, community, and policy; therefore, capturing the significance each level plays in shaping the results in food security (Green and Glanz, 2015). At an individual level, determinants like income, employment status, educational background, health conditions, etc., are most likely to shape access and affordability of healthy foods by an individual. For example, individuals with low income or being unemployed will face major hurdles in achieving food security. To worsen the situation is a health condition such as chronic diseases or disability, since it further worsens food insecurity by limiting the capacity of an individual to work while increasing health care costs. Social relationships with others, family relations, and social networks also impact food security. Social buffer from family relationships as well as support systems and strained relations with others in the household result in household instability hence posing a higher risk (Chilton et al., 2018). Social networks such as friends, neighbors, and community groups provide resources, knowledge, and emotional support all aimed at spreading the flourishing of food security (Gundersen & Ziliak, 2018). The institutional level, however, pertains more specifically to organizations and institutions, such as schools and workplaces, that comprise food security. For instance, a child in a food-insecure household could have access to a reliable source of nutrition from school meal programs. Similarly, workplace policies, such as living wages and paid sick leave, could also be relevant to this level when it comes to determining whether—and how—employees might retain their food security. Community levels of food insecurity are determined by food deserts or the availability of only unreliable, poor access to inexpensive, good quality food, in their community. This definition includes transportation barriers as lack of reliable public transportation or access to a vehicle, which adds to the burden of accessing food resources. context within which food security is known, be they local, state, and federal level policies and programs. For instance, the Supplemental Nutrition Assistance Program, and the National School Lunch Program are among the important programs which have been put in place in such contexts to support food-insecure households within society. Examples of critical decisions may be around the allocation of funds, sets of eligible people, and benefit levels among others, which would determine success in such policy interventions and the resultant in food security level. The SEM model is very relevant to the COVID-19 pandemic in establishing how differently undertaken regulations at various levels would differentially affect the food security landscape. For example, mass quarantine and business shutdowns at the community level might have led to increased unemployment, leading to decreased income and thus contributing to compounding the issue of food insecurity for many households even further (Raifman et al., 2021). In contrast, the school-based nature of meal provision at the organizational level might increase food insecurity for children and families as a result of school closures and the resultant disruptions of school meal programs (Dunn et al., 2020).

2.3.2 Political Economy Theory

One of the supporting theories towards a critical approach is the Political Economy Theory, which seeks to analyze how political and economic factors interact to influence food security, particularly under the COVID-19 pandemic (Laborde et al., 2021). This theory argues out the power relations, institutions, and policies of resource allocation that determine the consequences of policies taken to determine those that would maintain the process. Political Economy Theory, at the core, recognizes that choices for policy are not made in a vacuum; they are a reflection of the interests and incentives of the actors at different levels of the policy process, including policymakers, interest groups, or even the public at large (Dunn et al., 2021). The application of this theory in the design of policies regarding COVID-19 and on food security and nutrition in general suggests that the setup and design of such are subject to political ideology, electoral prospects, and the relative power of different stakeholders in society, either way (Gundersen et al., 2021). So, for example, in deciding the length of the lockdown, closure of businesses, and social distancing measures, policymakers will have to balance the benefits of public health concerns against the possible costs of economic interest. For example, the influence of public health advocates and business groups, and other stakeholders, will help structure the relative balance between the competing priorities and hence determine the extent to which policies are oriented toward specific food security outcomes. Besides, it draws attention to the political economy approach for the understanding of the distributional impacts of policies because there can be differential impacts on different classes in society (Klassen & Murphy, 2020). In the manner of protection of food security, there should be consideration of the fact that COVID-19 policies will likely shake low-income families, color communities, and other vulnerable populations from their already precarious situations on food security (Wolfson & Leung, 2020). The diverse groups hit by job losses in terms of wage reduction and incurring other varied economic hardships due to the pandemic are more likely to belong to these groups, which will exacerbate inequalities in access and affordability of the food basket (Laborde et al., 2021). More so, the effectiveness of policies developed in response to food insecurity may reflect not only their design, but also the implementation and other relevant institutional settings within which they are operationalized. Most critically, this would involve the capacity of relevant governmental organs to enforce implementation of those programs, the availability of means and sources, and coordination with other levels of government and civil society organizations. Decentralization tends to increase the wide variation across states and counties, and that, in turn, creates both challenges and opportunities for the political economy of food security in response to COVID-19 in the US. In one sense, that variation provides the means to investigate how different policy approaches—themselves determined by local or state political economic features—may shape food security outcomes, as has been done for health outcomes. On the other hand, a lack of coordinated national response may serve to lay bare that very same inequality and serves to assure that a piecemeal set of policies will be less effective in facing food insecurity down the road. This paper can therefore apply Political Economy Theory in understanding the COVID-19 policies as they regard how they affect food security by revealing the deep political and economic drivers behind the policy decisions. Consequently, this knowledge might aid in framing more equitable and effective policy interventions that give primacy to the needs of the vulnerable populace in a manner that redresses structural inequalities responsible for food insecurity (Laborde et al., 2021).

Chapter 3

Methodology

3.1 Data Sources

3.1.1 U.S. COVID-19 County Policy (UCCP) Database

The United States COVID-19 County Policy Database is a large database developed to systematically gather, characterize, and assess differences in the policies between counties in the United States. The initial wave of data collection for the UCCP Database occurred in 171 counties across seven states, them being California, Louisiana, Mississippi, New Jersey, New York, Texas, and Utah. Collectively, these counties accounted for a total population of 90.4 million, more than one-quarter of the U.S. total population. While this sample was not designed to be nationally representative, it aimed to obtain a reasonable mix of geography, race/ethnicity, and political alignment.

Data on these counties were collected from January through the end of March 2021, providing a snapshot of the policies in place during this period. The research team also collected data on the referring states twice—once in January 2021, just before collecting the county data, and again in February–March 2021, immediately following the county data collection.

The UCCP Database included information on 22 policies, organized under three broad domains identified in pre-existing work: containment and closure, economic support, and public health measures. The policies tracked were those from the Oxford COVID-19 Government Response Tracker, excluding those not applicable at the county level (e.g., border control) and including additional policies relevant to local health (e.g., housing support). Each policy was presented with a multi-point policy indicator created by the study team to score the policy based on its level of comprehensiveness. The allowed us to not only see if a policy was effective or not, but at what level of enforcement.

Due to issues with the FIPS (Federal Information Processing Standards) coding format used in other datasets, our sample of counties was reduced from the initial 171 to 94. The FIPS codes, which uniquely identify geographic areas, encountered compatibility issues when merged with datasets that used different formatting conventions or had discrepancies in the coding structure. These inconsistencies led to difficulties in accurately matching and integrating the county-level data with other sources, necessitating the exclusion of certain counties from the final sample. As a result, the analysis was conducted on a refined sample of 94 counties, which still provided a diverse mix of geographical locations, demographics, and policy environments, although it limited the breadth of the original dataset.

3.1.2 Feeding America's Map the Meal Gap Study

Feeding America's Map the Meal Gap dataset is an essential resource for understanding the landscape of food insecurity across the United States. This dataset provides comprehensive data on food insecurity at the county level, offering detailed insights into the prevalence and distribution of food insecurity among different populations.

Combining data from the Current Population Survey, the American Community Survey, the Bureau of Labor Statistics, and Nielsen, these datasets provide an illustrative survey of food insecurity. It measures the percent of the population that is food insecure and average meal costs at the county level. The methodology would take into account such aspects as poverty rates, median household income, and unemployment rates to get estimations that are locally reflective and accurate.

Key features included specific geographic data, the demographic makeup of food insecurity, and data on food cost for developing interventions and assessing targeted food assistance programmes. The dataset is for use by policymakers, community organizations, food banks, and researchers to provide the evidence needed to craft policy in the area of effective food security, programme planning, and research into the causes and impacts of food insecurity.

This is the data pertaining to the two outcome variables: the absolute number of the food-insecure population and the percent of the population that is food insecure.

3.1.3 American Community Survey Data

The American Community Survey (ACS), conducted by the U.S. Census Bureau, provides comprehensive socio-economic and demographic information. For this research, the ACS 5-year estimates from 2014-2019 were used as the pre-period dataset, while the ACS 1-year estimate for 2021 served as the post-period dataset. The 5-year estimates, based on data collected over 60 months, offer reliable and precise estimates for smaller geographic areas, making them suitable for examining county-level trends. The 1-year estimate for 2021 provides the most current snapshot of socio-economic conditions, albeit with smaller sample sizes and potentially higher margins of error. The ACS data was crucial for controlling various socio-economic factors in this study, accounting for potential confounding factors that might influence the observed outcomes. Key controls included income levels, employment and unemployment rates, educational attainment, poverty rates, population demographics, and housing characteristics. These factors can significantly impact food security, access to resources, and vulnerability to food insecurity. Using the ACS 5-year estimates for the pre-period established a stable baseline reflecting socio-economic conditions before the COVID-19 pandemic, while the 1-year estimate for 2021 provided insight into changes in the wake of the pandemic and associated policy responses. Comparing these periods enabled the identification of shifts in socio-economic factors and their potential impacts on food insecurity.

3.1.4 Department of Transportation County Car Use Data

The Department of Transportation (DOT) County Car Use Data was included in this analysis in order to capture the influence imparted by transport access and mobility on food security outcomes. The dataset provided information on the amount of frequency for the trips and the number of trips made by residents in total within every county. Access is a key logistical factor in whether one can access food in regions where it might be difficult to use public transportation or where food outlets

are not plentiful or available. Other studies have shown that inaccessibility of reliable transport exacerbates food insecurity, where distance to food outlets remains a barrier from stores with nutritious foods as simple as grocery stores to food banks, among others (Baek, 2016; Ver Ploeg et al., 2015). This research seeks to control for the influence of transportation access on food security outcomes by including the DOT County Car Use Data. Trips frequency and total trips will be proxies for the mobility level in a county, and this therefore means that in counties where the trips are more frequent, and cumulatively the total trips are higher then it may be easy to access transportation that may cushion the weight of food insecurity. Furthermore, the COVID-19 pandemic catalyzed dramatic changes in the patterns and behaviors of transportation: shelter-in-place orders, business-activity closures, and a shift towards remote work and learning have different implications for traveling and accessibilities. In addition, we can further understand how changes in mobility from transportation data of the post-pandemic period have affected food security outcomes in 2021. The data the county car of the department of transportation provide is thus harmonized with other variables from the socio-economy and demography, to establish the complex factors that impact food security. As such, this paper, through the addition of the transportation access variable, gives further insights on the role mobility plays in exacerbating or alleviating the effect of COVID-19 policies on food insecurity at courty levels.

3.2 Identification Strategies

3.2.1 Difference-in-Difference (DiD)

The DiD approach compares the changes in outcomes over time between a treatment group (counties exposed to COVID-19 policies) and a control group (counties not exposed to these policies). By comparing the differences in outcomes before and after the policy implementation, the DiD method can isolate the causal effect of the policies, controlling for any pre-existing differences between the treatment and control groups. In the context of this research, the treatment variables are the COVID-19 policies, which are categorized into different levels of severity and binary implementation status. The outcome variable is the overall food insecurity rate at the county level. The DiD approach is used to estimate the impact of these policies on food insecurity rates, comparing the pre-period (2014-2019) and post-period (2021) outcomes. The two DiD models are as follows:

$$\text{FoodInsecurity}_i = \beta_0 + \beta_1 \text{Policy} + \beta_2 \text{Post} + \beta_3 (\text{Policy} \times \text{Post}) + \delta X_i + \epsilon_i \quad (3.1)$$

The second model identifies looks at the absolute number of individuals who are food insecure:

$$|\text{FoodInsecurity}_i| = \beta_0 + \beta_1 \text{Policy} + \beta_2 \text{Post} + \beta_3 (\text{Policy} \times \text{Post}) + \delta X_i + \epsilon_i \quad (3.2)$$

Where:

- $|\text{OvrlFoodInsecRate}_i|$ is the overall food insecurity rate for county i.
- Policy is a dummy variable indicating the presence or severity of a specific COVID-19 policy.

- X_i is a vector of control variables for county i, including socio-economic and demographic factors.
- δ is a vector of coefficients for the control variables.
- ϵ_i is the error term.

The coefficient of interest is $\beta 3$, which represents the causal effect of the COVID-19 policies on food insecurity rates, after controlling for pre-existing differences and other relevant factors. The DiD approach relies on the parallel trends assumption, which requires that the treatment and control groups would have followed similar trajectories in the absence of the policy intervention.[1]

3.2.2 Two-Stage Least Squares (2SLS) with Instrumental Variables

The Two-Stage Least Squares (2SLS) instrumental variable regression is an econometric technique employed to address potential endogeneity issues in the relationship between COVID-19 policies and food insecurity rates. Endogeneity arises when unobserved factors influence both the treatment (COVID-19 policies) and the outcome (food insecurity rates), leading to biased estimates of the causal effect. In the context of this study, endogeneity may occur if there are underlying factors that simultaneously affect the implementation of COVID-19 policies and food insecurity rates, such as political ideology, socio-economic conditions, or public health considerations.

To mitigate endogeneity concerns, this study employs an instrumental variable (IV) approach using two instruments: the county-level vote share from the 2020 presidential election and a binary variable indicating whether a Republican or Democrat won the county. The idea behind this assumption is that political county identity, which is revealed by the vote share, might be positively related to the probability of policy adoption. This same identity, revealed in the vote share, could also be related to policy implementation or toughness on COVID-19. While the vote share percent and the binary are expected to have no direct impact on the food insecurity rate—since at the very core, the causes of food insecurity are basically economic, social, and individual—the instruments are likely to affect food insecurity rates only such as how they affect COVID-19 policy implementation, which in turn can affect the levels of employment, income, and food resources.

First Stage:

$$\text{Treat}_{ji} = \pi_0 + \pi_1 \text{VotePercent}_i + \pi_2 \text{PartyDummy}_i + \gamma X_i + \epsilon_i \tag{3.3}$$

Where:

- Treat_{ji} is the predicted value of the COVID-19 policy variable for county i.
- VotePercent_i and PartyDummy_i are the instrumental variables (vote percentage and party affiliation dummy).
- X_i is a vector of control variables for county i, including socio-economic and demographic factors.
- γ is a vector of coefficients for the control variables.
- u_i is the error term.

[1] Parallel trends and other assumptions being met are put forward in the appendix.

Second Stage:

$$\text{OvrlFoodInsecRate}_i = \beta_0 + \beta_1 \text{Treat}_{ji\_hat} + \delta X_i + \epsilon_i \tag{3.4}$$

In the context of the 2SLS IV regression, the choice of outcome variable can affect the interpretation and significance of the results. When using the percentage measure of food insecurity, the 2SLS IV regression estimates the causal effect of COVID-19 policies on the relative prevalence of food insecurity within counties. The IVs - vote percentage and the binary variable indicating the winning party - capture the exogenous variation in COVID-19 policies driven by political factors. The 2SLS regression using the percentage measure can reveal how changes in COVID-19 policies, as influenced by political support, impact the proportion of the population experiencing food insecurity.

Chapter 4

Results

4.1 2SLS Estimation Results

From **Table A.1**, it indicates that the coefficients for the gym closing (0.0477), restaurant closing (0.0494), movie theater closing (-0.0608), religious restrictions (-0.0379), and curfew requirement (-0.0421) are found significant at the level of 0.1%. The coefficients on the gym and restaurant closing variables are positively signed, meaning that the implementation of these policies is associated with growth in the rate of food insecurity. On the opposite, the coefficient signs for the movie theater closing, religious restrictions, and curfew requirement are all negatively signed, signifying that the implementation of these policies is associated with a decrease in the food insecurity rate.

Table A.2 presents results for additional COVID-19 policies. Two statistically significant coefficients at the 5% level, housing support (-0.114) and utility support (-0.108), are negatively related to the food insecurity rate. Two policies are statistically significant at the 1% level: contact tracing (-0.0593) and vaccine policy (0.0547). Here, contact tracing is negatively related to the food insecurity rate, while the vaccine policy is positively related to the food insecurity rate.

The results for the absolute measure of food insecurity are reported in **Tables A.3** and **Tables A.4**. None of the coefficients across the tables appears to be statistically significant at the 5% level or below; that is, resorting to the 2SLS IV approach returns no significant influence of COVID-19 policies on the absolute food insecurity indicator.

4.2 DiD estimation results

When examining the food insecurity rate, the DiD estimates reveal that none of the COVID-19 policies have a statistically significant effect at the 5% level or below. This finding suggests that, based on the DiD approach, the implementation of policies such as housing support, utility support, contact tracing, vaccine policy, gym closing, restaurant closing, movie theater closing, religious restrictions, and curfew requirements did not significantly influence the proportion of the population experiencing food insecurity. However, the results differ when considering the absolute measure of food insecurity. Table B.3 shows that the coefficient for vaccine policy (3817.9) is statistically significant at the 5% level, indicating a positive relationship with the absolute number of food-insecure individuals. This finding implies that the implementation of vaccine policies is associated with an increase in the total count of people facing food insecurity. It is important to note that this result does not necessarily contradict the lack of significance in the food insecurity rate analysis, as the absolute measure captures the overall magnitude of food insecurity rather than

the relative proportion. Table B.4 presents further interesting findings regarding the impact of religious restrictions and curfew requirements on the absolute measure of food insecurity. The coefficients for religious restrictions (-4811.7) and curfew requirements (-3339.7) are significant at the 1% and 5% levels, respectively, and both have negative values. These results suggest that the implementation of policies that restrict religious gatherings and impose curfews is associated with a reduction in the absolute number of food-insecure individuals.

Chapter 5

Discussion of Findings

5.1 Food Insecurity in the SEM framework

Interpreting these results through the lens of the Socio-Ecological Model (SEM), we can see how policies implemented at different levels of the social ecology can have varying impacts on food insecurity. The SEM framework allows us to consider the intricate interplay between individual, interpersonal, organizational, community, and policy factors that shape food security outcomes.

At a personal level, economic stability is brought into focus by programs like housing and utility support. Taking the economic pressure off the family when responsible for rent, mortgage, or utility payments allows them to maintain their housing status and not become so cost-burdened that it results in food insecurity. When these people have stable housing and can afford food basics, they are in a better position to allocate resources to the purchase of poor food in sufficient quantities.

Social networks and relationships are addressed at the interpersonal level of the SEM framework, and the ways that food security can be influenced are considered. The COVID-19 policies under review in this paper do not target the interpersonal factors directly, but they could alter people's capabilities to rely on their social connections to give food help. For example, people become less supportive in helping the rest of the network members, who are now food insecure, upon the closure of a business where a family member or close friend has lost a job.

Policies that affect businesses and institutions at an organizational level will spell doom with regard to food insecurity. For example, wherever there is a closure of gyms and restaurants, there comes a loss of jobs and lower incomes for such employees. Things are, therefore, likely to be really hard for such families that would previously afford to buy enough food. This is further compounded by the fact that when schools and childcare centers close, there is a break in the provision of food to children by such programs.

Community-level policies, like cinema closures, religious restrictions, and curfew requirements, can be intertwined with complicated relationships with food insecurity. While such policies are initiated for the major purpose of slowing down the spread of COVID-19, the secondary effects on local economies and social protection mechanisms would subsequently affect food security outcomes. theatres generate significant spillovers for restaurants and other local service businesses. With the closure of theatres, the local economic activity would suffer, and spillover effects of the expenditures would also be lost to most of the portion of the population in those areas, threatening food security. That is added to the backdrop of a moment when many of these workers are probably in low-wage or precarious employment and thus vulnerable to economic shocks.

On the flip side, religious restrictions, especially in terms of gathering and providing service, may also have snowballing impacts on food insecurity. Faith-based

institutions provide food aid, among other social services, to their members in need. Many religious congregations run food pantries, meal programs, and other initiatives that help reduce food insecurity. Religious restrictions are helpful in limiting the provision of in-service in the organization, which may hurt the already food-insecure and needy individuals and families. Additionally, the requirements for a curfew extend the limits of community-level indirect food insecurity. The time-bound implementation of curfews could translate into closure of the different sources of obtaining food among grocery shops and food markets and result in added costs accruing to making the accessibility of food from affordable and nutritious sources expensive (Hecht et al., 2020). The predicament is felt particularly by low-income families and those with few means of transport but who rely on off-peak hours to go grocery shopping or access food assistance programs (Shannon et al., 2022).

5.2 Politics and the Pandemic

The Political Economy Theory suggests that the electoral outcome, and the subsequent changing political power dynamics, may have changed the landscape of policy options regarding COVID-19 and their effects on food insecurity. The new administration bore a new set of priorities, values, and approaches in reacting towards the pandemic and its socio-economic fallout.

For instance, the Biden administration highly emphasized increasing the speed of vaccine distribution and access to vaccination in order to reach all hard-to-reach and marginalized populations, employing the country's community health centers. However, food insecurity is one area in which focusing on vaccination may have boomeranged, given the positive association of vaccine policy and identified food insecurity in the 2SLS IV food insecurity rate.

Besides, politics could also have changed the allocation of resources and the respective support to many social welfare programs of the changes in the political atmosphere. The Biden administration favored a more aggressive set of economic relief policies, like increased benefits from unemployment insurance and further direct economic impact payments to households (Tankersley & Crowley, 2021). While protective in design to protect the affected from the pandemic, these would differentially affect food insecurity based on their design, implementation, and target households.

The shift in political priorities and the policies that receive more attention than others may also have shaped public debate and views of how the response to the pandemic is unfolding. For instance, more intense political polarization and the competition of other narratives on issues of mask mandates, business closures, and social distancing measures may have affected public adherence to these specific policies. In what effect they would finally have on controlling the spread of the virus has been debated over (Allcott et al., 2020).

The 2020 election results, and the transfer of power, for that matter, are other influences that could have changed the intergovernmental dynamics among federal, state, and local governments in their response to the pandemic. How the new administration leads in intergovernmental coordination and in support of state and local efforts also could influence the ultimate consistency of resulting policies on COVID-19 and effectiveness across these jurisdictions (Gordon et al., 2020).

Second, the election outcome may have influenced the terms and timing of the negotiation and approval of COVID-19 relief legislation in Congress; allegedly, the

relative proportions of Democrats and Republicans in the House of Representatives and the Senate influenced not just the overall level and speed of relief but also the targeting of the relief provisions and, hence, of food insecurity on the more vulnerable demographic groups (Rocco et al., 2020).

In that spirit, vote share and party affiliation could be the exogenous instrumental variable in this 2SLS estimation through the IV of the long-term effects that political climate may have on COVID policies and food insecurity. Using the exogenous variation in policy decisions induced by electoral results, the approach would provide a way to explore the causal mechanisms through which political factors affect food security outcomes.

The less important point is just to notice that the relationship between political climate and food insecurity is much more complex and multidimensional. Although the 2020 election may change the policy landscape and its priorities, final impacts on food security are probably shaped by a much wider set of factors: policy effectiveness in implementation, resilience at the local levels, and larger economic and social conditions (Béné, 2020).

5.3 Temporal Interpretations of Rates and Absolutes

The rate of food insecurity will most likely decrease but over a long period of time because policies and interventions have a time-lag effect when they are implemented and diffused through levels of the social ecology. For example, access policies for food assistance, employment-increasing policies, and community-level food policy may all have a slow but sustained long-term effect in reducing the overall prevalence of food insecurity (Gundersen et al., 2021). Most of the time, structural changes, capacity building, and changes in social norms and behaviors are involved in such policies, and they take time to take hold, after which they bring about measurable changes in the rate of food insecurity (Béné, 2020).

This is not to say that the rate of food insecurity is much more sensitive to long-term shifts in the political climate and policy priories. The second-staged 2SLS IV estimation with vote shares and party affiliation among the instrumental variables allows attribution of more, if not most, aspects of this long-term feature of the political landscape. These instrumental variables are likely to pick up reflected policy decisions and resource allocations over a long time span that affect food insecurity in general (Huang et al., 2021). For example, the higher rate of vote shares could have been due to policy implementations promising a serious commitment in the long run concerning the elevation of social welfare programs or which affected community food systems.

In contrast, the absolute measure of food insecurity quantifies the number of people in the food-insecure condition; thus, it may be more responsive to policy short-term shocks and immediate economic disturbances. It captures the acute impact of policies and events on the depth and severity of food insecurity in affected populations over time (Coleman-Jensen et al., 2021).

Lockdown measures, business closures, and social-distancing requirements became suddenly operative, likely to bring variable instant changes in absolute numbers of those facing food insecurity. These policies disrupted supply chains for food, induced joblessness, and caused reductions in income, which in turn shot demand through the ceiling for emergency food assistance (Hecht et al., 2020). More probable, such sudden spikes in the number of people experiencing hardships because

of foods are captured by it, thus making the absolute measure of food insecurity sensitive to acute economic and social shocks catalyzed by the pandemic.

Second, the absolute measure is likely to be more sensitive to explicit policy and emergency relief actions that are directly targeted at meeting the immediate food needs of food-insecure people. For example, the use of food-assistance programs has expanded to include the Supplemental Nutrition Assistance Program and the Pandemic Electronic Benefit Transfer, in which direct benefits went to food-insecure households shortly after their implementation (Dunn et al., 2020). In this respect, such interventions can more quickly create the incidence effect by reducing the absolute count of food-insecure people, in contrast to directly changing the overall prevalence of food insecurity on a long-term basis.

Chapter 6

Conclusion

6.1 Summary of Key Findings

This study investigated the differential impacts of COVID-19 policy enforcement on food security dynamics in U.S. counties using a combination of Difference-in-Difference (DiD) and Two-Stage Least Squares (2SLS) with instrumental variables (IV) approaches. The analysis revealed several key findings:

- The 2SLS IV estimates showed that policies such as gym and restaurant closings were associated with an increase in the food insecurity rate, while movie theater closings, religious restrictions, and curfew requirements were associated with a decrease. Housing support, utility support, and contact tracing were negatively related to the food insecurity rate, while vaccine policy showed a positive relationship.
- The DiD estimates did not show significant effects of COVID-19 policies on the food insecurity rate but indicated significant relationships with the absolute measure of food insecurity for vaccine policies, religious restrictions, and curfew requirements.
- The Socio-Ecological Model (SEM) framework provided insights into how policies implemented at different levels of the social ecology can have varying impacts on food insecurity, highlighting the importance of considering the complex interplay between individual, interpersonal, organizational, community, and policy factors.
- The Political Economy Theory helped explain the observed relationships between COVID-19 policies and food insecurity, emphasizing the role of power dynamics, institutional arrangements, and competing interests in shaping policy decisions and their outcomes.
- The distinction between the food insecurity rate and the absolute measure of food insecurity revealed different temporal dynamics of policy impacts, with the rate capturing long-term effects and the absolute measure reflecting short-term impacts.
- The use of vote share and party affiliation as instrumental variables in the 2SLS IV estimation captured the potential long-term effects of the political climate on COVID-19 policies and food insecurity, suggesting that the 2020 U.S. presidential election and the resulting changes in the political landscape could have influenced policy priorities and their impacts on food security outcomes.

6.2 Contributions to the Literature

This study adds to the literature on food insecurity and policy responses to COVID-19. On the first account, through SEM and Political Economy Theory, it develops a new comprehensive framework in the mechanisms of policy moderation in the face of COVID-19. It makes the argument that multiple levels of influence in the policy solution and the influence of political factors shape the outcome of policy.

We adopt both the Difference-in-Differences and Two-Stage Least Squares Instrumental Variables approaches to allow a strict empirical analysis of the causal impact of COVID-19 policies on food insecurity. This dual-method approach will allay concerns of endogeneity and provide important insights into the temporal dynamics of policy effects.

It additionally distinguishes between a food insecurity rate and an absolute measure of food insecurity, pointing out the different dimensions of food insecurity the measures refer to, which will be important to draw out the respective policy implications of the measures.

The variation in COVID-19 policies comprises containment measures, economic support, and public health interventions, in which the study is involved. This broad assessment allows one to understand in detail the different effects that these policies could have on food security outcomes.

Last but not least, the potential long-term effects on COVID-19 policies and food insecurity, with the consideration of the political climate and the 2020 U.S. presidential election, expand the analysis further. It has exposed and deepened the political intricacies and interrelated factors in a way by which policy outcomes arise in a public health crisis.

Appendix A

2SLS IV Regression Outputs

TABLE A.1: IV 2SLS - Food Insecurity Rate I

	(1) ovrl_food_insec_rate	(2) ovrl_food_insec_rate	(3) ovrl_food_insec_rate	(4) ovrl_food_insec_rate	(5) ovrl_food_insec_rate
gym_closing_c_1	0.0477***				
	(0.0107)				
restaurant_closing_c_1		0.0494***			
		(0.0120)			
movie_theater_closing_c_3			-0.0608***		
			(0.0160)		
religious_restrictions_c_2				-0.0379***	
				(0.00762)	
curfew_requirement_c_1					-0.0421***
					(0.0108)
N	188	188	188	188	188

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

TABLE A.2: IV 2SLS - Food Insecurity Rate II

	(1) ovrl_food_insec_rate	(2) ovrl_food_insec_rate	(3) ovrl_food_insec_rate	(4) ovrl_food_insec_rate
housing_support_c_1	-0.114*			
	(0.0483)			
utility_support_c_1		-0.108*		
		(0.0475)		
contact_tracing_c_2			-0.0593**	
			(0.0181)	
vaccine_policy_c_3				0.0547**
				(0.0183)
N	188	188	188	188

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

TABLE A.3: IV 2SLS - Absolute Food Insecurity I

	(1) pct_food_insec_overall	(2) pct_food_insec_overall	(3) pct_food_insec_overall	(4) pct_food_insec_overall	(5) pct_food_insec_overall
gym_closing_c_1	4068.5				
	(2185.0)				
restaurant_closing_c_1		4387.1			
		(2408.4)			
movie_theater_closing_c_3			-3778.2		
			(2789.2)		
religious_restrictions_c_2				-3322.8	
				(1811.5)	
curfew_requirement_c_1					-5872.5
					(3273.8)
N	188	188	188	188	188

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

TABLE A.4: IV 2SLS - Absolute Food Insecurity II

	(1) pct_food_insec_overall	(2) pct_food_insec_overall	(3) pct_food_insec_overall	(4) pct_food_insec_overall
housing_support_c_1	-8420.7			
	(6797.9)			
utility_support_c_1		-4364.4		
		(5570.4)		
contact_tracing_c_2			-9313.8	
			(5796.6)	
vaccine_policy_c_3				7503.2
				(4097.3)
N	188	188	188	188

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

Appendix B

Difference in Difference Regression Outputs

TABLE B.1: DiD - Food Insecurity Rate I

	(1) ovrl_food_insec_rate	(2) ovrl_food_insec_rate	(3) ovrl_food_insec_rate	(4) ovrl_food_insec_rate	(5) ovrl_food_insec_rate
1.pre_post1.housing_support_c_1	0.00448				
	(0.00652)				
1.pre_post1.utility_support_c_1		0.00114			
		(0.00668)			
1.pre_post1.contact_tracing_c_2			0.00289		
			(0.00735)		
1.pre_post1.vaccine_policy_c_3				0.000531	
				(0.00674)	
1.pre_post1.gym_closing_c_1					-0.00297
					(0.00749)
N	188	188	188	188	188

Standard errors in parentheses

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

TABLE B.2: DiD - Food Insecurity Rate II

	(1) ovrl_food_insec_rate	(2) ovrl_food_insec_rate	(3) ovrl_food_insec_rate	(4) ovrl_food_insec_rate
1.pre_post1.restaurant_closing_c_1	0.000473			
	(0.00755)			
1.pre_post1.movie_theater_closing_c_3		0.00298		
		(0.00699)		
1.pre_post1.religious_restrictions_c_2			0.00272	
			(0.00765)	
1.pre_post1.curfew_requirement_c_1				-0.000666
				(0.00727)
N	188	188	188	188

Standard errors in parentheses

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

TABLE B.3: DiD - Absolute Food Insecurity I

	(1) pct_food_insec_overall	(2) pct_food_insec_overall	(3) pct_food_insec_overall	(4) pct_food_insec_overall	(5) pct_food_insec_overall
1.pre_post1.housing_support_c_1	-1003.0				
	(1962.1)				
1.pre_post1.utility_support_c_1		-2379.6			
		(2071.7)			
1.pre_post1.contact_tracing_c_2			-2148.1		
			(1805.2)		
1.pre_post1.vaccine_policy_c_3				3817.9*	
				(1585.3)	
1.pre_post1.gym_closing_c_1					2088.6
					(1814.1)
N	188	188	188	188	188

Standard errors in parentheses

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

TABLE B.4: DiD - Absolute Food Insecurity II

	(1) pct_food_insec_overall	(2) pct_food_insec_overall	(3) pct_food_insec_overall	(4) pct_food_insec_overall
1.pre_post1.restaurant_closing_c_1	2328.4			
	(1755.2)			
1.pre_post1.movie_theater_closing_c_3		-1141.4		
		(1781.8)		
1.pre_post1.religious_restrictions_c_2			-4811.7**	
			(1799.0)	
1.pre_post1.curfew_requirement_c_1				-3339.7*
				(1624.0)
N	188	188	188	188

Standard errors in parentheses

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

Appendix C

Instrument Variables

In this study, two IVs are employed: the county-level vote share from the 2020 presidential election and a binary variable indicating whether a Republican or Democrat won the county. For these IVs to provide consistent estimates of the causal effect, they must satisfy the relevance, exclusion, and exogeneity assumptions (Angrist & Pischke, 2009; Wooldridge, 2010).

C.0.1 Relevance Assumption

The assumption of relevance requires that the instruments are highly correlated with the endogenous explanatory variable, which is COVID-19 policies. The vote share in the county and the binary variable of the winning party are likely to be relevant instruments since they can capture the political preferences and the ideological leaning of the county, which can shape the stringency of COVID-19 policies (Allcott et al., 2020; Gollwitzer et al., 2020).

For example, counties with a higher vote share for the Democratic party or those won by a Democratic candidate are more likely to implement and enforce stricter COVID-19 policies, such as business closures, social distancing requirements, and mask mandates, given the party's generally more proactive stance on pandemic response measures (Grossman et al., 2020; Hsiehchen et al., 2020). Conversely, counties with a higher Republican vote share or those won by a Republican candidate may be less likely to adopt or enforce such policies, reflecting the party's generally more skeptical view of government intervention and emphasis on individual freedoms (Barrios & Hochberg, 2020; Painter & Qiu, 2021).

This hypothesis can be tested by the first-stage regression estimating the relationship between the IVs and the COVID-19 policy variables. Empirically, a high F-statistic and statistically significant coefficients for the IVs in the first-stage regression would provide evidence of their relevance (Stock et al., 2002).

C.0.2 Exclusion Restriction

The exclusion restriction assumes that the IVs affect the outcome variable (food insecurity) only through their impact on the endogenous explanatory variable (COVID-19 policies) and not through any other direct or indirect channels (Angrist & Pischke, 2009). In other words, the IVs should not have a direct effect on food insecurity; any effect should be entirely mediated by the COVID-19 policies.

In this case, it is plausible that the county-level vote share and the binary variable indicating the winning party satisfy the exclusion restriction. The political preferences and ideological leanings of a county, as captured by these IVs, are unlikely to have a direct impact on food insecurity outcomes. Instead, their effect on food insecurity is likely to operate through their influence on the adoption and enforcement

of COVID-19 policies, which in turn can affect employment, income, and access to food assistance programs (Bitler et al., 2020; Gundersen et al., 2021).

C.0.3 Exogeneity Assumption

The exogeneity of the county-level vote share and the binary variable indicating the winning party relies on the assumption that these IVs are not systematically related to unobserved factors that directly affect food insecurity, after controlling for relevant demographic, socioeconomic, and policy variables (Angrist & Pischke, 2009). This assumption may be reasonable given that the IVs are based on the outcomes of a specific election and are less likely to be influenced by the same unobserved factors that affect food insecurity at the county level.

In this study, the exogeneity of the county-level vote share and the binary variable indicating the winning party relies on the assumption that these IVs are not systematically related to unobserved factors that directly affect food insecurity, after controlling for relevant demographic, socioeconomic, and policy variables (Angrist & Pischke, 2009). This assumption may be reasonable given that the IVs are based on the outcomes of a specific election and are less likely to be influenced by the same unobserved factors that affect food insecurity at the county level.

Appendix D

Limitations

D.1 Data

D.1.1 Misaligned FIPS

One of the significant limitations encountered in this study was the inability to utilize the full set of 171 unique counties originally included in the U.S. COVID-19 County Policy (UCCP) Database. This limitation arose due to misaligned Federal Information Processing Standards (FIPS) formatting for certain counties. FIPS codes are unique identifiers assigned to geographic areas, such as states and counties, to facilitate data processing and analysis (U.S. Census Bureau, 2019). The misalignment in FIPS formatting occurred when merging the UCCP data with other datasets, such as the American Community Survey (ACS) and the Department of Transportation (DOT) County Car Use Data. Inconsistencies in the FIPS codes, such as differences in formatting conventions or the presence of leading zeros, prevented the successful matching of data for some counties across the various datasets (Eckert et al., 2020; Ingram & Franco, 2014). As a result of these misaligned FIPS codes, the sample of counties included in the analysis was reduced from 171 to 94. While the remaining 94 counties still provided a diverse representation of geographical locations, demographics, and policy environments, the reduction in sample size may have limited the statistical power and generalizability of the findings (Button et al., 2013; Faber & Fonseca, 2014). Future research could benefit from ensuring consistent FIPS formatting across all datasets and exploring alternative methods for matching and integrating county-level data to maximize the number of observations included in the analysis.

D.1.2 Limited Policy Analysis

Another limitation of this study was the restriction of the analysis to a specific set of COVID-19 policies due to the distribution of treatment and control counties. Although the UCCP Database contains data on a myriad of policies across containment and closure, economic support, and public health measures, it was not feasible to include all policies due to the need to maintain a reasonable balance between treatment and control groups (Imbens & Rubin, 2015; Stuart, 2010).

To ensure the validity of the Difference-in-Difference (DiD) and Two-Stage Least Squares (2SLS) with instrumental variables (IV) approaches, the analysis was limited to policies where the distribution of treatment and control counties ranged from 1:1 to 1:3. This means that for every county that implemented a specific policy (treatment group), there were between one and three counties that did not implement that

policy (control group). While a 1:3 ratio is somewhat high, this threshold was necessary due to the previous reduction in observations resulting from the misaligned FIPS formatting (Imbens & Wooldridge, 2009; Kahn-Lang & Lang, 2020).

The limited policy analysis may have restricted the scope of the findings and the ability to draw conclusions about the impact of other COVID-19 policies on food insecurity. Policies that had a more skewed distribution of treatment and control counties could not be reliably assessed using the DiD and 2SLS IV approaches (Cunningham, 2021; Wing et al., 2018). Future research could explore alternative methods for evaluating the impact of these policies, such as synthetic control methods or propensity score matching, to provide a more comprehensive understanding of the relationship between COVID-19 policies and food insecurity (Abadie et al., 2010; Caliendo & Kopeinig, 2008).

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