IMPACT OF COVID-19 RELIEF PACKAGES ON U.S. HOUSEHOLD FOOD SECURITY AND FOOD EXPENDITURE

By

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This thesis is approved as a creditable and independent investigation by a candidate for the master's degree and is acceptable for meeting the thesis requirements for this degree. Acceptance of this does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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ABBREVIATIONS

CTC	Child Tax Credit
EIP	Economic Impact Payment
ERS	Economic Research Service
FAH	Food at Home
FAFH	Food Away from Home
FPL	Federal Poverty Line
HPS	Household Pulse Survey
LPM	Linear Probability Model
NSLP	National School Lunch Program
OLS	Ordinary Least Squares
P-EBT	Pandemic Electronic Benefit Transfers
SNAP	Supplemental Nutrition Assistance Program
UI	Unemployment Insurance
USDA	United States Department of Agriculture

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ABSTRACT

IMPACT OF COVID-19 RELIEF PACKAGES ON U.S. HOUSEHOLD FOOD SECURITY AND FOOD EXPENDITURE

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The COVID-19 pandemic led to changes in consumer shopping habits, including food expenditures. The pandemic induced changes in food expenditure patterns, food accessibility, and declining household income contributed to increased food insecurity during the pandemic. The objective of this study is to examine the impact of COVID-19-related relief packages on food security and food expenditures. The effect of Economic Impact Payments, P-EBT, SNAP, and free food will be considered.

Using data from the Household Pulse Survey (HPS), a total sample of 1,899,929 households were analyzed in this study. The HPS is a nationally representative survey structured to produce data on the social and economic impact of the pandemic on households in the US as well as to measure household experiences during the pandemic. OLS, Tobit and Cragg's double hurdle models were used to examine the association between package receipt and food expenditure, while linear probability models and probit models were used to analyze food security.

Results from all the models provide evidence that COVID-19 relief packages, including EIP, P-EBT, and SNAP had a significant, positive association with household FAH and FAFH expenditures. In contrast, free food resources were associated with a reduction in both FAH and FAFH expenditures. Also**,** results from the analysis suggest P-EBT and EIP receipt had the intended effect of helping reduce food insecurity among households during the pandemic. However, several packages, including SNAP, had a

significant positive association with food insecurity. This positive association is likely attributable to the endogeneity associated with receiving these packages.

INTRODUCTION

The issue of food security is a global concern from which the United States is not exempt. While most households in the United States are food secure, some households do not always have access to food due to limited resources. According to the United States Department of Agriculture's (USDA) report on household food security in 2020, 89.5% of US households are food secure, and the remaining 10.5% are food insecure (either marginally or severely). Food security, as defined by the USDA, is access to enough food at all times by all people for an active and healthy life (USDA-ERS, 2021). Not only is food a necessity, but it is also essential for human development and promotes a healthy life. Food insecurity in the US varies across households as well as across states (USDA-ERS, 2018). Households that experience food insecurity are more likely to have certain characteristics such as low income, unemployment, and food assistance program participation (Choi et al., 2017). At the state level, food insecurity is greatly affected by the cost of housing, average wages, unemployment, and state assistance policies (Coleman-Jensen et al., 2019).

Food acquisition is the means by which individuals get access to food. Households can obtain food away from home (food purchases at sit-down restaurants, fast food restaurants, etc.) or prepare it at home. Food away from home (FAFH) and food at home (FAH) expenditures in the United States increased from 1997 to 2019. However, FAFH expenditures increased faster at 60.5% compared to FAH expenditures at 39.7% (Zeballos & Sinclair, 2021). There has been a sizeable shift in the share of food expenditures spent on FAFH and FAH since the outbreak of the COVID-19 pandemic in early 2020. People were encouraged to stay home and many areas of the United States were on lockdown to

reduce the spread of the virus. These restrictions changed food expenditure trends as households shifted to eating more FAH than FAFH.

Household food expenditures are an indicator of food security (Coleman-Jensen et al., 2021). The higher a household's food expenditures, the lower their probability of being food insecure. On average, food-secure households spend more on food than food-insecure households (Coleman-Jensen et al., 2021). Logically, a decrease in food expenditures can lead to a disruption of eating habits and a reduction in food intake.

The COVID-19 pandemic has further affected individuals' health and social and economic well-being (Haleem & Javaid, 2020). Efforts to contain the spread of the virus disrupted economic activities and slowed the world's economy. Restrictions imposed to curtail the spread of the virus led to the disruption of economic activities such as manufacturing essential goods and food supply chains. The decline in food production resulted in the unavailability of many food products. The decrease in the production of agricultural products, trade restrictions, and other factors during the pandemic worsened food security in the United States (Laborde et al. 2020). In addition to this, individuals lost their jobs either voluntarily or involuntarily. This resulted in a decline in income and increased food hardship among many households.

Together, the pandemic induced changes in food expenditure patterns, food accessibility, and household income contributing to increased food insecurity during the COVID-19 pandemic. While food insecurity declined significantly from 2011 (14.9%) to 2019 (10.5%), it remained essentially unchanged in 2020 (USDA-ERS, 2021). However, many households with children who were formerly food secure but were relatively disadvantaged became food insecure during the pandemic (Morales, et al., 2021). Research

also suggests a strong association between food security risk and mental health during the COVID-19 pandemic (Di et al., 2021). The pandemic increased the risk of food insecurity and rendered certain population groups vulnerable (Lauren et al., 2021). Low-income individuals and those with poor mental health were at higher risk. Other studies that explored inequality associated with food security found that food security was more prevalent among Black and Latin American households and low-income households during the pandemic (Larson, Ong, & Peoples, 2020).

In response, COVID-19 relief packages were introduced to address household income and food access challenges caused by the pandemic. In part, these packages sought to increase food availability either directly through food assistance or indirectly through cash payments, increasing the income available to purchase food. This enabled households to afford and access food as they stayed home and complied with COVID-19 restrictions. The relief packages introduced include, but are not limited to, Economic Impact Payments, unemployment compensation, Child Tax Credits, and changes to existing food assistance programs (US Department of Treasury, 2021).

Through the Economic Impact Payments, families received a series of payments under the Coronavirus Aid Relief Economic Security (CARES) Act and the COVID-19 Related Tax Relief Act of 2020 (US Department of Treasury, 2021). Individuals that lost their jobs could claim unemployment benefits, and this assistance was extended to March 2020. Also, the American Rescue Plan increased the Child Tax Credit and expanded its scope to support families during the crisis (Internal Revenue Service, 2022). The benefits and coverage of existing food assistance programs such as the Supplemental Nutrition Assistance Program (SNAP) and Women, Infants and Children (WIC) were expanded. The

Pandemic Electronic Benefits Transfer (P-EBT) was created to compensate beneficiaries who missed school meals due to the shift of learning from in-person to online. Additionally, the Food Box Program was launched, and through this, food was donated to food banks and other charitable organizations to be distributed to eligible households (Coleman-Jensen et al., 2021).

While preliminary research on food insecurity during the COVID-19 pandemic has been conducted, the combined effect of the pandemic relief packages on food insecurity has not been fully explored. Also, the COVID-19 pandemic led to changes in consumer shopping habits, including food expenditures. Changes in food expenditures are likely driven by shelter-in-place orders, business closures, fear of contagion, and declining household income. The packages introduced may also have accounted for the changes in food expenditure behavior among US households during this period. However, the impact of relief packages on food expenditure has not yet been studied in the literature. Considering nutritional quality and cost, FAH, according to existing literature, is healthier and more economical (Lin & Guthrie, 2012). Understanding the impact of relief packages on FAH and FAFH spending will inform the design of future relief policies to ensure the food security and dietary quality for Americans.

The objective of this study is to examine the impact of COVID-19-related relief packages on food security and food expenditures. The effect of Economic Impact Payments, Child Tax Credits, Unemployment Insurance, P-EBT, and food assistance program participation will be considered. This study will provide critical insight into the effectiveness of the relief policies introduced to reduce food insecurity and ensure diet quality during the COVID-19 crisis (US Department of Treasury, 2021).

LITERATURE REVIEW

Food Security

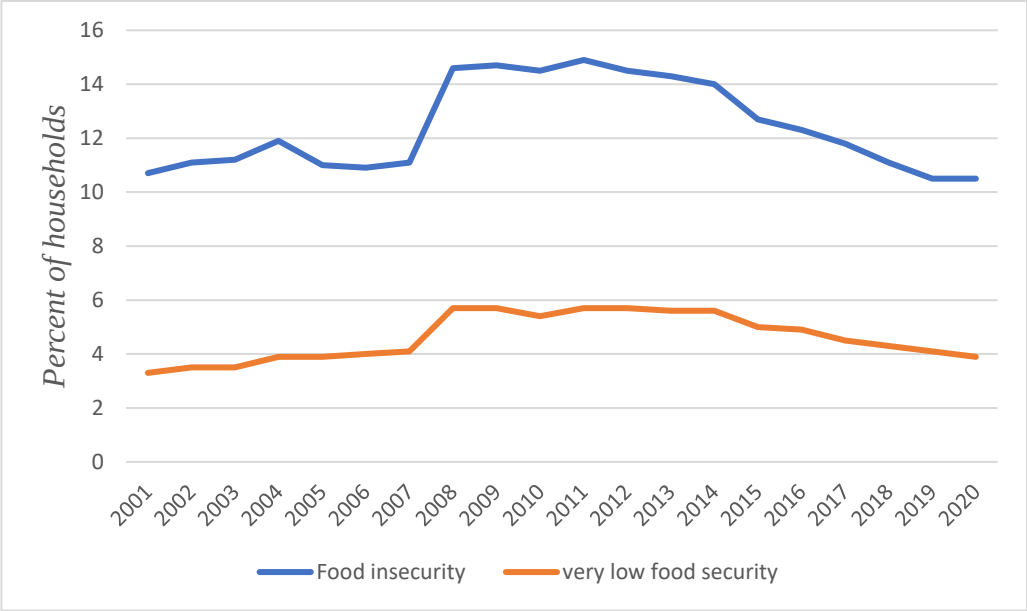
While most households in the United States are food secure, about 10.5 percent are food insecure (USDA-ERS, 2021; Coleman-Jensen, 2020). The presence of food insecurity in the United States is determined by responses to a set of questions in the Food Security Supplement to the Current Population Survey (CPS) conducted in December 2020. The questionnaire contains ten questions for households without children and an additional eight for households with children. Based on the responses, households are classified as having either high food security (consistently have access to food), marginal food security (have a problem accessing food at times but quantity and quality were not reduced), low food security (quality and variety were reduced but eating patterns remain undisrupted) or very low food security (reduced food intake and disrupted eating pattern sometimes within the year) (USDA-ERS, 2021).

Using food security data from the 2020 Current Population Survey, the USDA found that 89.5% of households in the US were food secure, that is households always had access to food during the year. Even though overall food insecurity remains unchanged from 2019(see figure 1), food insecurity among households with children increased from 6.5% in 2019 to 7.6% in 2020 (USDA-ERS, 2021).

Prior studies have established the relationship between socio-demographic characteristics and food security. Income has a positive relationship with food security; that is, high-income households are less likely to be food insecure, and vice versa (USDA-ERS,2018; Coleman-Jensen,et al., 2021; Adams, et al., 2020; Lugo-Morin, 2020; Wolfson

& Leung, 2020). On the contrary, Kreider (2011) uses data from Current Population Survey (CPS) with incomes between 0 to 400% and finds about 65% of households close to the

Figure 1: Food Insecurity in the United States (2001 – 2020)



Source: (USDA ERS, 2021)

poverty line is food secure, and some households with income above the poverty line are food insecure (Kreider, 2011). A 2010 study by Leete and Bania considers income volatility and further finds adverse income shocks increase the probability of food insecurity.

Additionally, research indicates households with children are more likely to be food insecure than households without children; (Wolfson & Leung, 2020; USDA-ERS, 2018, USDA-ERS, 2021). Also, non-Hispanic Black and Hispanic households are more likely to be food insecure than non-Hispanic White households (USDA-ERS, 2018; Wolfson &

Leung, 2020). Food insecurity is also heterogeneous across geographic regions, with households in the South more likely to be food insecure than those in the Midwest (Wolfson & Leung, 2020; USDA-ERS, 2018). Households with a married head are more likely to be food secure than their single counterparts. However, male household heads with no spouse are more likely to be food secure than their female counterparts (Wolfson & Leung, 2020; USDA-ERS, 2018). Full-time and retired workers are less likely to be food insecure than part-time workers and the unemployed (Coleman-Jensen, 2020; Wolfson & Leung, 2020). Similarly, households with heads who have less than a college education are more likely to be food insecure than their counterparts with post-secondary education.

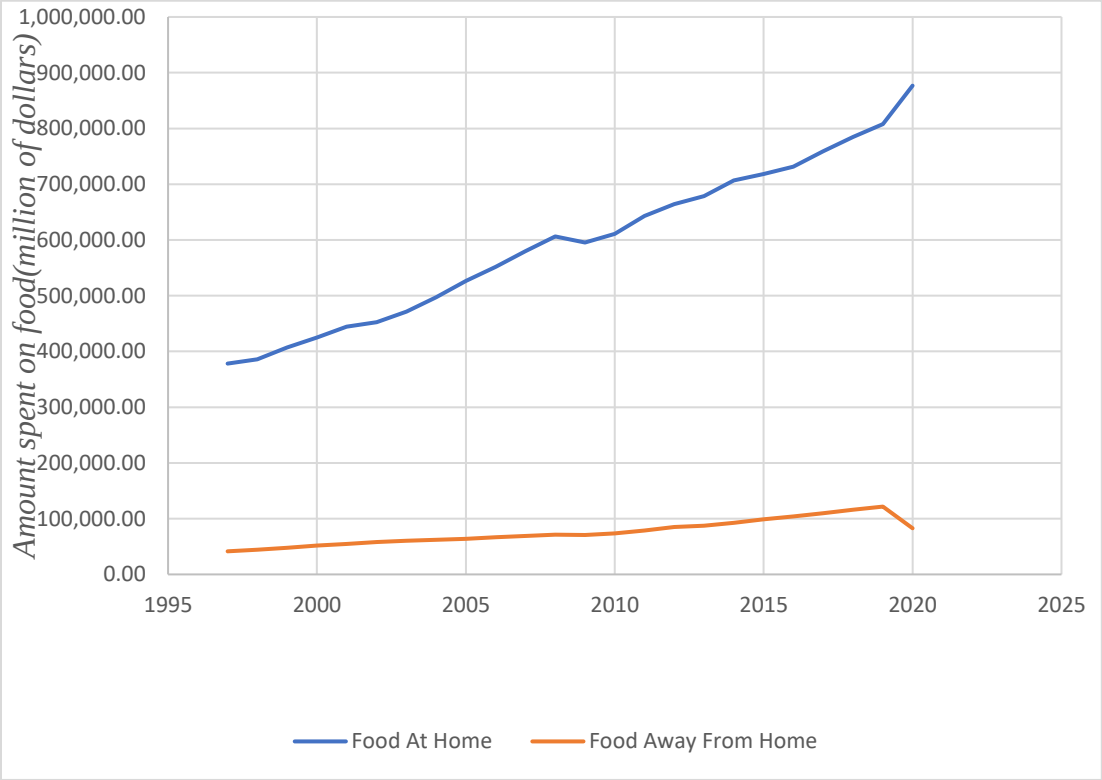
Food expenditure

Food expenditures are a good indicator of food security (Coleman-Jensen et al., 2021) . The higher a household's food expenditure, the less likely it is to be food insecure. Intuitively, a reduction in a households' food expenditure can disrupt eating habits as well as decrease food intake. Using a nationally representative survey, Ferrante et al. (2021) studied the potential long-term impact of the Covid- 19 pandemic on the lifestyle of US families. Using descriptive statistics, the pandemic was found to affect American families' eating habits. The study was conducted after the protective measures were lifted, yet families reported increased in-home cooking and reduced dining outside of the home. Additional studies by ((Carroll, et al., 2020; Flanagan, Beyl, Fearnbach, Altazan, & Martin, 2020) and (Sanchez, 2020) found similar results. When dining away from home, families considered ordering take-out safer than dining in.

Health risks associated with food consumption has resulted in a growing literature focused on understanding the source and quality of the food households consume. According to a USDA report on American eating habits, there has been an increase in FAFH's share of total food expenditures over the past 30 years (USDA-ERS, 2018). The report simultaneously indicated a decline in the nutritional quality of FAFH across all income groups compared to FAH. Food expenditure trend in the U.S from 1997 to 2020 is provided in figure 2 (USDA-ERS, 2021).

Participation in food assistance programs affects food choice and diet quality, especially for low-income households (Leschewski et al., 2018; Jetter & Cassady, 2005). Leschewski et al. (2018) use the National Household FoodAPS Survey and estimate double-hurdle models to

Figure 2: Food expenditure Trends in the United States (1997-2020)



Source: (USDA ERS, 2021).

identify the determinants of households' decision to purchase healthy FAFH. According to the study, households' decision to buy healthy FAFH varies with income, SNAP participation, dieting, region, and household composition. The results again suggest that while some households are unable to find healthy items when dining away from home, some deliberately choose not to purchase healthy items. The price of healthy food is also a deterrent to purchase, especially for a low-income household when eating away from home (Jetter & Cassady, 2005)

Additionally, the USDA-ERS (2018) found that changes in income, work schedules, access to fast food, and affordability of FAFH have all contributed to the changes in the dining habits of American households. The frequency at which households purchase FAFH varies across socio-demographic groups. Income is found to be positively

related to FAFH purchases; higher-income households tend to eat outside the home more often than low-income households (USDA-ERS, 2018). Considering age, the frequency of FAFH acquisition is higher among young adults than their older counterparts, as younger adults are often more engaged with work and have less time to prepare food (Dave et al., 2009). Households with children acquire less FAFH than households without children (USDA-ERS, 2018).

Numerous prior studies have explored the relationship between food assistance program participation and diet quality. A study by Burney (2018) reveals SNAP participation leads to a $1.47 decline in household weekly FAFH expenditures and a 0.77% decrease in FAFH as a share of the total food budget. Also, the USDA-ERS (2018) reported households with children that participate in the National School Lunch Program (NSLP) eat less FAFH (USDA-ERS, 2018). Some studies also indicate the unintended effect of SNAP participation to promote poor diet quality and obesity due to the income effect SNAP participation has on FAFH (Burney, 2018).

While some studies find a positive relationship, Mancino et al. (2018) find SNAP households had lower diet quality than non-SNAP low- and higher-income households (Mancino, et al., 2018). Also, Andreyeva et al. (2015) found that receiving SNAP benefits had no effect on the nutritional intake of fruit, vegetables, grains, or dairy products and increased the consumption of meat, added sugar, and fats. This evidence suggests that dietary quality is lower among SNAP participants than non-participants. Additionally, a study on WIC participation conducted by Fanget et al. (2019) finds that WIC households have a higher Healthy Purchasing Index (HPI) value than non-participating households.

COVID-19 Relief Packages

The COVID-19 pandemic affected various aspects of life, including food security and acquisition (Laborde et al., 2020). COVID-19 relief packages were introduced to address the food hardships caused by the pandemic. In addition to modifying existing food assistance programs, new assistance, including Economic Impact Payments, unemployment compensation, and Child Tax Credits, were introduced.

Economic Impact Payments under the CARES Act, COVID-Related Tax Relief Act of 2020, and the American Rescue Plan Act of 2020 provided a series of payments to individuals and households with children under 17. The purpose was to compensate households for the fall in income and address other hardships caused by the pandemic (US Department of Treasury, 2021). Also, individuals lost their jobs during the COVID-19 pandemic, and to address this, the American Rescue Plan extended unemployment assistance. It waived some federal taxes on unemployment benefits to allow individuals to use their benefits to purchase essentials during the pandemic (US Department of Treasury, 2021). Additionally, the Child Tax Credit was revised and expanded to reduce child poverty by boosting beneficiaries' earnings and making the credit available to many new families (US Department of Treasury, 2021). As part of the COVID-19 Food Box Program, the USDA contracted with agricultural products distributors to deliver boxes of fresh produce, milk, dairy, and cooked meats to less privileged Americans across the country (USDA-Agricultural Marketing Service, 2021).

In addition to the new packages, the benefits and coverage of existing food assistance programs such as SNAP, WIC, and NSLP, were expanded and/or modified. SNAP provides nutritional benefits to supplement the food budget of low-income

households. During the COVID-19 pandemic, SNAP benefits were temporarily increased by 15%, and every household was boosted to the maximum benefit for their household size. The USDA further ensured that families who already received the maximum benefit before the Pandemic received at least a $95 increase in benefits (USDA-Food and Nutrition Service, 2021).

The WIC program provides federal grants to states for supplemental foods, health care referrals, and nutrition education for low-income pregnant and postpartum women, infants, and children under age five. In response to the pandemic, the USDA Food and Nutrition Service granted waivers to ensure flexibility in the program's requirements that state agencies could not meet due to the COVID-19 pandemic (USDA-Food and Nutrition Service, 2021). The NSLP provides nutritious, free, or low-cost meals to children in public and non-profit private schools and residential childcare institutions. During the COVID-19 pandemic, P-EBT was introduced as a substitute for children who missed the free or reduced-price meals provided by NSLP due to school closures. P-EBT provided eligible school children temporary emergency benefits loaded onto electronic benefit transfer (EBT) cards to purchase food. School children who would have received free or reduce meals if school were in session. Additionally, it provided benefits to children in households participating in SNAP, whose covered childcare facility was closed (US Department of Treasury, 2021).

Before the COVID-19 pandemic, a large body of research indicates food assistance program participation reduces the prevalence of food insecurity. Studies on the impact of the relief packages were conducted during the pandemic. Siddiqi et al. (2021) examine how SNAP participants residing in food deserts (areas with limited access to healthy and

affordable food) have been affected by the COVID-19 pandemic. Using longitudinal data from an ongoing cohort of Black households living in a food desert in Pittsburgh, Pennsylvania, changes in food insecurity and SNAP participation from 2018 to the early stages of the pandemic in 2020 were examined. The authors modeled changes in food insecurity from 2018 to 2020 using covariate-adjusted logistic regressions. The results find a significant increase in food insecurity from 25.9% in 2018 to 46.9% in 2020 among SNAP participants residing in food deserts (Siddiqi et al., 2021).

Similarly, Singleton et al. (2021) examines the role of SNAP participation in determining the relationship between a change in employment status and food security during the pandemic. The study analyzed cross-sectional survey data gathered from a sample of Black and Latino adults in the Midwest. The authors utilize an interaction term and stratified logistic model to answer the economic question. The study results indicate that very low food security was more than two times (four times) higher among SNAP (non-SNAP) participants who lost their job compared to individuals whose employment status remained unchanged during the pandemic.

The Household Pulse Survey (HPS) was administered during the pandemic to provide data on the social and economic impact of the pandemic in the United States. Bauer et al. (2020) and Shafer et al. (2022) use data from HPS and a difference-in-difference analysis in their studies. Bauer et al. (2020) analyze the effects of P-EBT on food hardship, finding P-EBT reduces food insecurity by six percentage points and food insecurity among children by eight percentage points. Likewise, Shafer et al. (2022) analyze the advance payment for the Child Tax Credit and its association with food insufficiency in the US.

Their results indicate that food insufficiency among households with children was reduced by 25.9% after the first advance payment of the Child Tax Credit.

To answer whether Unemployment Insurance impacts food insecurity during the COVID-19 Pandemic, Raifman et al., 2020 utilize data from the Understanding Coronavirus in America cohort, limiting the sample to households with annual income less than $75,000 during February 2020. The study uses the difference-in-differences method with the assumption that recipients of Unemployment Insurance in a specific period have the same trends in food insecurity as the non-recipient households. Their results indicate food insecurity was lower among households that received unemployment benefits.

Lai et al. (2021) indicate in their study on COVID-19 stimulus packages that the most considerable portion of the stimulus package was allocated towards non-durable goods, especially food, during the pandemic. Additionally, 42% of the respondents reported increased spending at the grocery store because of the pandemic. 31% and 34% of the respondents further indicated increasing their expenditures on delivery and take-out, respectively (Lai et al., 2021).

Prior studies have explored the impact of individual COVID-19 relief packages on food insecurity and food expenditure. Using different methods and data sets, studies generally show that relief packages reduced food insecurity. This study adds to the literature by examining the combined effect of the COVID-19 relief packages on food insecurity as well as FAH and FAFH expenditures.

DATA

This study uses data from the Household Pulse Survey (HPS), a nationally representative survey designed and administered by the United States Census Bureau in collaboration with multiple federal agencies, including the Bureau of Labor Statistics, the Bureau of Transportation Statistics, and the USDA Economic Research Service. The HPS is structured to produce data on the social and economic impact of the pandemic on households in the United States and to measure households' experiences during the COVID-19 pandemic. In addition to household demographic characteristics, the survey asks questions that measure the pandemic's impact on food sufficiency, household spending, employment, and education, among others.

Starting in April 2020, the US Census Bureau conducted the HPS, consisting of a bi-weekly survey grouped into phases. The HPS currently consists of seven phases which provide an update on the social and economic conditions of households, each addressing the pandemic's impact at that point in time. This study utilizes data from Phase 3 - 3.4, which refers to data collected between October 28, 2020, and May 9, 2022. The selected phases include questions on food sufficiency, food expenditure, and the receipt and use of various stimulus packages.

The HPS is designed to be a short turnaround instrument that provides valuable information that addresses the pandemic's impact and helps in the pandemic recovery. Also, the HPS is one of the first nationally representative surveys to provide detailed and timely information on the social and economic impact of COVID-19 (Field et al., 2020). In partnership with the USDA's Economic Research Service, the Census Bureau developed questions that addressed food insufficiency during the COVID-19 pandemic. The HPS

measures food sufficiency by asking for food sufficiency in the last seven days. Also, questions are asked about the amount of money spent on FAH and FAFH. Additionally, a series of questions are asked on the receipt of COVID-19 relief packages.

Table 1: COVID-19 Relief Packages

Variables	**Description**
Economic Impact Payment (EIP)	Receipt and use of EIP (1= yes, 0= no)
Unemployment Insurance (UI)	Received UI in the last seven days (1=yes, 0=no)
Child Tax Credit (CTC)	Receipt and use of CTC (1= yes, 0= no)
SNAP	SNAP receipt (1= yes, 0= no)
P-EBT	P-EBT receipt (1= yes, 0= no)
Free food	Did anyone in the household get free food or a free meal during the past seven days (1= yes, 0= no)

SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit Transfers

Dependent Variables

This study analyses food sufficiency and food expenditure. Food sufficiency and food security are closely related concepts that essentially describe the same issue. This study will therefore use food sufficiency as a proxy for food security in this study as the HPS measures food sufficiency. The HPS measured food sufficiency by asking respondents to describe the current food situation in their households. Responses to the question are used in this study to measure the degree of household food sufficiency during the pandemic. These responses range from 1 = "enough of the kinds of food I/we wanted to eat," 2 =

"enough, but not always the kinds of food I/we wanted to eat," 3= "sometimes not enough to eat" and 4= "often not enough to eat." The higher the value, the higher the food insufficiency of the household. This approach has been an accurate, reliable, and standard measure of food security (USDA-ERS, 2021) Additionally, to measure food expenditure in the HPS, respondents were asked to indicate the dollar amount they spent on FAH and FAFH in the last seven days.

Table 2: Demographic Characteristics

Variables	Description	Unit
Age	Year of birth (1932-2002)	Year
Gender	Gender of the respondent (Male=1, Female=0)	Discrete Variable
Race 1 - 4	Race of the respondent (1= White 0=otherwise; 1= Black 0 = otherwise; 1= Hispanic 0 = otherwise; 1= any other race 0= otherwise)	Discrete Variables
Educ 1	Highest education level attained (0= less than college education, 1=college education or more)	Discrete Variables
Income	Household annual income (1= above $200,000, 0 = otherwise; 1 = below $100,000, 0 = otherwise; 1= between $100,000 and $200,000, 0 = otherwise)	Continuous Variable
Marital status	Marital status (1= married, 0 = not married)	Discrete Variable

Household size	Number of people in the household	Discrete Variable
Employment status	Employment status for the past seven days	Discrete Variable

Note: Discrete variable takes on distinct, countable values. Continuous variables can take on any value within a range.

Independent Variables

Additional variables used in this study are grouped into COVID-19 relief packages (Table 1), household demographics (Table 2), and state and week indicators. The relief packages in Table 1 include economic payments that were introduced, and the modifications made to existing food assistance programs during the Pandemic. The economic payments include EIP, CTC, and UI. The HPS asks respondents to identify whether they have applied and received each form of stimulus, as well as how the payment was spent. Regarding food assistance programs, respondents are asked about the receipt of the benefits, and the month benefits were received, and the use of the benefits. The HPS provides data on SNAP, P-EBT, and free meals; however, data is not provided on WIC.

METHODOLOGY

This section outlines the methods used to examine food security and food expenditure. Methods used to examine food security are introduced first, followed by a description of the methods used to analyze food expenditure.

Food Security

The dependent variable in this study is a binary indicator of food security, proxied using the food sufficiency measure from the HPS. To examine the impact of the COVID-19 relief packages on food security, this study estimates Linear Probability Models (LPM) and Probit Models given the binary nature of the response variable. The LPM is specified as in equation (1):

$$P(Y_i = 1|\boldsymbol{X_i}, \boldsymbol{Z_i}, \boldsymbol{S_i}, \boldsymbol{w_i}) = \delta + \boldsymbol{\alpha X_i} + \boldsymbol{\beta Z_i} + \boldsymbol{\gamma S_i} + \emptyset \boldsymbol{w_i} + \varepsilon_i \quad (1)$$

The LPM is easy to estimate and provides coefficients that are easier to interpret than other binary choice models such as Logit and Probit. However, the LPM violates the assumption of homoscedasticity of the Ordinary Least Square (OLS). To correct this issue, this study estimates robust standard errors considering the heteroscedasticity of the LPM error term (Wooldridge, 2016). Another fundamental issue with the LPM is the fact that the probability of the estimate is not strictly between zero and one.

The probit model addresses the fundamental issue of the LPM by restricting the outcomes between 0 and 1. The Probit model is specified as:

$$Y_i^* = \delta + \boldsymbol{\alpha X_i} + \boldsymbol{\beta Z_i} + \boldsymbol{\gamma S_i} + \emptyset \boldsymbol{w_i} + \varepsilon_i \quad (2)$$

$$Y_i = \begin{cases} 1 & if\ Y_i^* > 0 \\ 0 & if\ otherwise \end{cases}$$

where Y_i Is the dependent variable that measures food security, Y_i^* is the latent household food security, $\boldsymbol{X_i}$ is a vector of explanatory variables that control for the COVID-19 relief packages and food assistance benefit receipt. $\boldsymbol{Z_i}$ is a vector of explanatory variables controlling household demographics (income, marital status, race, education, household size, and employment status). The impact of COVID-19 is heterogeneous across states, hence, $\boldsymbol{S_i}$ is a vector of state dummy variables that control for state-level heterogeneity, such as differences in COVID-19 impact and attitudes towards welfare packages in various states. w_i is the week dummy variable that controls the difference in the variables measured across different weeks. The parameter α, estimates the coefficients of each COVID-19 relief package. While β, are the coefficients for each household demographic characteristic, γ and $\emptyset$ are he coefficients of state and week dummies, respectively. ε_i is a random error term and δ measures the constant coefficient.

To analyze the impact of the COVID-19 relief packages on food security, both LPM and Probit models are estimated in this study. The results from the LPM and the marginal effects of Probit are compared. Both the LPM and the Probit models are estimated twice. In the first estimation, the dependent variable $\boldsymbol{Y_i}$ measures whether household i is food insecure or food secure. In the second estimation, the dependent variable $\boldsymbol{Y_i}$ measures whether the household is food secure or very food insecure.

Food expenditure

The food expenditure measures in the HPS indicate how much households spend on FAH and FAFH. Considering the continuous nature of the dependent variables, Ordinary Least Squares (OLS), which is simple and easy to estimate, will be utilized. Additionally, Tobit and Cragg's Double-Hurdle Models will be estimated to account for the possibility of households spending zero dollars on FAH and/or FAFH within a specific week. The OLS model estimated is specified in equation (3).

$$Y_i = \delta + \boldsymbol{\alpha X_i} + \boldsymbol{\beta Z_i} + \boldsymbol{\gamma S}_i + \emptyset \boldsymbol{w_i} + \varepsilon_i \quad (3)$$

where Y_i is the dependent variable that measures household food expenditures, and $\boldsymbol{X_i}$ is a vector of explanatory variables that control for the COVID-19 relief packages and food assistance benefit receipt. $\boldsymbol{Z_i}$ is a vector of explanatory variables controlling household demographics. The impact of COVID-19 is heterogeneous across states, hence, $\boldsymbol{S_i}$ is a vector of state dummy variables that control for state-level heterogeneity, such as differences in COVID-19 impact and attitudes towards welfare packages in various states. $\boldsymbol{w_i}$ is a week dummy variable controls for the difference in the variables measured across different weeks. The parameter $\boldsymbol{\alpha}$, estimates the coefficients of each COVID-19 relief package, while $\boldsymbol{\beta}$ is the coefficient for each household demographic characteristic, and $\boldsymbol{\gamma}$ and $\emptyset$ are the coefficients of state and week dummies, respectively. ε_i is the random error term and δ measures the constant coefficient.

The Tobit model is convenient for estimating a corner solution response (Burke, 2009), such as food expenditure, a continuous variable with a proportion of the respondents spending zero dollars on food in a specific week. Conceptually, a corner-solution model is specified as:

$$Y_i^* = \delta + \boldsymbol{\alpha X_i} + \boldsymbol{\beta Z_i} + \boldsymbol{\gamma S_i} + \emptyset \boldsymbol{w_i} + \varepsilon_i \quad (4)$$

$$Y_i = Y_i^* \quad if \quad Y_i^* \geq 0$$

$$Y_i = 0 \quad if\ Y_i^* < 0$$

where Y_i is the dependent variable that measures household food expenditure, $Y_i^*$is the latent household food expenditure. All other variables and coefficients are as previously defined.

The likelihood function for the Tobit Model is specified as

$$f(y|x_1) = \{1 - \emptyset(x_1\beta/\sigma)\}^{1(y=0)} \left[(2\pi)^{-\frac{1}{2}}\sigma^{-1} \exp\{-(y - x_1\beta)^2/2\sigma^2\}\right]^{1(y>0)} \quad (5)$$

where $\emptyset$ is the standard normal cumulative distribution function. $y > 0$ If households spend more zero dollars within a week and $y = 0$ if household spend zero dollars. Two values of interest are the probability that FAH or FAFH expenditures are positive, i.e., $p(y_i > 0|x_i)$, and the conditional expected value of FAH or FAFH expenditure, $E(y_i|y_i > 0, x_i)$.

A limitation of the Tobit model is that the same underlying process is used to estimate both the probability of non- zero y and expectation of y because these values are determined by the same vector of parameters β. To address this, Cragg's Double-Hurdle model uses a different parameter to estimate the probability of non-zero y and expectation specified in equation (6).

$$f(w,y|x_1) = \{1-\emptyset(x_1\gamma)\}^{1(w=0)}\left[\emptyset(x_1\gamma)(2\pi)^{-\frac{1}{2}}\sigma^{-1}\exp\{-(y-x_1\beta)^2/2\sigma^2\}/\emptyset(x_1\beta/\sigma)\right]^{1(w=1)} \quad (6)$$

where y is the response variable (FAH or FAFH expenditures), x_1 represents the explanatory variables, γ and β estimates of the probability and the expected value of y, respectively. w is a binary indicator which is $w = 1$ if households spend more than zero dollars (y>0) and 0 otherwise. The first hurdle considers how COVID-19 relief package receipt impacts the decision to purchase

Table 3: Household Food Security and Food expenditure Indicators

Dependent Variable	**Household Category**	**Description**
	FOOD SECURITY	
Food insecurity	*First estimation* Sometimes not enough to eat	1 = food insecure 0 = otherwise
	Second estimation	

Very low food security	Often not enough to eat	1 = very low food security, 0 = otherwise
	FOOD EXPENDITURE	
	First estimation	
FAH	Households do in-store shopping	Dollar amount household spend on FAH.
	Second estimation	
FAFH	Households eat indoors at the restaurant.	Dollar amount household spend on FAFH.

FAH: Food at Home, FAFH: Food Away from Home

FAH or FAFH. The second hurdle estimates how much households spend on FAH or FAFH, given the household purchases FAH or FAFH.

To estimate the probability and the conditional expected value of y, the following are estimated:

$$\frac{\partial p(y_i > 0|x_1)}{\partial x_i} = \gamma_i \emptyset(x_1\gamma)$$

(7)

$$\frac{\partial E(y_i|y_i > 0, x_{2i})}{\partial x_i} = \beta_i[1 - \lambda(x_2\beta/\sigma)\{x_2\beta/\sigma + \lambda(x_2\beta/\sigma)\}]$$

(8)

In summary, the effect of COVID-19 relief packages on household food expenditure is analyzed using the LPM, Tobit, and Cragg's Double Hurdle models. Each of these models is estimated twice. First, the dependent variable Y_i , measures how much

household i spends on FAH. In the second estimation, the dependent variable Y_i is FAFH expenditures for household i. Descriptions of the dependent variables can be found in table 3.

RESULTS

This section provides a description of study results which include descriptive statistics, OLS, LPM, Probit Tobit, and Cragg's Double Hurdle model estimates. Table 4a and 4b provides descriptive statistics for all variables used in this analysis. Within these tables, independent variables are categorized into two groups. The first group characterizes relief packages provided to households during the pandemic to supplement their household expenditures, in many cases for food. The second group of independent variables includes household characteristics.

Data from Phases 3-3.4 of the HPS, which includes weeks 18 to 45, provided a total sample of 1,899,929 households. However, not all survey weeks had questions that measured all variables used in this analysis, primarily because the assistance type was not distributed that week. Complete data after considering observations with all variables are 1,088,645 and 630,163 for food security and food expenditure respectively. Among sample households, about 5% were food insecure, indicating that a small percentage of households did not have enough food to eat at some point in time. Only 1% of households had very low food security or had to disrupt their meal pattern and reduce food quality. On average, households spent $179.50 on FAH and $70.80 on FAFH each week.

The relief packages considered in this analysis include SNAP, EIP, free food and P-EBT. Of the sample households for food security analysis, 7% indicated they participated in SNAP and 3% indicated they received an EIP payment. This percentage was low because EIP payments were only issued for two weeks during the survey period considered; hence the data used does not include all EIP distributed.

Additionally, free food was provided at various food pantries to supplement households' food during the pandemic. Approximately 4% of sample households received free food. Approximately 2% of sample households received P-EBT during the survey week. This percentage

Table 4a: Descriptive Statistics for Food Security

Variable	Obs	Mean/ Proportion	Std. Dev.	Min	Max	Base
Dependent Variable						
Food security	1,088,645	0.05	_	0	1	Food Insecure
Very Low Food Secure	1,088,645	0.01	_	0	1	Very low food secure
Assistance Packages						
SNAP	1,079,175	0.07	_	0	1	Receives SNAP
Free Food	1,088,645	0.04	_	0	1	Receive Free Food
P-EBT	1,088,645	0.02	_	0	1	Receives P-EBT
Economic Impact Payment (EIP)	1,088,645	0.03	_	0	1	Receives EIP
Household Demographics						
Gender	1,088,645	0.41	_	0	1	Male
Education	1,088,645	0.67	_	0	1	College
Marital Status	1,088,645	0.54	_	0	1	Married
Number of Kids	1,088,645	0.16	0.62	0	5	_

Number of adults	1,088,645	2.02	0.90	1	10	_
Black	1,088,645	0.07	_	0	1	_
White	1,088,645	0.85	_	0	1	_
Other	1,088,645	0.08	_	0	1	_
Hispanic	1,088,645	0.08	_	0	1	_
Between 0 and 100,000	1,088,645	0.64	_	0	1	_
Between 100,000 and 199,000	1,088,645	0.26	_	0	1	_
200,000 and above	1,088,645	0.10	_	0	1	_

Mean and Standard Deviation are displayed for continuous variables, while proportions are for discrete variables. SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit Transfers, FAH: Food at Home, FAFH: Food Away from Home. Discrete variables take on distinct, countable values. Continuous variables can take on any value within a range.

Table 5b: Descriptive Statistics for Food Expenditure

Variable	**Obs**	**Mean/ Proportion**	**Std. Dev.**	**Min**	**Max**	**Base**
Dependent Variable						
FAH	630,163	179.50	130.57	0	900	_
FAFH	630,163	70.80	87.41	0	500	_
Assistance Packages						
SNAP	630,163	0.06	_	0	1	Receives SNAP
Free Food	630,163	0.04	_	0	1	Receive Free Food
P-EBT	630,163	0.01	_	0	1	Receives P-EBT
Economic Impact Payment (EIP)	630,163	0.05	_	0	1	Receives EIP

Household Demographics						
Gender	630,163	0.42	_	0	1	Male
Education	630,163	0.68	_	0	1	College
Marital Status	630,163	0.56	_	0	1	Married
Number of Kids	630,163	0.2	0.67	0	5	_
Number of adults	630,163	2.04	0.90	1	10	_
Black	630,163	0.06	_	0	1	_
White	630,163	0.85	_	0	1	_
Other	630,163	0.09	_	0	1	_
Hispanic	630,163	0.07	_	0	1	_
Income between 0 and $100,000	630,163	0.63	_	0	1	_
Income between $100,000 and $199,000	630,163	0.27	_	0	1	_
$200,000 and above	630,163	0.10	_	0	1	_

Mean and Standard Deviation are displayed for continuous variables, while proportions are for discrete variables. SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit Transfers, FAH: Food at Home, FAFH: Food Away from Home. Discrete variables take on distinct, countable values. Continuous variables can take on any value within a range.

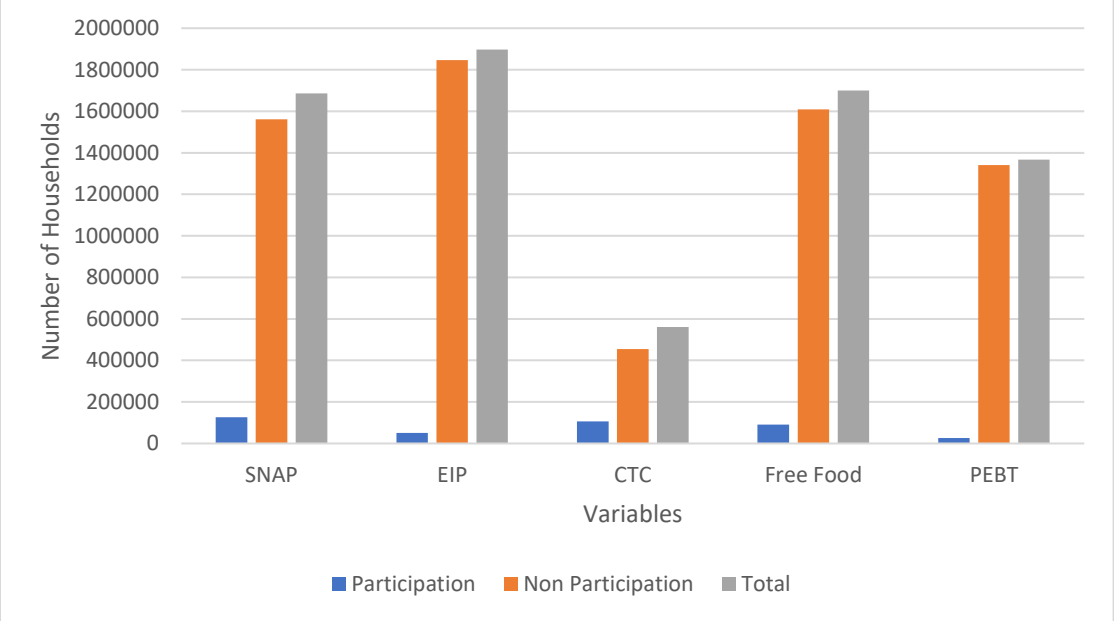
is low partly because P-EBT was issued twice a year, and the survey was administered every two weeks. Refer to Figure 3 for household participation in Covid-19 relief packages.

Household demographics considered include household income, race, household size, education, and marital status. In total, 41% of household heads had a college degree, and 52% were married. On average, a household had one child and about two adults. Considering race, 13% were Black, 77% were White, 15% were Hispanic, and 10% were Other. Most households, 72%, had an annual income below $100,000, while about 7% had an annual income above $200,000.

Food expenditure

Household food expenditures were categorized into expenditures on FAFH and FAH. The impact of the relief packages on household food expenditure is estimated using OLS, Tobit Models, and

Figure 3 : Household Participation in Covid-19 Relief Packages



Source: Household Pulse Survey
SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit Transfers, FAH: Food at Home, FAFH: Food Away from Home. EIP: Economic Impact Payment, CTC: Child Tax Credit.

Cragg's Hurdle Models, and results are provided in Tables 5, 6, 7, 8,9, and 10 respectively. Each table presents results for two dependent variables, FAH and FAFH expenditures.

Also, there are three different columns for each dependent variable in Tables 5, 6,7, and 8. The first column is the simple model, which includes the assistance packages and household demographics. The second column is the first column with the addition of state controls for all 50 states, and the third is the second column plus survey week controls for 28 weeks included in the analysis.

As shown in the OLS results (see table 5 and 6), the relief packages all have a significant *(p*<0.01) association with FAH and FAFH expenditures. SNAP has a positive association with FAH expenditures and a negative association with FAFH expenditures. SNAP participation is associated with increased FAH expenditures of $22.98 and decreased FAFH expenditures of $8.28.

Table 6: Ordinary Least Square; Dependent Variable=FAH

VARIABLES	(1) FAH	(2) FAH	(3) FAH
SNAP	22.984***	22.623***	22.567***
	(1.574)	(1.575)	(1.573)
Economic Impact Payment	29.908***	29.590***	29.841***
	(1.803)	(1.799)	(1.889)
P-EBT	28.258***	30.095***	29.556***
	(5.529)	(5.537)	(5.531)
Free Food	-8.719***	-9.023***	-8.953***
	(1.793)	(1.787)	(1.784)
Gender	7.879***	7.911***	7.894***
	(0.630)	(0.629)	(0.628)
Education	-1.511**	-2.021***	-2.008***
	(0.606)	(0.611)	(0.611)
Marital status	15.993***	16.740***	16.759***
	(0.740)	(0.738)	(0.737)
Household Kids	39.935***	40.181***	39.757***
	(0.692)	(0.693)	(0.728)

Household Adults	28.145***	27.789***	27.782***
	(0.464)	(0.463)	(0.462)
Black	8.847***	7.727***	7.684***
	(1.296)	(1.323)	(1.322)
Other	16.246***	11.988***	12.022***
	(1.257)	(1.297)	(1.294)
Hispanic	32.428***	28.502***	28.495***
	(1.448)	(1.445)	(1.443)
Income above $200,000	63.828***	61.489***	61.446***
	(1.220)	(1.238)	(1.236)
Income between $100,000-$199,000	27.545***	26.521***	26.505***
	(0.753)	(0.761)	(0.758)
Constant	81.967***	90.744***	88.520***
	(0.930)	(2.440)	(2.738)
State Controls	No	Yes	Yes
Week Controls	No	No	Yes
Observations	637,029	637,029	637,029
R-squared	0.156	0.160	0.160
F-Statistics	1651.11	389.82	320.97
Prob > F	0.000	0.000	0.000

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Note: Other packages, such as CTC and UI, were missing data for most weeks considered for the analysis; hence they were omitted .

SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit Transfers. FAH: Food At Home.

Table 7: Ordinary Least Square; Dependent Variable=FAFH

VARIABLES	(1) FAFH	(2) FAFH	(3) FAFH
SNAP	-8.289***	-8.082***	-8.200***
	(1.125)	(1.125)	(1.129)
Economic Impact Payment	17.421***	17.093***	11.408***
	(1.247)	(1.247)	(1.295)
P-EBT	16.040***	17.577***	17.000***
	(3.764)	(3.763)	(3.771)
Free Food	-7.454***	-7.651***	-7.106***

	(1.242)	(1.238)	(1.243)
Gender	12.263***	12.324***	12.346***
	(0.454)	(0.453)	(0.453)
Education	1.493***	1.385***	1.266***
	(0.428)	(0.434)	(0.433)
Marital status	-2.031***	-1.725***	-1.734***
	(0.523)	(0.523)	(0.523)
Household Kids	16.022***	16.087***	13.050***
	(0.456)	(0.456)	(0.477)
Household Adults	11.807***	11.640***	11.683***
	(0.307)	(0.308)	(0.308)
Black	16.792***	14.997***	15.124***
	(0.947)	(0.958)	(0.960)
Other	18.754***	16.636***	16.745***
	(0.992)	(1.016)	(1.016)
Hispanic	27.159***	23.966***	24.045***
	(1.121)	(1.114)	(1.113)
Income above $200,000	59.399***	58.453***	57.925***
	(0.906)	(0.913)	(0.907)
Income between $100,000-$199,000	24.766***	24.563***	24.198***
	(0.540)	(0.542)	(0.540)
Constant	24.845***	32.033***	28.224***
	(0.623)	(1.710)	(1.956)
State Controls	No	Yes	Yes
Week Controls	No	No	Yes
Observations	636,679	636,679	636,679
R-squared	0.100	0.104	0.110
F-Statistics	1162.80	287.81	248.88
Prob > F	0.000	0.000	0.000

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Note: Other packages, such as CTC and UI, were missing data for most weeks considered for the analysis; hence they omitted data.

SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit Transfers. FAFH: Food Away from Home.

Also, EIP and P-EBT were found to have a significant positive association with both FAH and FAFH expenditures. Thus, households participating in any of the two programs have

higher expenditures on FAH and FAFH. Unlike EIP and P-EBT, households receiving free food had lower expenditures on both FAFH and FAH. This is likely because households receiving food from food pantries and other sources had to purchase less FAH and FAFH, reducing food expenditure.

The household characteristics considered are all statistically significant. The gender of the household head, whether the household is Black, Hispanic, or other race, all have a positive and significant association with FAH and FAFH expenditures. On the other hand, household head's educational level and marital status were found to have a contrasting effect. While household heads with a college degree reduce their FAH spending and increase their FAFH spending, households with married household heads were found to increase their FAH spending and reduce their FAFH spending. Moreover, the number of children and adults in the household is also associated with household food expenditure. An additional child or adult is associated with increased expenditures on FAH and FAFH. Similarly, household income has a significant positive association with household expenditures.

Tables 7 and 8 presents results for the Tobit model, which accounted for the proportion of households that spent zero dollars on food within a specific week. The variables considered in this model are significant, at least at the 5% significance level. Results for all variables are consistent with OLS results in Tables 5 and 6. However, the magnitude of the association between assistance packages and demographics is lower than in the OLS results. This is because the Tobit model accounts for households with zero expenditures on FAH and FAFH.

Additionally, Cragg's hurdle model results are presented in two tables. Table 9 shows estimated model coefficients, and Table 10 illustrates the hurdle model's average marginal and partial effects. From Table 10, the second and fourth columns are the average marginal effects of

Table 8: Marginal Effect for Tobit Model; Dependent Variable=FAH

VARIABLES	(1) FAH	(2) FAH	(3) FAH
SNAP	17.325***	17.285***	17.266***
	(1.179)	(1.180)	(1.181)
Economic Impact Payment	22.098***	22.065***	21.213***
	(1.348)	(1.347)	(1.362)
P-EBT	21.243***	21.459***	21.400***
	(4.081)	(4.082)	(4.085)
Free Food	-6.613***	-6.677***	-6.570***
	(1.345)	(1.344)	(1.343)
Gender	5.634***	5.644***	5.648***
	(0.474)	(0.474)	(0.474)
Education	-0.924**	-0.962**	-0.979**
	(0.456)	(0.456)	(0.456)
Marital Status	12.563***	12.638***	12.641***
	(0.556)	(0.556)	(0.556)
Household kids	29.515***	29.551***	29.112***
	(0.510)	(0.510)	(0.528)
Household Adults	20.947***	20.908***	20.913***
	(0.350)	(0.349)	(0.349)
Black	5.877***	5.808***	5.819***
	(0.985)	(0.986)	(0.986)
Other	11.859***	11.471***	11.493***
	(0.940)	(0.943)	(0.943)
Hispanic	23.964***	23.613***	23.632***
	(1.082)	(1.078)	(1.078)
Income above $200,000	47.349***	47.165***	47.092***
	(0.901)	(0.901)	(0.901)
Income between $100,000-$199,000	20.645***	20.564***	20.515***
	(0.562)	(0.561)	(0.561)
State		-0.113***	-0.114***

		(0.015)	(0.015)
Week			0.235***
			(0.054)
Observations	637,029	637,029	637,029
F-Statistics	1214.96	384.49	316.14
Prob > F	0.000	0.000	0.000

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10

SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit Transfers, FAH: Food at Home.

Table 9: Marginal Effect for Tobit Model; Dependent Variable=FAFH

VARIABLES	(1) FAFH	(2) FAFH	(3) FAFH
SNAP	-8.999***	-9.019***	-9.069***
	(0.740)	(0.739)	(0.742)
Economic Impact Payment	10.355***	10.337***	6.894***
	(0.740)	(0.739)	(0.744)
P-EBT	11.073***	11.171***	10.889***
	(2.123)	(2.122)	(2.126)
Free Food	-5.992***	-6.020***	-5.579***
	(0.798)	(0.798)	(0.803)
Gender	7.639***	7.645***	7.676***
	(0.283)	(0.283)	(0.283)
Education	2.056***	2.036***	1.961***
	(0.263)	(0.263)	(0.263)
Marital Status	-0.811**	-0.776**	-0.766**
	(0.318)	(0.318)	(0.319)
Household kids	9.683***	9.701***	7.918***
	(0.257)	(0.256)	(0.265)
Household Adults	7.670***	7.651***	7.678***
	(0.183)	(0.183)	(0.183)
Black	10.550***	10.519***	10.586***
	(0.582)	(0.582)	(0.584)
Other	10.796***	10.603***	10.713***
	(0.584)	(0.584)	(0.584)
Hispanic	16.536***	16.363***	16.459***

	(0.652)	(0.649)	(0.649)
Income above $200,000	33.906***	33.817***	33.562***
	(0.508)	(0.508)	(0.505)
Income between $100,000-$199,000	15.598***	15.559***	15.380***
	(0.318)	(0.318)	(0.317)
State	No	-0.056***	-0.057***
		(0.009)	(0.009)
Week	No	No	0.967***
			(0.032)
Observations	636,679	636,679	636,679
F-Statistics	1214.96	297.55	256.88
Prob > F	0.000	0.000	0.000

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10

SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit Transfers, FAFH: Food Away from Home.

Table 10: Coefficients for Cragg's Hurdle Model

	FAH Probability	*FAH Expenditure*	*FAFH Probability*	*FAFH Expenditure*
SNAP	0.1233***	43.9872***	-0.3545***	38.6888***
Economic Impact Payment	0.0086	53.7372***	0.1033***	105.1337***
P-EBT	0.3360***	34.2933***	0.1547***	120.5091***
Free Food	-0.0481*	-17.1668***	-0.1609***	-38.9361***
Gender	-.0687***	17.5215***	0.0966***	131.6896***
Education	0.0666***	-4.8166***	0.1092***	-14.8329***
Marital Status	0.2844***	34.3732***	-0.0030	10.6676*
Household Kids	0.0612***	59.3949***	0.1497***	80.7198***

Household Adults	0.0563***	50.3559***	0.1318***	89.6705***
Black	-0.1975***	24.8539***	0.1275***	162.6619***
Other	-0.0517**	31.7189***	0.0721***	151.8837***
Hispanic	0.0069	61.027***	0.2028***	202.5406***
Income above $200,000	0.1839***	111.8593***	0.3327***	456.7956***
Constant	1.6837***	-85.4372***	0.3336***	-1136.35***
Observation	637,029	637,029	637,029	637,029

*** p<0.01, ** p<0.05, * p<0.1

SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit Transfers, FAH: Food at Home, FAFH: Food Away from Home.

participation for FAH and FAFH, respectively. Similarly, columns three and five are the partial effects of conditional expenditures for FAH and FAFH. Most variables have a significant ($p<0.05$) participation probability and expenditure partial effect. While SNAP participating households are 0.67% more likely to purchase FAH, they are 9.7% less likely to purchase FAFH than non-participants. Unlike the OLS and Tobit models' results, Cragg's model reveals that SNAP-participating households spend $3.66 more on FAFH given purchases than non-SNAP households. EIP does have a significant participation probability ($p<0.01$) for FAFH but does not have a significant ($p<0.05$) participation probability for FAH; however, its expenditure share is significant at 1% for both dependent variables. Households that received an EIP are 0.25% less likely to purchase FAFH. Again, EIP recipient households increase their food expenditure by $26.57 and their FAFH expenditures by $9.96, given purchase.

Again, households that receive P-EBT are 1.8% more likely to buy FAH and 4% more likely to purchase FAFH. This indicates that receipt of P-EBT increases the probability of purchasing FAFH more than the probability of purchasing FAH. Like the

OLS and Tobit results, receiving free food reduced expenditures on both FAH and FAFH. Also, household heads with a college degree were 0.3% and 3.24% more likely to buy FAH and FAFH, respectively; however, they spent $2.38 and $1.40 less on FAH and FAFH were given purchases, respectively.

Comparing the OLS, Tobit, and Cragg's Hurdle results for the full model provide consistent as well as contrasting results. Relief packages such as EIP and P-EBT, as well as if the household head is male, Black, Hispanic, or other race, had a significant positive association with expenditures on both FAH and FAFH. Similarly, an increase in the household number of kids and adults has a positive and significant association with expenditures on both FAH and FAFH. Again, free food has a negative impact on both FAH and FAFH for all three models. That is households that receive free food reduce their expenditure on both FAFH and FAH.

On the contrary, SNAP, education, and marital status results are similar in the OLS and the Tobit models but different from their results in the Cragg's model. The results in both OLS and Tobit models reveal that the household's head's educational level, marital status, and household SNAP participation increases household expenditure on FAH and reduces FAFH expenditures. However,

Table 11: Margins for Cragg's Double Hurdle Model

	FAH	*FAH*	*FAFH*	*FAFH*
	Marginal Effects (Participation)	*Partial Effects (Expenditure)*	*Marginal Effects (Participation)*	*Partial Effect (Expenditure)*

SNAP	0.00675***	21.7524***	-0.0977***	3.6672***
Economic Impact Payment	0.00046	26.5739***	-0.0025***	9.9652***
P-EBT	0.01839***	16.9586***	0.0400***	11.4226***
Free Food	-0.0026*	-8.48927***	-0.0436***	-3.6906***
Gender	-.00375***	8.66471***	0.0272***	12.4823***
Education	0.00364***	-2.38192***	0.0324***	-1.4059***
Marital Status	0.01557***	16.9981***	-0.0020	1.0111*
Household Kids	0.00335***	29.3718***	0.0273***	7.6511***
Household Adults	0.00308***	24.9019***	0.0375***	8.4995***
Black	-0.0108***	12.2906***	0.0334***	15.4180***
Other	-0.0028**	15.6856***	0.0224***	14.3964***
Hispanic	0.00038	30.1791***	0.0587***	19.1980***
Income above $200,000	0.01007***	55.3163***	0.0959***	43.2979***
Income between $100,000-$199,000	0.0086***	26.6897***	0.0767***	21.8867***
Observation	1,081,058	1,081,058	1,081,058	1,081,058

*** p<0.01, ** p<0.05, * p<0.1

SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit Transfers, FPL: Federal Poverty Line, FAH: Food at Home, FAFH: Food Away from Home.

Cragg's Double Hurdle model results show that these variables are associated with increased FAH and FAFH expenditures given purchase. Considering the differences and similarities across different models, this study discusses the results of the Cragg's Double Hurdle model. The Cragg's Double Hurdle model provides results of the impact of the packages on households' decision to purchase either FAH and FAFH as well as how much household spend on FAH and FAFH, given they made purchase within the week.

Food Security

Food security is analyzed using both LPM and Probit models. The dependent variable of the first estimation measures whether a household is a food insecure (food insecurity=1). In the second estimation, the dependent variable measures whether the household is very low food secure (very low food security=1). Tables 11 and 12 present results for the first and second estimations, respectively. There are four different models in Table 11, the first includes all relief packages, except SNAP, as well as the household demographics. The second is the first plus a state dummy, and the third model is the second with the addition of a week dummy. The last model is the third model plus the SNAP variable.

EIP is only significant in the third model ($p<0.05$) and the fourth model ($p<0.1$). The coefficients suggest that if households received the EIP, the probability that the household is food insecure increases by 0.9%. Additionally, both P-EBT and free food are significant ($p<0.01$) across all the models, and both variables are positively associated with food insecurity. However, the coefficient of P-EBT of the full model has a negative association indicating that households that receive P-EBT are 1.7% less likely to be food insecure.

Moreover, all households' demographics are statistically significant ($p<0.01$). Household heads' educational level and marital status have a negative association, indicating if a household head is married as well as has a college education, there is an decreased likelihood that the household is food insecure. Similarly, an increase in households' income decreases the likelihood that a household is food insecure. Conversely, if the household head is male, Black, Hispanic, or of other race, the household's possibility

of being food insecure increases. Similarly, an increase in the number of children and adults in the household increases the likelihood that the household is food insecure.

Similar to Table 11, Table 12 provides results for four models with very low food security as the dependent variable. The results show that EIP is significant in both the first and second models. Households that receive an EIP are 0.4% less likely to be very low food insecure. This

Table 12: Linear Probability Model; Dependent Variable=Food Insecurity

VARIABLES	(1)	(2)	(3)	(4)
Economic Impact Payment	0.001	0.001	0.009**	0.007*
	(0.004)	(0.004)	(0.004)	(0.004)
P-EBT	0.027***	0.027***	0.026***	-0.017***
	(0.006)	(0.006)	(0.006)	(0.006)
Free Food	0.133***	0.134***	0.133***	0.113***
	(0.004)	(0.004)	(0.004)	(0.004)
SNAP	_	_	_	0.096***
				(0.003)
Gender	0.010***	0.010***	0.010***	0.012***
	(0.001)	(0.001)	(0.001)	(0.001)
Education	-0.052***	-0.051***	-0.051***	-0.046***
	(0.001)	(0.001)	(0.001)	(0.001)
Marital Status	-0.052***	-0.053***	-0.053***	-0.045***
	(0.001)	(0.001)	(0.001)	(0.001)
Household Kids	0.011***	0.011***	0.013***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)
Household Adults	0.009***	0.009***	0.009***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)
Black	0.057***	0.056***	0.055***	0.047***
	(0.003)	(0.003)	(0.003)	(0.003)
Other	0.027***	0.029***	0.029***	0.027***
	(0.002)	(0.002)	(0.002)	(0.002)
Hispanic	0.037***	0.038***	0.038***	0.037***
	(0.003)	(0.003)	(0.003)	(0.003)
Income_200000_and_above	-0.053***	-0.052***	-0.051***	-0.047***

	(0.001)	(0.001)	(0.001)	(0.001)
From_100000_199999	-0.057***	-0.056***	-0.055***	-0.051***
	(0.001)	(0.001)	(0.001)	(0.001)
State Controls	No	Yes	Yes	Yes
Week Controls	No	No	Yes	Yes
Constant	0.102***	0.120***	0.129***	0.120***
	(0.002)	(0.005)	(0.006)	(0.006)
Observations	1,088,645	1,088,645	1,088,645	1,079,175
R-squared	0.070	0.071	0.072	0.080
F-Statistics	1131.81	309.96	221.67	221.04
Prob > F	0.000	0.000	0.000	0.000

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit

indicates that EIP reduces households' very low food security. For the P-EBT variable, only the full model has a significant ($p<0.01$) association with very low food security, indicating that households receiving P-EBT are 1.2% less likely to be very low food security. Free food and SNAP are also significant ($p<0.01$); however, they are both positively associated with households with very low food security.

All household characteristics considered are significant ($p<0.01$) except for household kids and adults. Household heads' educational level, marital status, and income level all have the same results as in Table 11. Also, the household head's gender and race have a negative association with very low food security. Tables 13 and 14 presents results with very low food security as the dependent variable. Compared to table 12, the results comprise the full model and models conditioned on household characteristics, including whether a household has kids, is without kids, is Black, Hispanic, or above or below the Federal Poverty Line (FPL). These results provide insight into how various food packages impacted very low food security for different households. For Hispanic households and

households with income above the FPL, EIP had a significant ($p<0.01$) association and reduced household likelihood of being very low food security by 1.3% and 1.4%, respectively.

The marginal effects estimate for the first estimation of the probit model with food insecurity as the dependent variable are provided in table 15. All COVID-19 relief packages had a significant($p<0.01$) but positive association with food insecurity. These results indicate that receiving any package increased households' likelihood of food insecurity. However, high-income households were 10% less likely to be food insecure than low-income households.

Table 16 provides results for the Probit marginal effects of the second estimation (the model with very low food security as the dependent variable). EIP and P-EBT were significant and inversely associated with low food security households at 5% and 1%, respectively.

Table 13: Linear Probability Model; Dependent Variable= Very Low Food Security

VARIABLES	(1)	(2)	(3)	(4)
Economic Impact Payment	-0.004*	-0.004*	-0.001	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)
P-EBT	-0.000	0.000	-0.001	-0.012***
	(0.003)	(0.003)	(0.003)	(0.003)
Free Food	0.038***	0.038***	0.038***	0.033***
	(0.003)	(0.003)	(0.003)	(0.003)
SNAP	_	_	_	0.024***
				(0.002)
Gender	0.005***	0.005***	0.005***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)
Education	-0.015***	-0.015***	-0.015***	-0.013***
	(0.001)	(0.001)	(0.001)	(0.001)
Marital Status	-0.015***	-0.015***	-0.015***	-0.013***

	(0.001)	(0.001)	(0.001)	(0.001)
Household Kids	0.001	0.001	0.001*	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Household Adults	0.001	0.001	0.001	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Black	0.013***	0.013***	0.013***	0.010***
	(0.002)	(0.002)	(0.002)	(0.002)
Other	0.010***	0.011***	0.011***	0.010***
	(0.001)	(0.001)	(0.001)	(0.001)
Hispanic	0.007***	0.007***	0.007***	0.007***
	(0.002)	(0.002)	(0.002)	(0.002)
Income above $200000	-0.010***	-0.009***	-0.009***	-0.008***
	(0.001)	(0.001)	(0.001)	(0.001)
Income between $100000-$199999	-0.013***	-0.012***	-0.012***	-0.011***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.028***	0.031***	0.036***	0.034***
	(0.001)	(0.002)	(0.003)	(0.003)
State Controls	No	Yes	Yes	Yes
Week Controls	No	No	Yes	Yes
Observations	1,088,645	1,088,645	1,088,645	1,079,175
R-squared	0.018	0.019	0.019	0.021
F-Statistics	235.53	65.60	47.47	46.96
Prob > F	0.000	0.000	0.000	0.000

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit

Table 14: Linear Probability Model; Dependent Variable=Very Low Food Security

VARIABLES	(1) Full model	(2) Households with kids	(3) Household without kids	(4) Household is Black
Economic Impact Payment	-0.002	-0.005	0.000	0.007
	(0.002)	(0.004)	(0.002)	(0.008)
P-EBT	0.012***	-0.002	_	0.007
	(0.003)	(0.005)		(0.009)

Free Food	0.033***	0.036***	0.032***	0.019***
	(0.003)	(0.005)	(0.003)	(0.006)
SNAP	0.024***	0.003	0.029***	0.012**
	(0.002)	(0.004)	(0.002)	(0.005)
Gender	0.006***	0.006**	0.006***	0.010***
	(0.001)	(0.003)	(0.001)	(0.003)
Education	-0.013***	-0.011***	-0.014***	-0.021***
	(0.001)	(0.002)	(0.001)	(0.002)
Marital Status	-0.013***	-0.015***	-0.013***	-0.012***
	(0.001)	(0.003)	(0.001)	(0.004)
Household Kids	0.000	_	_	-0.001
	(0.001)			(0.002)
Household Adults	0.000	0.004**	-0.000	-0.002
	(0.000)	(0.002)	(0.000)	(0.002)
Black	0.010***	0.016***	0.009***	
	(0.002)	(0.004)	(0.002)	_
Other	0.010***	0.010***	0.010***	
	(0.001)	(0.004)	(0.001)	_
Hispanic	0.007***	-0.002	0.009***	0.001
	(0.002)	(0.004)	(0.002)	(0.007)
Income above $200000	-0.008***	-0.005	-0.008***	-0.007
	(0.001)	(0.004)	(0.001)	(0.008)
Income between $100000-$199999	-0.011***	-0.011***	-0.011***	-0.021***
	(0.000)	(0.002)	(0.000)	(0.002)
State Controls	Yes	Yes	Yes	Yes
Week Controls	Yes	Yes	Yes	Yes
Constant	0.034***	0.025**	0.034***	0.059***
	(0.003)	(0.010)	(0.003)	(0.012)
Observations	1,079,175	90,282	988,893	71,954
R-squared	0.021	0.023	0.022	0.018
F-Statistics	46.89	6.45	44.35	6.20
Prob > F	0.000	0.000	0.000	0.000

Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit Transfers.

Table 15: Linear Probability Model; Dependent Variable=Very Low Food Security

VARIABLES	(1) Household is Hispanic	(2) Household Is below FPL	(3) Household Is above FPL
Economic Impact Payment	-0.013***	0.000	-0.014*
	(0.004)	(0.002)	(0.008)
P-EBT	-0.024***	-0.015***	-0.011
	(0.007)	(0.003)	(0.009)
Free Food	0.021***	0.032***	0.032***
	(0.006)	(0.003)	(0.007)
SNAP	0.018***	0.024***	0.007
	(0.006)	(0.002)	(0.006)
Gender	0.009***	0.005***	0.014**
	(0.003)	(0.001)	(0.006)
Education	-0.018***	-0.013***	-0.028***
	(0.002)	(0.001)	(0.004)
Marital Status	-0.014***	-0.011***	-0.014***
	(0.003)	(0.001)	(0.005)
Household Kids	0.002	0.000	-0.003
	(0.002)	(0.001)	(0.002)
Household Adults	-0.004***	-0.003***	0.004*
	(0.001)	(0.000)	(0.002)
Black	0.009	0.010***	0.009
	(0.007)	(0.002)	(0.007)
Other	0.021***	0.009***	0.023***
	(0.006)	(0.001)	(0.007)
Hispanic		0.009***	-0.013**
		(0.002)	(0.006)
Income above $200000	-0.009*	-0.006***	_
	(0.005)	(0.001)	_
Income between $100000-$199999	-0.020***	-0.009***	
	(0.002)	(0.000)	
State Controls	Yes	Yes	Yes
Week Controls	Yes	Yes	Yes
Constant	0.080***	0.036***	0.071***
	(0.021)	(0.003)	(0.025)
Observations	81,601	1,045,266	33,909
R-squared	0.020	0.021	0.018
F-Statistics	5.47	38.28	2.73
Prob > F	0.000	0.000	0.000

Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1
SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit Transfers, FPL: Federal Poverty Line.

Table 16: Marginal Effects for Probit Model; Dependent Variable=Food Insecurity

VARIABLES	(1)	(2)	(3)
Economic Impact Payment	0.000	0.000	0.009***
	(0.003)	(0.003)	(0.003)
P-EBT	0.010***	0.010***	0.010***
	(0.003)	(0.003)	(0.004)
Free Food	0.073***	0.073***	0.073***
	(0.002)	(0.002)	(0.002)
Gender	0.010***	0.011***	0.010***
	(0.001)	(0.001)	(0.001)
Education	-0.056***	-0.055***	-0.055***
	(0.001)	(0.001)	(0.001)
Marital status	-0.053***	-0.054***	-0.054***
	(0.001)	(0.001)	(0.001)
Household Kids	0.009***	0.009***	0.011***
	(0.001)	(0.001)	(0.001)
Household Adults	0.008***	0.008***	0.008***
	(0.001)	(0.001)	(0.001)
Black	0.044***	0.043***	0.042***
	(0.002)	(0.002)	(0.002)
Other	0.027***	0.029***	0.028***
	(0.002)	(0.002)	(0.002)
Hispanic	0.030***	0.030***	0.030***
	(0.002)	(0.002)	(0.002)
Income above $200,000	-0.146***	-0.144***	-0.144***
	(0.005)	(0.005)	(0.005)
Income between $100000-$199999	-0.106***	-0.105***	-0.105***
	(0.002)	(0.002)	(0.002)
State Controls	No	Yes	Yes
Week Controls	No	No	Yes
Observations	1,088,645	1,088,645	1,088,645
Chi2	14214.54	14940.69	16106.02
Prob > Chi2	0.000	0.000	0.000

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit Transfers, FPL: Federal Poverty Line.

Receiving either of these two packages during the pandemic reduced households' likelihood of having very low food security. Conversely, SNAP, and free food both had a significant (p<0.01) positive association with very low food security. High-income households were 3% less likely to be food insecure compared to low-income households. Also, Black, Hispanic, and other race households

Table 17: Marginal Effects for Probit Model; Dependent Variable=Very Low Food Security

	(1)	(2)	(3)
VARIABLES			
Economic Impact Payment	-0.003*	-0.003*	-0.001
	(0.002)	(0.002)	(0.002)
P-EBT	-0.001	-0.000	-0.006***
	(0.002)	(0.002)	(0.002)
Free Food	0.019***	0.019***	0.016***
	(0.001)	(0.001)	(0.001)
SNAP			0.012***
			(0.001)
Gender	0.005***	0.005***	0.006***
	(0.001)	(0.001)	(0.001)
Education	-0.017***	-0.017***	-0.016***
	(0.001)	(0.001)	(0.001)
Marital Status	-0.016***	-0.016***	-0.015***
	(0.001)	(0.001)	(0.001)
Household Kids	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)
Household Adults	0.001**	0.001**	0.001*
	(0.000)	(0.000)	(0.000)
Black	0.010***	0.010***	0.008***
	(0.001)	(0.001)	(0.001)
Other	0.009***	0.010***	0.009***
	(0.001)	(0.001)	(0.001)
Hispanic	0.006***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)
Income above $200,000	-0.030***	-0.029***	-0.028***

	(0.002)	(0.002)	(0.002)
Income between $100,000-$199,999	-0.031***	-0.030***	-0.029***
	(0.001)	(0.001)	(0.001)
State Controls	No	Yes	Yes
Week Controls	No	No	Yes
Observations	1,088,645	1,088,645	1,079,175
Chi2	3768.10	4296.28	4812.96
Prob > Chi2	0.000	0.000	0.000

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
SNAP: Supplement Nutrition Assistance Program, P-EBT: Pandemic Electronic Benefit

were more likely to be very low food secure compared to White households.

Households from other races have an insignificant association with the likelihood that households are very low food secure. Again, P-EBT had a negative significant ($p<0.01$) association with the likelihood that household is very low food secure for Hispanic households and households below the FPL. Conversely, free food has a significant ($p<0.01$) but positive association with low

food security for the households considered. Like free foods, SNAP is positively associated with low food security. P-EBT was helpful to Hispanic households and households below the FPL; however, the full sample results show that P-EBT is positively associated with household food insecurity. Again, EIP reduced very low food security among Hispanics and households above the FPL but did not significantly impact other households as well as the whole sample. Additionally, free food and SNAP have a significant but positive association with households with very low food security for the entire sample and all other

households. That is, households that received free food and /or SNAP had great levels of food insecurity.

DISCUSSION

This study aims to estimate the effect of the COVID-19 relief packages on US households' food expenditure and food security. The COVID-19 relief packages were introduced to curb food hardship, which emanated from a decline in food production, trade restriction, business closures, and loss of income resulting from the pandemic. Using the Household Pulse Survey, OLS, Tobit, and Cragg's double-hurdle models are estimated to identify the impact of the relief packages on household food expenditure at home (FAH) and away from home (FAFH). Also, the impact of these packages on food insecurity and very low food-insecurity was estimated using the LPM and Probit model.

Food expenditure

The COVID-19 relief packages provided during the pandemic directly and indirectly affected household food expenditure. Food assistance issued as part of the COVID-relief packages was directly associated with increased FAH and FAFH expenditures. At the same time, Economic Impact Payments disbursed indirectly increased food expenditure through an increase in household disposable income.

Results provide evidence that COVID-19 relief packages, including EIP, P-EBT, and SNAP, had a significant, positive association with household FAH and FAFH expenditures. This estimated association between relief package receipt and FAH and FAFH expenditures for US households is consistent with existing literature on food expenditures during the pandemic (Dhakal et al., 2022; Ellison et al., 2021). In contrast, free food was associated with reduced household expenditures on both FAH and FAFH. Receipt of EIP, SNAP, and P-EBT was associated with $26.57, $21.75, $16.96 increases

in weekly household FAH expenditures, and $9.96, $3.67, $11.42 increases in weekly household FAFH expenditures, respectively. On average, SNAP participating households receive $230.34 per month as SNAP benefit (Bauer et.al., 2020). Households that receive this benefit in the past seven days increase their weekly FAH purchases by $21.75 and their FAFH purchase by $3.67. Similarly, EIP was issued three times during the pandemic (U.S Department of Treasury, 2021) and eligible households increased their weekly FAH and FAFH purchase by $26.57 and $9.96 respectively. With the EIP, eligible individual taxpayers received $1,200, $600, and $1,400 for the first, second and third payment respectively and payments were made by the end of December 2021. Additionally, P-EBT benefits ranged from $250 to $400, varying by state and days school were closed within the state (Bauer et.al., 2020). The payment was often only once per school year. Beneficiaries increase their weekly FAH and FAFH purchases by $16.96 and $11.42 respectively.

EIP had a more significant association with FAFH expenditures than any other relief package issued to address food hardship during the pandemic. Conversely, increased FAFH expenditures associated with P-EBT receipt exceeded the increase from other relief packages. Receiving any COVID-19 relief packages increased households' disposable income for FAH and FAFH in different ways. Households that received EIP experienced an increase in their disposable income and hence income available for food. Also, the receipt of SNAP, P-EBT, and free food had an income effect as income allocated for FAH became available to spend on FAFH.

The analysis also indicates how household FAH and FAFH spending differed across various household characteristics. The study reveals results consistent with existing

literature (USDA-ERS, 2018; Dave, et al., 2009). High-income households spent more on FAFH and FAH than low-income households. Households with a Hispanic, Black or other race head spent more on FAFH and FAH than households with a Whitehead. Additionally, households with kids had higher expenditures on FAH and FAFH than households without kids. However, the increase in FAH expenditures for a household with kids exceeds their expenditure on FAFH.

Relief packages were provided to supplement income and encourage purchasing healthy food during the pandemic. While relief packages were associated with increases in both FAH and FAFH expenditures, results suggest that the rise in FAH (often considered healthier than FAFH) expenditures exceeded the increase in FAFH expenditures. This result provides evidence that the intended purpose for which the packages were designed was achieved; that is, addressing food hardship and encouraging the purchase of healthy food. During this period**,** individuals were more concerned about their health and often avoided lifestyle choices that could jeopardize their health. Past studies associated FAFH consumption with poorer diet quality, and FAFH is commonly regarded as an unhealthy meal (Banfield, Liu, Chang, Shine, & C., 2016, Lin & Guthrie, 2012, Overwyk et al., 2019). Additionally, the fear of contracting the disease coupled with preventive measures such as the lockdown restricted individuals from stepping outside, reducing the frequency of households eating outside the home, hence their expenditure on FAFH.

Furthermore, a FAFH meal is relatively more expensive than a FAH meal. Loss of jobs coupled with fear of contagion resulted in a decline in income for many households, which led to a reduction in the income available for food. Spending on FAH in times like this was economical, especially for low-income households (Jetter & Cassady, 2005). Most

households cut down on FAFH expenditures not only because of its health implications but it was also an economical and rational decision at the time.

COVID-19 relief packages may also have significantly affected FAH expenditures more than FAFH expenditures due to the non-monetary form of most packages. Packages provided during these periods were monetary and non-monetary; however, most of the packages considered could only be used for food purchases. Packages such as SNAP and P-EBT, even though they were given in monetary form, could only be used to purchase FAH. EIP was the only package that was in monetary form and could be used for purposes other than food purchases. The form in which the packages were given could also explain the considerable increase in FAH expenditure.

Although results suggest an increase in FAH expenditures resulting from the packages exceeds the increase in FAFH expenditures, these packages had an unintended association with increased FAFH expenditures. This association could be driven by the income effect associated with the receipt of these packages (Burney, 2018). The COVID-19 relief packages were intended to increase household income for food and support purchasing healthy food during the pandemic. However, income that was meant for FAH became available to be used on FAFH purchases. FAFH, in the existing literature, is considered to have low nutritional quality and is often less nutritious than FAH (Overwyk et al., 2019). Even though the packages were introduced to encourage the purchase of healthy food, results suggest they indirectly increased the buying of FAFH. In the future, policymakers should consider designing policies to encourage purchasing FAH and discourage purchasing less healthy FAFH to ensure dietary quality.

Food Security

Results from the analysis suggest most packages had a significant association with food insecurity. P-EBT and EIP receipts had the intended effect of helping reduce very low food security among households during the Pandemic. However, several packages, including SNAP, had a significant positive association with food insecurity and very low food security. The positive association of these packages is counterintuitive; generally, receipt of any of these packages would be expected to reduce household food insecurity; however, our results show otherwise. These diverging results can be attributed to the endogeneity of receiving some of these packages. Existing literature argues that not controlling endogeneity will result in a positive association between assistance receipt Such SNAP and food insecurity (Ratcliffe et al., 2011; Gundersen et al., 2017). The source of this endogeneity is the selection bias associated with participating and receiving these packages; households with greater food insecurity are more likely to participate in assistance programs such as SNAP than eligible households with lower levels of food insecurity. This explains why receipt of some of these packages had a positive association with food insecurity and very low food insecurity. Unlike SNAP and free food, P-EBT and economic impact payment are not endogenous; individuals received these packages without necessarily applying for them. In that case, benefits were provided not only to households with greater food insecurity or with low income. Despite the exogeneity of EIP and P-EBT, EIP was found to have a positive association with food insecurity due to the bias introduced by the endogeneity associated with SNAP and free food.

CONCLUSION

This study estimated the impact of the COVID-19 relief packages on food insecurity and food expenditure among US households. Overall, results from this study provide evidence that COVID-19 relief packages increased FAH and FAFH expenditures and that some relief packages, such as P-EBT and EIP, helped reduce food insecurity during the Pandemic. Also, SNAP and free food receipt were positively associated with food insecurity, likely due to endogeneity.

Understanding the impact of these packages on food security and food expenditure is essential to literature, but it has some limitations. Not controlling endogeneity resulted in counterintuitive results for the association between several relief packages and household food insecurity. Addressing endogeneity in future studies would provide the actual association of these packages with household food insecurity and very low food insecurity. Also, the study used food sufficiency as a proxy for food insecurity, as the HPS did not measure food insecurity. Another limitation of the HPS is how the data was collected; not all survey weeks included questions that measured all the variables used in the analysis. Also, providing sufficient data on variables such as Unemployment Insurance and the Child Tax Credit would enable the estimation of the impact of these relief packages on food insecurity and food expenditures.

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