APPLICATIONS OF THE HOUSEHOLD LIVING BUDGET USE CASE TO DEVELOP ECONOMIC INSECURITY MEASURES AND STANDARDS FOR THE 21ST CENTURY CENSUS CURATED DATA ENTERPRISE WITH A FOCUS ON FOOD INSECURITY, TECHNICAL REPORT BI-2023-261

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Applications of the Household Living Budget Use Case to Develop Economic Insecurity Measures and Standards for the 21st Century Census Curated Data Enterprise with a Focus on Food Insecurity

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Abstract

This report presents an application of the **Curated Data Enterprise (CDE)** Demonstration Use Case on the household living budget (HLB). The HLB is a yardstick that can be used to evaluate economic insecurity measures, construct new ones, and evaluate the adequacy of public assistance programs for low-income families. In this report we demonstrate how the HLB along with procedural data can be used to construct a food insecurity measure and assess the qualification thresholds of the Supplemental Nutrition Assistance Program (SNAP).

The USDA Economic Research Service has monitored food insecurity over time at national and state levels since 1995 using the Current Population Survey Food Security Supplement (CPS-FSS). But if a food insecurity measure is to inform action and target interventions, it must be constructed for smaller geographic levels that take into account geographic price differences. The HLB is constructed at the census tract level and incorporates three key determinants of food insecurity: household size and composition, household income, and food costs. In this application of the HLB, we construct a novel measure of food insecurity and evaluate the Supplemental Nutrition Assistance Program (SNAP) qualification thresholds for households in Washington, D.C. We benchmark our estimate of food insecurity against the 2022 food insecurity survey conducted by the National Opinion Research Center (NORC) in the National Capital Region sponsored by the Capital Area Foodbank.

The 21st Century Census Curated Data Enterprise (Keller et al., 2022) is a paradigm shift from data collection through designed surveys towards statistical products defined by stakeholder purposes and uses. This model focuses on the end product, it starts with the research questions of interest and constructs statistical products to provide data-driven insights to inform decision-making. This *Statistical Products First* approach emphasizes the agile re-use and wrangling of all data, designed, administrative, opportunity, and procedural, to respond to evidence-based policy issues more nimbly.

Exhibit 1: Curated Data Enterprise Framework

The center of the CDE framework is purpose and use – the specific research questions and problems to be addressed. Research questions addressed through the CDE should be impactful and benefit from the CDE's emphasis on data re-use, data integration, and timely and geographically granular data. This application of the HLB method (Lancaster et al.) addresses a pressing policy issue, the need for new economic affordability measures constructed for small geographic areas to consider geographic price differences and provide more actionable insights. With the publication of NASEM's *An Updated Measure of Poverty: (Re)Drawing the Line* (2023), the U.S. moved closer to acknowledging the role a household's basic needs budget could play in constructing a new poverty measure. We propose taking this approach and constructing a new measure of food insecurity at the census tract level that uses the HLB (Lancaster et al., 2023) and the residual income method proposed by Stone (2006) to measure housing affordability. The approach moves away from a single federal threshold with a multiplier for determining social benefit eligibility and instead uses the income needed for a household to function in society at a modest yet adequate standard of living.

In this report, we focus on a novel food insecurity measure to research the feasibility of this approach which can then be used as a starting point for creating statistical products relating to economic affordability measures. The importance of food security is highlighted by describing conditions during COVID-19 and the impact of the 2021 reevaluation of the Thrifty Food Plan. The lessons learned during the pandemic help to illustrate the need for timelier affordability measures within smaller geographic areas.

We provide a literature review on the history of food insecurity measures and the determinants of food insecurity. We introduce the reader to the residual income method and its use in constructing a housing affordability indicator. We provide an example of how this approach can be used to construct a measure of food insecurity in Washington, DC and benchmark our estimate against the 2022 food insecurity survey conducted by the National Opinion Research Center (NORC) in the National Capital Region sponsored by the Capital Area Foodbank. We end by discussing other measures of economic affordability that can be developed into statistical products using the HLB and the residual income method.

History of Food Insecurity Definition and Measurement

> *"Although numerous food security indicators have been developed for use in research, there is no agreement on the single 'best' food security indicator among scientists or practitioners for measuring, analysing, and monitoring food security."*
>
> (Manikas et al., 2023, p.25)

Since 1995, the U.S. Department of Agriculture (USDA) has sponsored annual data collection efforts to obtain information on food insecurity and hunger, using a definition that has evolved over time. As far back as the 1960s, research efforts aimed at defining and measuring hunger failed to achieve consensus on criteria (Wunderlich & Norwood, 2006). By 1990, based on the advice of an expert panel, the decision was made to define hunger in terms of the provision of nutritionally adequate food. In that year, the Life Sciences Research Office (LSRO) of the Federation of American Institute of Nutrition, under a cooperative agreement with the Department of Health and Human Services (DHHS), prepared a report that summarized a discussion of the ad hoc committee tasked with identifying the core indicators to assess nutritional status (Anderson, 1990). Consensus definitions were developed:

- *Food insecurity*: limited or uncertain availability of nutritionally adequate and safe food or limited or uncertain ability to acquire acceptable foods in socially acceptable ways.

- *Food security*: access by all people at all times to enough food for an active healthy life, includes at a minimum the ready availability of nutritionally adequate and safe foods and

an assured ability to acquire acceptable foods in a socially acceptable way (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies).

The LSRO conceptual definitions provided a basis for a USDA/DHHS initiative to operationalize the definition for use in a national survey. In 1994, USDA/DHHS sponsored the First National Conference on Food Security Measurement and Research (USDA ERS, Nd), where the following five guidelines were adopted to define food insecurity to:

1. limit the measure to resource-constrained food insecurity;
2. limit the operational definition and measurement to those elements that can be captured at the household level;
3. focus on the behavioral and experiential dimensions of food insecurity;
4. estimate prevalence by scaling items into a single measure across all levels of severity;
5. develop a standard set of prevalence estimates at several designated levels of severity for consistent application and comparisons over time.

In 1995, these guidelines helped to shape the Household Food Security Survey Module (HFSSM) that was added to the Current Population Survey (CPS), to elicit information on whether a household had trouble in meeting basic food needs due to lack of resources[1] (Coleman-Jensen 2022, page 4). These food security questions were asked only of households with incomes below 185% of the federal poverty line (Official Poverty Measure) and above 185% if the household gave any indication of food access problems on either of two screener questions (USDA ERS 2021). The questions in the HFSSM are used widely, having been incorporated in their entirety or in part into other national surveys, such as the Centers for Disease Control's (CDC) National Health and Nutrition Examination Survey, the Census Bureau's Survey of Income and Program Participation (SIPP), and the National Center for Education Statistics' Early Childhood Longitudinal Studies (ECLS) (Exhibit 2).

In addition, the HFSSM has been used by number of non-governmental organizations as the standard for measuring food insecurity, such as in the University of Michigan's Panel Survey of Income Dynamics (PSID) and the Urban Institute's Health Reform Monitoring Survey (HRMS). Finally, the HFSSM has served as a model for the Food Insecurity Experience scale (FIES), which is used by the United Nations, to gauge the prevalence of Food Insecurity internationally as part of the UN Sustainable Development Goals (SDGs) initiative (Cafiero et al., 2018; Ballard et al., 2014). Exhibit 2 contains a partial list of the surveys that include all or part of the HFSSM.

We propose constructing a new measure of food insecurity at the census tract level that uses the HLB (Lancaster et al., 2023) and the residual income method proposed by Stone (2006) to

[1] There are 18 questions, 8 of which are for households with persons under 18 years of age. Information on the questions and coding is available in Coleman-Jensen et al. (2022), p. 4.

measure housing affordability. The approach moves away from a single federal threshold with a multiplier for determining benefit eligibility and instead uses the income needed for a household to function in society at a modest yet adequate standard of living. The income needed is estimated as a function of household size and composition for a particular census tract and includes the adequacy standards or thresholds for seven components: the cost of housing, food, healthcare, childcare, transportation, broadband, and other necessities such as clothing, household supplies, personal care, nonprescription medicine, and school supplies, along with a household's tax liability. It is a transparent approach to ensuring the equitable treatment of all households that incorporates geographic price differences into adequacy standards for each of the components.

COVID-19 and Government Response

The following sections review the pandemic periods and the rise in inflation that followed. When describing the level of food insecurity during the pandemic, it is instructive to divide the research literature into three periods. The first period is the onset of the pandemic in February/March of 2020; the second, is the government and non-governmental response from Fall of 2020 through 2021; and the third, is the rise in inflation that followed.

COVID-19 Onset: February 2020 through September 2020

It is hard to talk about food insecurity without revisiting the COVID-19 pandemic, the emergency allotments that ended nationwide in March 2023,that ended nationwide on March 2023 and the impact the allotments had on food insecurity. The Urban Institute estimated that emergency allotments alone, independent of the reevaluation of the Thrifty Food Plan, kept 4.2 million people out of poverty in the fourth quarter of 2021, reducing poverty by 9.6 percent in states with emergency allotments, relative to a scenario in which emergency allotments were eliminated in other states. Child poverty was reduced by 14.0 percent in states with emergency allotments and was reduced most among Black, non-Hispanic children, falling by 18.4 percent (Wheaton & Kwon, 2022).

The upheaval experienced by households from employee layoffs, business shutdowns and slowdowns, supply chain disruptions, school closures, and stay-at-home orders, created economic challenges that affected food security. This disruption increased the level of food insecurity for many households and this fact has been a key finding of research studies. Using a national sample of more than 10,300[2] persons and the USDA 10-question module (online survey released 03/23/2020), Fitzpatrick et al. (2021) found that food insecurity was elevated during the

[2] The final sample was post-stratification weighted using 2018 ACS five-year estimates by gender, age, race, income, and geography (state) to ensure the equitable contribution to respondents across their individual demographic and geographic strata relative to their representation in the overall population of the United States (Fitzpatrick et al., 2021;5).

early stages of the pandemic, with 38 percent reporting moderate or high levels, well above pre-COVID-19 levels of 15 percent.

Exhibit 2. Selected Major Surveys that Include Measures of Food Insecurity Using All or Part of the USDA Food Insecurity Measure (HFSSM)

*Source	Agency	Timeframe	Sample	Geographic Estimates
Current Population Survey (CPS)	Census Bureau for the Bureau of Labor Statistics	Annual 1995 - Present	Civilian Non-institutional Population (N=~60,000 households)	Nation, States, Selected Metro Areas
National Health and Nutrition Examination Survey (NHANES)	National Center for Health Statistics and Centers for Disease Control, Division of Nutrition	Biennial 1999 - Present	Civilian Non-institutional Population (N=~5,000 persons)	Nation
Survey of Income and Program Participation Studies (SIPP)	Census Bureau	Topical Modules for 1996, 2001, 2004, and 2008; Annually 2018 - 2021	National Representative Longitudinal Survey (Wave 1 sample for 2020 was 22,000 households)	Nation, Regions, States, Metro and Nonmetro Areas
Early Childhood Longitudinal Studies (ECLS)	National Center for Education Statistics	Annual with selected dates for HFSSM	**Kindergarten Class of 2010-2011 followed to 5th Grade (N=18,200)	Nation
Panel Survey of Income Dynamics (PSID)	University of Michigan	Annual 1999 - 2003; 2014 to present	National Representative Household Sample (N=~9,600 family units)	Nation
Health Reform Monitoring Survey (HRMS)	Urban Institute	Annual 2013 - present	National Representative, (N=~9,000 adults 18-64)	Nation
Household Food Security Survey Module (HFSSM)	NORC at the University of Chicago and the Capital Area Food Bank	2/04/2022 - 3/02/2022 (One Time)	N=3,769 adults ³ 18	National Capital Region
Household Pulse Survey *(HPS)*	Census Bureau	Started April 23, 2020, with 12 collection phases	N = 62943, for Oct 18 - Oct 30, 2023	National

US Department of Health and Human Services, Office of Disease Prevention and Health Promotion. Current Population Survey Food Security Supplement (CPS-FSS). Healthy People 2030. https://health.gov/healthypeople/objectives-and-data/data-sources-and-methods/data-sources/current-population-survey-food-security-supplement-cps-fss

Center for Disease Control and Prevention, National Center for Health Statistics (CDC NCHS). (nd) National Health and Nutrition Examination Survey (NHANES). https://www.cdc.gov/nchs/nhanes/index.htm

US Census Bureau. (2021). Survey of Income and Program Participation Users' Guide. August 2022, Reissued September 2023, Washington, D.C. U.S. Department of Commerce. Economic and Statistics Administration. https://www.census.gov/programs-surveys/sipp/guidance/users-guide.html

Institute for Education Statistics, National Center for Education Statistics. (IES NCHS) (nd) Early Childhood Longitudinal Studies Program (ECLS)-Overview. https://nces.ed.gov/ecls/index.asp

**Additional cohort studies were conducted for the birth cohort of 2001 (to kindergarten), the 1998-99 kindergarten class to 8th, as well as the forthcoming 2023-23 kindergarten cohort, which will be followed to Grade 5.

University of Michigan, Survey Research (UM SRS). (nd). Panel Study of Income Dynamics (PSID)Getting Started (umich.edu). https://psidonline.isr.umich.edu/GettingStarted.aspx

Urban Institute (nd). Health Reform Monitoring Survey. Project Home. https://www.urban.org/policy-centers/health-policy-center/projects/health-reform-monitoring-survey

Similarly, the National Food Access and COVID-19 Research Team studied the shorter-term impact of the pandemic on food insecurity (NFACT 2020). They used the USDA short-form HFSSM[3] to survey respondents from 18 sites in 15 states for a total of 27,000 respondents.[4] In virtually all sites studied, elevated levels of food insecurity were the norm after the onset of the pandemic, with representative state samples showing a range of 29 to 36 percent, which was 28 percent or more over pre-pandemic levels (Niles, 2021).[5] Even nontraditional data collection using various social media platforms revealed an increase in food insecurity with the onset of the pandemic, 15 percent with "low" or "very low" food security, which was above pre-pandemic USDA-reported levels (Parekh et al., 2021).[6]

These trends are reflected in the rise in Supplemental Nutrition Assistance Program (SNAP) participation during the early months of the pandemic, June through September 2020. Average monthly SNAP participation increased by over 2.6 million households in the 47 states reporting in both periods. There was a larger share of these households with no earned income, an increase from the pre-pandemic period by almost 3 percent points (USDA FNS, 2022).

Even the largest nonprofit hunger-relief organization, Feeding America, distributed 42 percent more food in the second quarter of 2020 than it did in the first quarter. In 2020, their nationwide network of food banks and pantries distributed 6 billion meals. Just like the rise in SNAP participation, four out of ten people visiting the Feeding America network were there for the first time (Morello, 2021).

COVID-19 Government Response: Fall 2020 through 2021

The second stage of the pandemic was characterized by a large array of governmental efforts to mitigate the rise in food insecurity. Work to address the food shortage yielded substantial results in late 2020 and throughout 2021. Using data from the CPS HFSSM, 10.2 percent of all households or 13.5 million were food insecure at some time during 2021 (Coleman-Jensen et al., 2022). Overall, food insecurity was stable between 2020 and 2021, albeit at relatively high levels, which some have attributed to economic mitigation efforts, such as expanding access to unemployment benefits, expanding SNAP benefits (discussed below), getting food assistance to children who were out of school, and expanding the Earned Income Tax Credit and Child Tax Credit among others (Center on Budget and Policy Priorities, 2022). In fact, other survey research using the Urban Institute's Health Reform Monitoring Survey (HRMS) found a

[3] The six-item short form of the Household Food Security Module used by USDA to estimate food insecurity rates is a subset of the 18 question Food Security module, which reduces respondent burden and has been deemed as a "reasonably reliable substitute" (USDA ERS 2022)
[4] Most of the data collection occurred during the Spring/Summer of 2020, but all interviews used March 20, 2020 as the reference point for a pre- and post-covid assessment. Three types of samples were included: those representative of the general population, those focused on high risk populations, and convenience samples using social media networks and community organizations (NFACT 2020).
[5] Site representative samples included the states of Arizona, Main, Maryland, Massachusetts, Vermont, and Wisconsin. In addition, a representative sample was included for the NY-Capital Region (Niles, 2021).
[6] An anonymous nonprobability sample of social media users was recruited from Facebook, Instagram, Messenger, and the Facebook Audience network (other mobile apps and websites partnered with Facebook (Parekh et.al., 2021).

statistically significant decline in household food insecurity (Urban Institute, nd)[7] between April 2020 and April 2021, from 21.6 to 15.3 percent (Waxman et al., 2022). A similar pattern was seen using the concept of "food scarcity" in the Census Bureau's Household Pulse Surveys: administered between 2020 and 2021 (US Census Bureau, 2023).

This decline in food insecurity can be traced to a number of initiatives, aimed at helping communities. Congress acted in December 2020 to raise SNAP maximum benefits by 15 percent from January through June 2021 and to boost every household to the maximum benefit for their household size (USDA FNS, 2021). Under the Biden Administration, the American Rescue Plan extended the 15 percent increase through September 30, 2021, when the increase expired for everyone (USDA FNS, 2021). Separate from the COVID emergency allotments, Congress included the Agricultural Improvement Act in the 2018 Farm Bill which requires the Thrifty Food Plan (TFP) to be reevaluated every five years using current food prices, food composition data, consumption patterns, and dietary guidance. The first reevaluation was in 2021, resulting in a cost adjustment of 40 cents per person per meal, that began on October 1st of that year. This was the first time the purchasing power of the plan had changed since it was first introduced in 1975 (USDA, 2021).

Rise of Inflation: 2022

The United States experienced a period of low inflation prior to the pandemic. But the pandemic created market problems causing a rise in energy prices and supply chain challenges which in turn caused prices for goods and services to rise (Ball et al., October 2022). The Urban Institute's analysis found that the most recent period has been characterized by a sharp rise in the level of food insecurity associated with increases in the cost-of-living, a significant increase from 15.3 percent in April 2021 to 21.4 percent in June 2022. The authors attribute this pattern to an initial safety net that has gradually been withdrawn and given way to high levels of inflation in the latest year of the survey (Waxman et al., 2022:6). Moreover, recent samples from the Census Bureau's Household Pulse Surveys also have shown an increase in "food scarcity" between 2021 and 2022 (US Census Bureau, 2023).

On October 1, 2022, the maximum SNAP benefits, which are tied to food inflation at the national level, automatically increased by 12.5 percent (USDA FNS, 2022). The benefit update is based on food inflation for the 12 months prior, ending in June. In addition to the benefit increase, policy changes were made to the cash limits, the limit for households increased by $250 to $2,750 and the resource limit for households where at least one person is age 60 or older, or is disabled, increased by $500 to $4,250.

[7] The Urban Institute HRMS sample consisted of approximately 9,000 adults 18-64 years of age reporting food insecurity in their households in the "last 30 days," using the USDA short-form food security module (Urban Institute, nd).

Supplemental Nutrition Assistance Program (SNAP)

> *"… there is greater variation in food prices across geography than over time - although, in the United States, the Supplemental Nutrition Assistance Program (SNAP, formerly Food Stamps)[8] benefits are adjusted to reflect variation across time but not geography. Moreover, significant variation exists in the prices of healthy relative to less healthy foods across geographic market groups (Todd et al. 2011). Thus, geographic variation in food prices across the United States may affect some low-income households' ability to purchase adequate, healthful food."*
>
> (Gregory and Coleman-Jensen, 2013, p. 680)

Many households and individuals that receive SNAP benefits are still food insecure. The DHHS guidelines used to determine SNAP eligibility and benefits are the same for the 48 contiguous states and the District of Columbia. Besides Alaska and Hawaii, there are no adjustments for the geographic price differences, even though six states and the District of Columbia (DC) have regional price parity (RPP) values greater than Alaska. The RPP is the primary source of public data on geographic price differences produced by the Bureau of Economic Analysis. RPPs are weighted averages of price levels in one geographic region compared to all other regions in the U.S. The RPPs are expressed as a percentage of the overall national level, with the national level set to 100. For example, D.C. has a 2021 RPP value of 111.3, indicating that prices in the District are 11.3% higher than the U.S. on average. In contrast, Mississippi has a 2021 RPP value of 86.6, and prices in Mississippi are 13.4% lower than the U.S. on average (BEA, 2022). While the rate of inflation and changes to it have a number of quality-of-life and policy implications, so do these geographic price disparities. Policies that rely on data unadjusted for geographic location to determine who qualifies for certain benefits, such as SNAP, inadvertently benefit some more than others (Weinstock, 2022).

Although research shows that SNAP is one of our most effective tools in reducing food insecurity (McKernan et al., 2021; Cheng et al., 2019; Swan, 2017), even after the recent (2021) reevaluation of the Thrifty Food Plan (TFP) and the subsequent cost adjustments, 40.5 percent of the 3,142 counties and independent cities in the U.S. experience a negative gap between the maximum SNAP benefit per meal and the actual price of that meal (Waxman et al., 2021). This is a consequence of the failure of the TFP reevaluation (Agricultural Improvement Act (PL 115–334) in the 2018 Farm Bill) to incorporate the geographic variation in food prices across the U.S. (Waxman et al., 2018). Todd et al. (2010) reported that most analyses of food prices consider annual inflation over time at the national level, ignoring the fact that food price variation between geographic market groups within the U.S. is greater than annual inflation. They used the 2006 Quarterly Food-at-Home Price Database to show the cost difference for eggs between the

[8] The Food Stamp Act was passed in 1964 and became a national program in 1974, providing a mechanism for food stamps to become available across all counties by July of that year (Woteki et al., 2020).

highest and lowest geographic market groups was 80 percent, the cost difference for low-fat milk was 77 percent, and for fresh/frozen fruit 80 percent.

Despite the 2021 reevaluation of the Thrifty Food Plan (TFP) which resulted in a 21 percent increase in the maximum SNAP benefits, Leung & Wolfson (2023) showed no statistically significant (p-values < 0.05) effects of the benefit increase on food insecurity, diet quality, or mental health of adult SNAP participants, compared to low-income, non-participants. They used an online web-based survey of 1,004 adults with incomes at or below $65,000 prior to and after the policy change. In contrast, Wheaton & Kwon (2022) used Urban Institute's Analysis of Transfers, Taxes, and Income Security microsimulation model to assess the impact and estimated the increase in SNAP benefits kept nearly 2.3 million people out of poverty (using the Supplemental Poverty Measure thresholds) in the fourth quarter of 2021. They estimated that this reduced poverty by 4.7 percent relative to a scenario without the TFP reevaluation. Even though the increase in SNAP benefits moved people out of poverty, one cannot assume there was an increase in food security. We estimate the HLB is three to six times the 2021 Official Poverty Measure (OPM) thresholds and indication that a 21 percent increase in SNAP benefits, or an average benefit per person per day of $1.20 to about $5.45 (Llobrera et al., 2022), will still leave many household incomes below the HLB.

Literature Review: Determinants of Food Insecurity

> *"Food insecurity is a multidimensional concept, experienced differently by different household types and population groups. While an overall measure of food insecurity, valid for the whole U.S. population, would be desirable, it is likely that such a measure would underestimate hunger and food insecurity for certain subgroups, especially for children and elderly adults. . . Food insecurity is a complex issue that may not be fully captured by a one-dimensional item response model, especially as it will be used to track food insecurity over time, across different surveys, and for different subpopulations."*
>
> (Opsomer et al., 2002, p 35).

While acknowledging the overall level of food insecurity at the national level is important for identifying the degree of the problem, the prevalence of food insecure households at the local level is necessary for informing policies and interventions. Such knowledge permits local officials to better address the problem with targeted outreach and mitigation strategies, such as nutrition education and social service referrals. In this section, we describe the literature on the determinants of food insecurity that we used to inform our model. The model is designed to predict the prevalence of households that are food insecure, food secure, and at risk to food insecurity at the census tract level.

The empirical literature on the determinants of food insecurity can be grouped into two broad categories. The first is the demographic and socioeconomic characteristics of the food insecure, and the second consists of expenditures on basic needs that compete with the amount of money available for food.

Demographic and Socioeconomic Characteristics of the Food Insecure

Many demographic and socioeconomic characteristics are associated with food insecurity (Fiese, 2016; Chang et al., 2014; Gundersen, 2011; Bartfeld et al., 2006). Using predominantly federal survey and state administrative data, researchers identified a number of at-risk households and individuals: people without homes (Fitzpatrick, 2021); college students (Ellison, 2021); food bank clients (Long et al., 2021); large households (Swann, 2017); households with children (Parekh et al., 2021); single-parent households (Bartfeld et al., 2006; Blank, 1996); people with disabilities (Heflin, 2019; Sonik 2016; Bartfeld et al., 2006); veterans (Cohen, 2021); SNAP recipients (Cox, 2022; Carlson, 2021; Waxman et al., 2021; Waxman, 2018; Ratcliffe, 2011); and various racial/ethnic groups (Cox, 2022; Waxman, 2022; Fitzpatrick et al., 2020; Haynes et al., 2020; Bartfeld et al., 2006).

Using the CPS HFSSM for 2021, Coleman-Jensen et al. (2022) showed higher rates of food insecurity for households with children (12.5 percent), especially those with female-headed households (24.3 percent) and households that are Black non-Hispanic (19.8 percent) or Hispanic (16.2 percent); these rates are above the overall rate of 10.2 percent. Ribar and Hamrick (2003) found that female-headed households are more likely to transition into food insecurity and less likely to transition out. Again, much of this has to do with low income and high unemployment, as more than one-quarter (26.5 percent) of households below 185 percent of the poverty threshold were food insecure. Similarly, there were statistically significant differences for Black and Hispanic adults reporting food insecurity in the Urban Institute's HMRS – 29.2 and 32.3 percent, respectively, compared with an overall average of 21.4 percent for all adults (Waxman, 2022).

Research findings suggest that higher rates for those at the lower end of the income spectrum, and Black and Hispanic households have to do with the absence of policies to index SNAP to the geographic cost-of-living (Fitzpatrick, 2021; Carlson, 2021; Cheng, et.al.,2020; Gregory and Coleman-Jensen, 2013).[9] Further, the aforementioned study by the NFACT team in 15 states found that the incidence of food insecurity during 2020 was disproportionately born by households with children, much of it related to the loss of income in these households (Niles et al., 2021). And studies utilizing nontraditional data sources, such as social media sites, found that groups with high unemployment, low levels of education, and lower income were all prone to be food insecure, especially when those households contained children (Parekh et al., 2021).

[9] Keep in mind that this research predates the current surge in the geographic cost of living.

Competition for Basic Need Expenditures

The second broad category consists of expenditures on basic needs that compete with the amount of money available for food. These include utilities (Tuttle, 2017; Nord et al., 2006; Bhattacharya et al., 2003), rising food prices (Gregory et al., 2013), taxes (Short, 2011; McIntyre et al., 2003), child-care (Short, 2011), medical insurance (Bowen 2021), medical bills (Long et al., 2021; Short, 2011; Nielsen et al., 2010), transportation (Muellar et al., 2021), education (Bartfeld et al., 2006), and housing (Muellar et al., 2021). Tuttle found that a 41 percent increase in gas prices increased food insecurity in low-income households between 12.4 to 14.7 percent. This is also true for utility prices – when the cost of heating homes rises, poor parents and their children spend less on food and eat less during cold-weather budgetary shocks (Bhattacharya et al., 2023). Among poor families, a monthly temperature that was 10°F colder than normal would result in a reduction of $11 per month – on average – for food expenditures and an increase of $37 in fuel expenditures; this resulted in a 10 percent reduction in caloric intake during the winter months.

Gregory and Coleman-Jensen (2013), using data from the CPS HFSSM and the Quarterly Food-At-Home Price Database, showed that the average effect of food prices on the probability of food insecurity is positive and statistically significant (p-value <0.01). A one-standard deviation increase in food prices is associated with increases of 2.7, 2.6, and 3.1 percent in household, adult, and child food insecurity, respectively. The increases for SNAP recipients are even higher, 5.0, 5.1, and 12.4 percent increases in food insecurity for households, adults, and children, respectively. Many researchers discuss the hardships of resource-constrained households and how they are more likely to experience income shocks and are less able to weather them with savings or through borrowing (Chang et al., 2013; Gundersen et al., 2011). The consequences of these resource constraints have led many to call for adjustments to the SNAP and poverty guidelines that take into account the geographic cost of living (Mueller et al., 2021; Gregory et al., 2013; Renwich, 2011; National Research Council, 1995). We add that this is more urgent than ever with the increasing disruptions from extreme climate events and the risk of outbreaks escalating into epidemics or pandemics (Haileamlak, 2022; Marani et al., 2021) and the economic uncertainty that follows.

Geospatial Access to Food Sources

Research on food insecurity has focused on geospatial approaches in the form of the identification of "food deserts." As far back as 1995, questions were being asked about the usefulness of this concept for policies aimed at addressing food insecurity (Cummins and Macintyre, 2002). The food desert narrative, however, overlooks the basic relationship between supply and demand; increasing the supply of food will only increase consumption if there is enough demand to meet it. Malbi (2014) followed SNAP benefit recipients and found that geographic access to food was generally not associated with the percentage of households that

were food insecure.[10] This was true for both urban and rural households. This is also confirmed by Allard et al. (2017) who found little evidence that greater geographic access to food retailers in the Detroit Metropolitan Area was associated with food security (Danziger et al., 2014).

Moreover, the role of geospatial access to food sources for those most in need may be changing, with the rollout of online food purchases using Electronic Benefit Transfer (EBT) for SNAP; however, this pathway to food access requires internet resources, and any charges associated with the home delivery of food are still borne by the recipient (SNAP 2023). In response to the pandemic, the USDA Food and Nutrition Service (FNS) expanded the pilot to incorporate additional states and retailers. By the end of September 2020, online SNAP benefit redemption was available in 45 states and District of Columbia, and by the end of March 2022, it was available in all states except Alaska (SNAP, 2023). The number of FNS authorized retailers also increased during this period, from 13 in December 2020 to 148 in March 2022. These efforts led to an increase in the value of online benefits redeemed, $1.5 billion for the eleven months, February 2020 (the earliest month for which data are available) through December 2020; this amount more than quadrupled to $6.2 billion in 2021. The share of online redemptions continued to grow in 2022, with the first three months totaling $1.9 billion in benefits (Jones 2022).

Thus, while geospatial approaches have helped to call attention to food access issues, this approach oversimplifies complex food access problems by emphasizing spatial propinquity and – often times – neglecting issues involving community resources, household resource-constraints, and structural injustice and government policies (Bowen et al., 2021; George and Tomer, 2021; De Master, 2019; Meenar, 2017). Perhaps the most important geospatial issue concerns the dramatic differences in cost-of-living across the nation, the result of big geographic differences in food prices, the cost of acquiring food, housing, transportation, childcare, and other components affecting household budgets (George and Tomer, 2021). Such considerations are vital for models aimed at guiding strategies for the effective identification and remediation of food insecurity at a local level.

[10] Data for this study come from the SNAP Food Security (SNAPFS) survey, which Mathematica Policy Research conducted for the USDA Food and Nutrition Service between October 2011 and September 2012. (Malbi 2014).

A New Indicator for Food Insecurity Using the Household Living Budget

Household Living Budget

We define the household living budget (HLB) as the amount of income necessary to meet a household's needs to function at a modest yet adequate standard of living in the community in which they reside and to pay federal and state income tax. We include "living" in our designation to connect this to a "living wage" and to emphasize that the HLB is not a deprivation budget. Instead, it is a budget that could be used to back out a living wage. The basic needs include housing, food, transportation, healthcare, childcare, broadband, and other necessities such as clothing, household supplies, personal care, nonprescription medicine, and school supplies (see Box 1). It is a "no frills" budget, that does not include meals outside the home, entertainment, or savings for retirement, education, and vacations. It assumes the total cost of each need without government subsidies (e.g., public housing, Medicaid, or childcare assistance); or nonprofit or informal assistance from family and friends (e.g., unpaid childcare by a relative, food from food banks, or shared housing). It is a transparent approach to ensuring the equitable treatment of all households that incorporates geographic price differences into adequacy standards for each of the components.

Box 1. Eight Components of the HLB

HOUSING: "Decent, affordable housing should be a basic right for everybody in this country. The reason is simple: without stable shelter, everything else falls apart" (Desmond 2016).

FOOD: All have a right to adequate food to achieve food security (FAO 2006).

HEALTHCARE: Access to healthcare provides preventative care, treats life-threatening conditions, and can keep households from falling into poverty because of health-related expenses.

TRANSPORTATION: Reliable and safe transportation to reach jobs, shop for groceries, take children to childcare, and accomplish other household tasks.

CHILDCARE: For single-parent households and households where both parents work, childcare is a necessity.

BROADBAND: Broadband's connection to essential services is so wide ranging that it has become part of our infrastructure.

OTHER NECESSITIES: This component includes the other basic needs not accounted for in the previous six larger components, such as clothing, household supplies, personal care, nonprescription medicine, and school supplies.

TAX LIABIILTY: Federal, state, and FICA (Social Security and Medicare).

The HLB is constructed using the seven monthly adequacy standards for a particular household combination and census tract adding them together and multiplying by twelve to get the yearly budget on which the taxes are calculated using TAXSIM (Feenberg and Coutts, 1993). The estimation of the food component, for example, considers the age of every household member. The USDA Food and Nutrition Service provides estimates for four food monthly plans divided by gender and age at the national level. We used the low-cost food plan and adjusted these estimates down to the county level using Feeding America's Map the Meal Gap. We assumed that half the householders are female, and half are male. The adequacy standard of food is the sum of the adjusted monthly low-cost food plan for each member of the household. The estimates include an adjustment for economies of scale, depending on household size. The details on the construction of the other components of the HLB, the data sources used, the assumptions, and how

the adequacy standards were determined can be found in the HLB Use Case report (Lancaster et al., 2023).

To construct the HLB for every household combination within a census tract in DC, we generated a synthetic population. DC has 206 census tracts, 310,100 households, and 264 household combinations. The data used to generate the synthetic population were a combination of individual household data from the American Community Survey (ACS) Public Use Microdata Sample (PUMS) and ACS 5-YR 2021 household income and size data aggregated at the census tract level. Details on how the 2010 DC census tracts were realigned to the 2020 census tracts to use the ACS 5-YR 2021 data are provided in Appendix A. The details of how we generated the synthetic population can be found in the HLB Use Case report (Lancaster et al., 2023).

Residual Income Method

We define residual income as the amount of income left after subtracting out the adequacy standards of all or selected components included in the HLB plus taxes. Stone (2006) used this method to define housing affordability as a household's inability to meet its nonhousing needs at some basic level of adequacy after paying for housing. The two impediments to constructing a housing affordability standard based on residual income that he cited in 2006 have been resolved using data types and sources that were not available in 2006 and publicly available software to estimate taxes.

Stone (2006) has long advocated for the residual income method for housing affordability as an alternative to the current measure of the ratio of housing to income and the 30 percent standard. He argues there is no theoretical or logical foundation for the concept of the 30 percent standard and raises the issue that this standard implies "…the lower the income of a household, the lower the amount it requires for nonshelter needs, with no minimum whatsoever…" (Stone, 2006). In contrast, the residual income method provides a sliding scale of housing affordability that takes into account household size, composition, income, and geographic price differences. We adopt this method to introduce a new indicator of food insecurity – the residual income left after the HLB nonfood adequacy standards and tax liability have been subtracted from a household's income.

Residual Income Approach to Food Insecurity

Exhibit 3 describes how the HLB and the residual income method categorize households into three food secure categories: secure, insecure, and severely insecure. The monthly residual food income (Exhibit 3, Item 2) is the monthly household income minus the monthly HLB minus the adequacy standard for food. We assume that households allocate budget commitments for all other expenditures ahead of food-related expenses. Since the food adequacy standard is a function of the household combination and location, we normalize the monthly residual food income by dividing it by the monthly food adequacy standard – we refer to this as the food

coverage ratio (Exhibit 3, Item 3). The *food coverage ratio* (FCR) is used to classify households into one of the three categories (Exhibit 3, Item 4).

- Food Secure – a food coverage ratio greater or equal than 1. The monthly residual income is greater than or equal to the food adequacy standard.
- Food Insecure – a food coverage ratio less than 1 and greater or equal than -2, a condition expressed as: $-2 \leq FCR < 1$. The monthly residual food income is less than the food adequacy standard.
- Severe Food Insecurity – a food coverage ratio less than -2, that is, $FCR < -2$. The monthly residual food income is less than twice the food adequacy standard, and the monthly income does not cover some of the other HLB component adequacy standards.

By normalizing the monthly residual food income to create the indicator, food coverage ratio, we can compare different household combinations, for example, more single-parent households are food insecure than two-parent households.

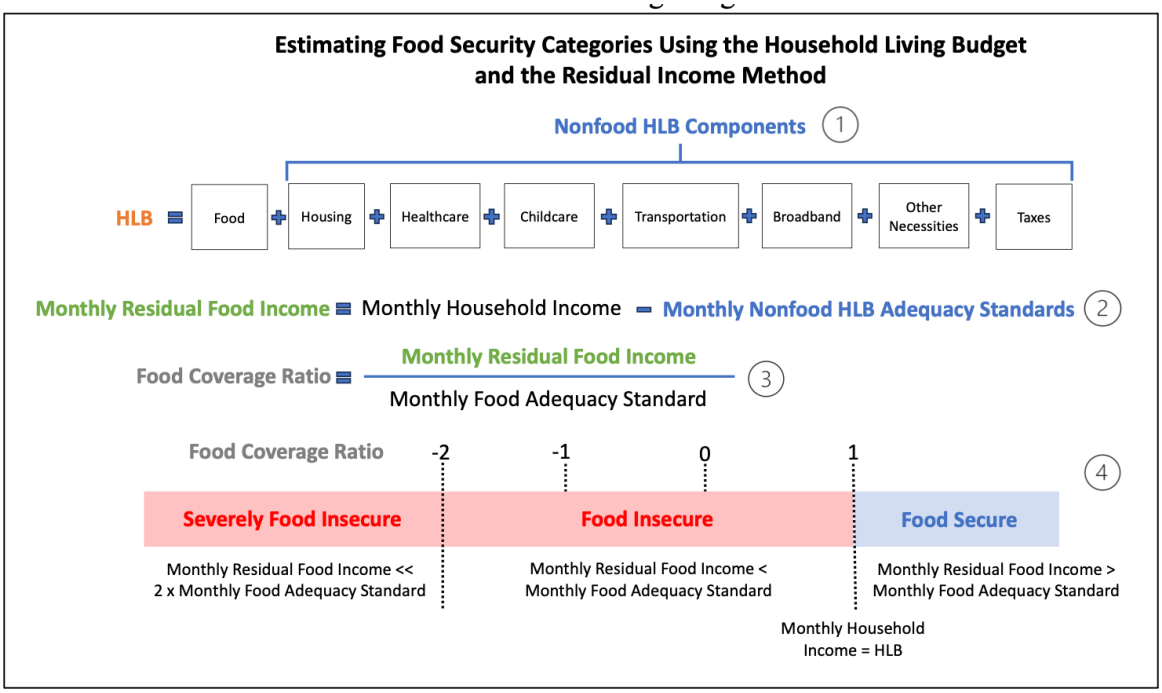

Exhibit 3. A Residual Income Approach to Defining Food Security Using the Household Living Budget

Food Insecurity in the District of Columbia

This section uses the approach described in Exhibit 3 to estimate food insecurity for households in Washington, DC. The analysis focuses on three areas: the prevalence of food insecurity, the

exploration of severe food insecurity by household combinations, and the geographic identification of census tracts by the prevalence of food insecurity.

Using the residual income approach to classify households in Washington DC, we find that 34.4%, or 106,752 of the 310,100 households, are food insecure – 1 in every 3 households. These estimates are in line with the 2021 survey conducted by NORC at the University of Chicago for the Capital Area Food Bank that estimated a 36% prevalence of food insecurity in DC. They surveyed 3,769 adults ages 18 and older in the DC metropolitan area using the Household Food Security Survey Module (HFSSM). They found that 14 percent were food insecure, and 22 percent were severely food insecure (Capital Area Food Bank, 2022). With the residual income approach, we estimate that 12.1 percent (37,541) of households are food insecure, and 22.3 percent (69,211) are severely food insecure. Although further research is needed to evaluate the residual income methodology, the fact that these estimates are closely aligned, and the HFSSM survey is the gold standard, indicates that using the HLB and the residual income approach is promising.

Exhibit 4 displays the number (horizontal axis) and prevalence (vertical axis) of household combinations with children who are severely food insecure and food insecure. We identify household combinations using six digits for the age group categories defined by the ACS PUMS:

1st digit: number of adults (≥19),
2nd digit: number of teenagers (12 – 18),
3rd digit: number of schoolers (6 – 11),
4th digit: number of preschoolers (4 – 5),
5th digit: number of toddlers (1 – 3), and
6th digit: number of infants (< 1 year).

Of the 106,752 households that are food insecure or severely food insecure, 40,118 or 38 percent have children. Single-parent households are the largest household combination, 17,154 or 43 percent, and the largest food insecurity category for single-parent households is severely food insecure, 13,205.

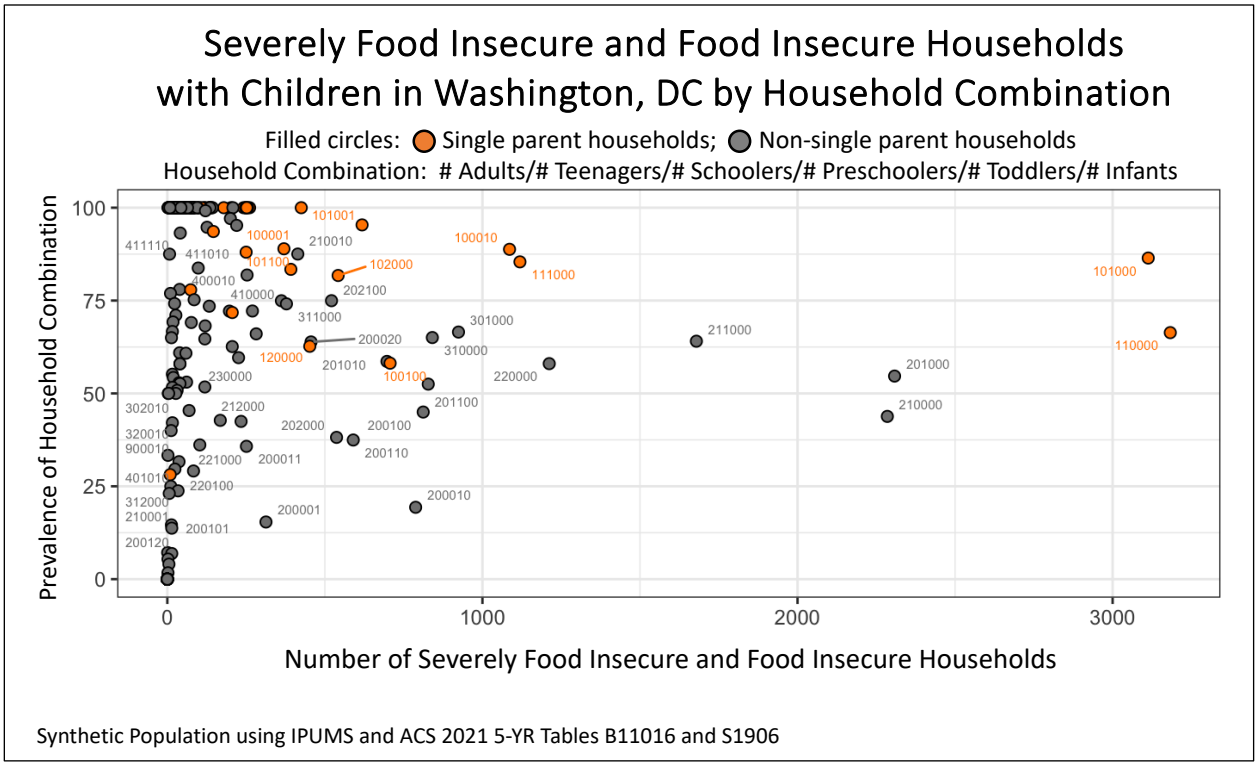

Exhibit 4. Prevalence and Number of Severely Food Insecure and Food Insecure Households with Children in Washington DC Identified by Household Combination

As seen in Exhibit 4, the greatest number of severely food insecure and food insecure households are single-parent households with one teenager or schooler (3,179 and 3,113 households, respectively). This is also true for two-parent households with one teenager or schooler. In terms of prevalence, over fifty percent of all single-parent households are severely food insecure or food insecure.

Exhibit 5 displays the range of the food coverage ratios for the forty most frequent household combinations with children who are severely food insecure and food insecure. It is interesting to observe that the single-parent households have some of the lowest food coverage ratios. There are 1,086 single-parent households with a toddler with ratios as low as ten; this highlights the importance of programs like WIC, the supplemental nutrition program for Women, Infants, and Children.

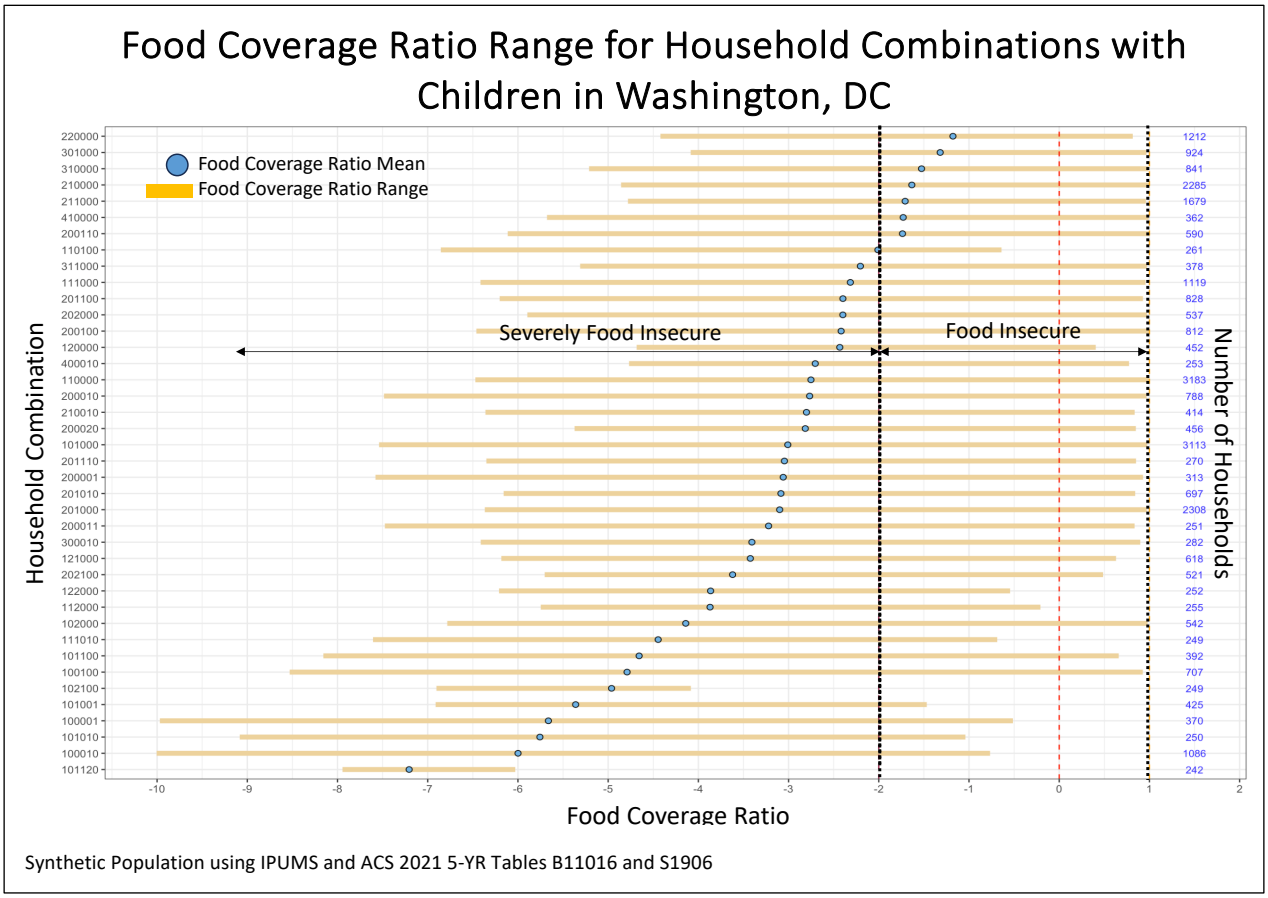

Exhibit 5. Food Coverage Ratio by Household Combination with Children
Household Combination: # Adults/# Teenagers/# Schoolers/# Preschoolers/# Toddlers/# Infants

By constructing the HLB at the census tract level for all household combinations, we can identify census tracts with a high prevalence of food insecure and severely food insecure households. Exhibit 6 displays the prevalence of the two food security categories at the census tract level. Severe food insecurity is mainly concentrated in the eastern part of Washington DC. Notably, Census Tract 47.04, located at the center, stands out with the highest proportion of severely food-insecure households. This tract coincides with the lowest household median income in DC, which is $10,700 annually (2021 5-YR). The household combinations in this census tract are one adult (68 percent) and two adults (20 percent).

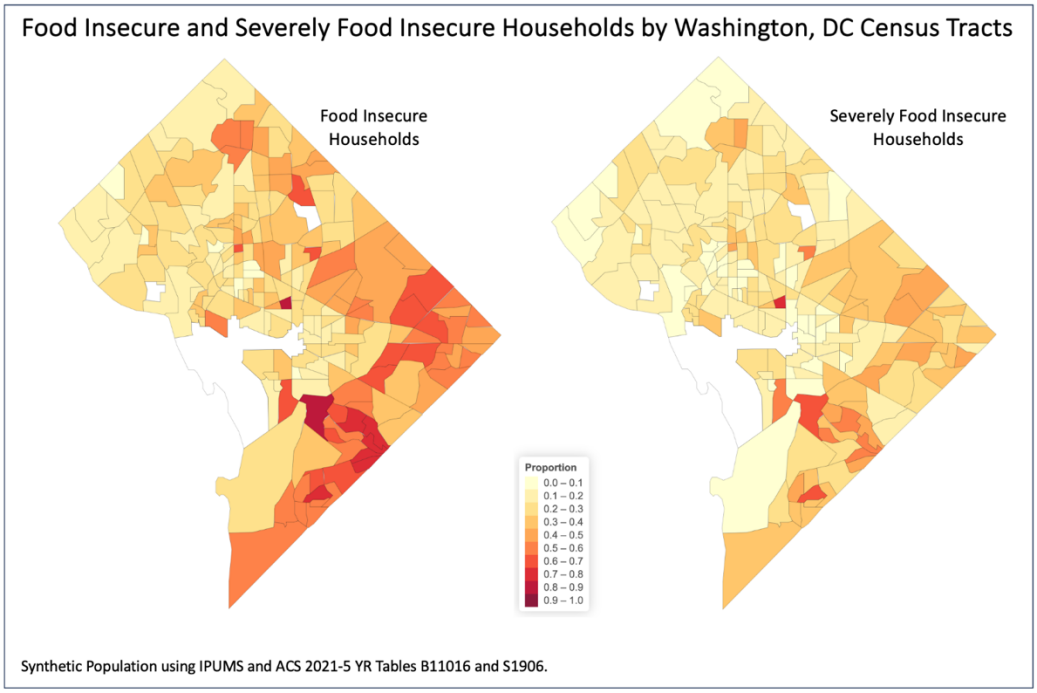

Exhibit 6. Prevalence of Food Insecure and Severely Food Insecure Household by Washington, DC Census Tract

SNAP Eligibility in the District of Columbia

The calculations for SNAP eligibility used the incomes and household sizes in the synthetic population. SNAP eligibility is based on income tests, either the gross or net income is compared to the 130 percent (gross income) or 100 percent (net income) of the **Federal Poverty Line** for a particular household size. The SNAP benefit amount is determined by subtracting 30% of the net income from the maximum SNAP benefit for a particular household size. Since these two numbers do not always align, it is possible to satisfy both the net income requirements of SNAP and have a calculated allocation of zero. This occurs for a small number of households when 30% of the net income (expected contribution to the food budget) is greater than the maximum SNAP benefit. Of the 106,782 households in DC that are food insecure, we estimate that approximately 73,329 households would have been eligible to receive SNAP benefits (See Exhibit 7). All households that passed the eligibility test based on gross income would receive a SNAP benefit whereas 1,943 of the households that passed the eligibility based on net income did not. Using the SNAP recipiency variable (FS) approximately 42,496 households actually received SNAP. Access to social benefit administrative data would provide additional insights into this discrepancy – this is definitely a data gap. The administrative data with the actual amounts received by households would provide the data needed to evaluate the adequacy on social benefits.

Exhibit 7. Number of Food Insecure Households in D.C. that receive SNAP

Food Insecure Households	106,782 (34%) out of 310,100 households
Food Insecure Households	75,272 (24%) out of 310,100 qualified for SNAP or

that Qualify for SNAP	71% of the food insecure households	
How the Households Qualified for SNAP	50,838* qualified using gross income less than 130% of the FPL	75,272 qualified using net income less than 100% of the FPL
Qualified Households that Receive No SNAP Benefit	0 of the 50,838 received no SNAP benefit	1,943 of the 75,272 received no SNAP benefit

*All 50,838 households that qualified using gross income also qualified using net income.
FPL – Federal Policy Line

Conclusion

This report is a starting point for the application of the HLB to estimate food insecurity, or multiple applications on economic insecurity measures and standards. Although we used food insecurity as an exemplar, the issues and arguments against current practices are the same for poverty and housing. The prevailing measures and standards for food insecurity, housing affordability, and poverty, have a long tradition, are easy to understand, estimate, and apply, but they are not based on today's economic reality. The food insecurity and poverty measures and standards are a multiple of the Official Poverty Measure which is based on the cost of a nutritionally adequate diet. The housing affordability measure and standard is the ratio of housing cost to income - a "simple rule of thumb" from the 1800s which eventually found its way into the Brooke Amendment to the Housing and Urban Development Act of 1969 (HUD, nd).

We conclude with a brief analysis of the food insecurity in DC households where food insecurity is measured using the HLB and the residual income method. The fact that our estimates of food insecure and severely food insecure households match those estimated using the HFSSM show the promise of this method and the suitability of this research area for broader application across other geographic areas. Even though this application only focused on food insecurity, housing affordability, the other HLB components, and poverty would benefit from this more equitable and transparent approach. In the HLB Use Case Demonstration (Lancaster et al., 2023) the HLB was used to estimate economic vulnerability at the census tract level, this could also serve as a new measure of poverty. Finally, applications of the HLB for measuring economic insecurity measures and standards, food insecurity, housing affordability, and poverty, would provide the opportunity to develop tools, methods, and processes to be applied elsewhere within the Curated Data Enterprise. For example, combining synthetic populations with the HLB estimates, administrative data on evictions and social benefits would provide a wealth of information to better inform policies to benefit low-income families.

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Appendix A

This section briefly explains the solution to identify the census tracts and corresponding Public Use Microdata Areas (PUMAs) for 2022. The limitation arises because the Integrated Public Use Microdata Series (IPUMS) presents the microdata for households using the 2010 PUMA classification. However, to match the estimates for the most recent year (2022), it is necessary to have the information for the 2020 PUMA classification.

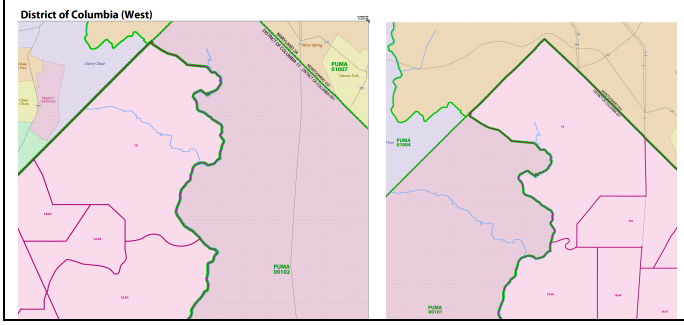
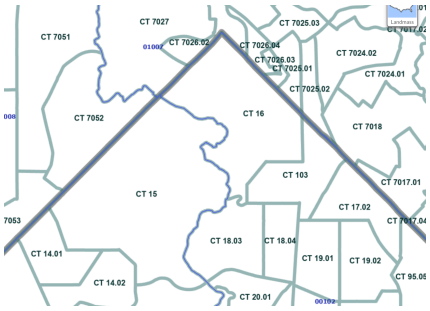
1. Identification of the problem

The District of Columbia included 179 census tracts within 5 PUMAs in the 2010 classification. For 2020, DC presents 206 census tracts across 6 PUMAs. There are 27 new census tracts that were created in DC, and in some cases, census tracts stayed in their 2010 PUMAS, but others moved to the 2020 PUMA classification. This is a summary of the number of census tracts by PUMA in the 2010 and 2020 categorizations:

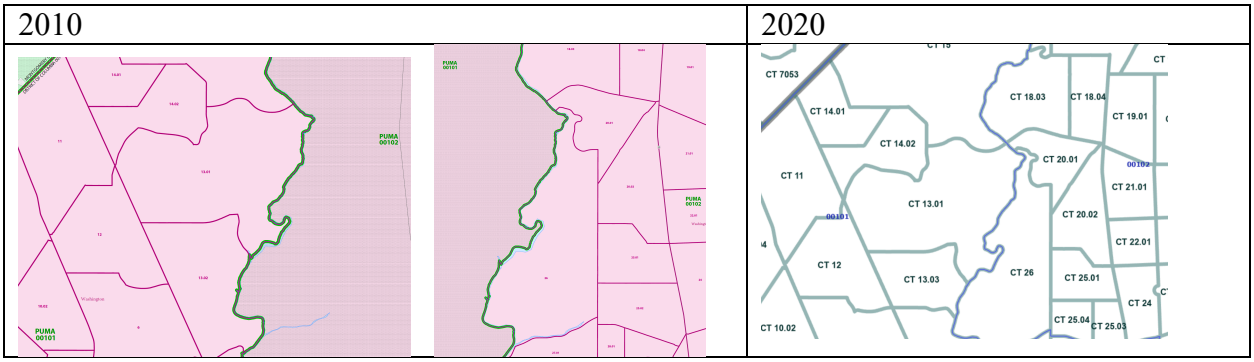
PUMA 2010	00101	00102	00103	00104	00105	Total
# census tracts	24	31	38	47	39	179

PUMA 2010	00101	00102	00103	00104	00105	00106	Total
# census tracts	29	31	34	44	32	36	206

Geographical example of a direct and evident match: Census Tract 16

2010	2020
	

Geographical example of an unclear match: Census Tract CT 13.01



2. Available information

The US Census Bureau maintains relational files that explain the comparability between the same type of geography over time. This method used three crosswalks for PUMA tracts from the Census Bureau. The following are the relational files and their direct reference:

1. Tract - Puma 2020:
https://www.census.gov/geographies/reference-files/time-series/geo/relationship-files.2020.html#list-tab-1709067297

2. Tract - Puma 2010:
https://www.census.gov/geographies/reference-files/time-series/geo/relationship-files.2010.html#list-tab-1709067297

3. Tract 2020 – Tract 2010:
https://www.census.gov/geographies/reference-files/time-series/geo/relationship-files.2020.html

3. Match

This is a quick graphical explanation to help you understand how to match and update the census tracts and PUMAs.

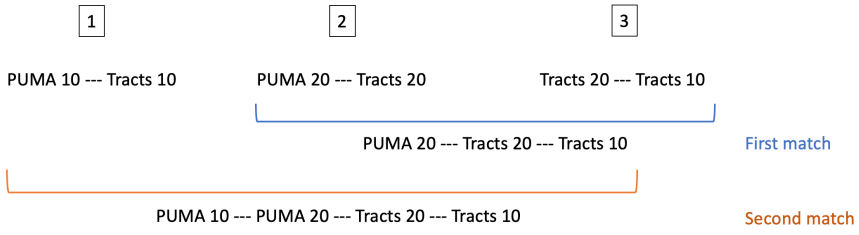


Exhibit A1: Matching process to obtain a general relational file for PUMAS and tracts between 2010 and 2020.

4. Crosswalks To Identify Tract-PUMA

After merging the three crosswalks to obtain one dataset tract20_tract10_puma_20_puma10, there are still repeated and nonunique records (rows). The following table presents an example of this problem.

GEOID_TRACT_20	NAMELSAD_TRACT_20	GEOID_TRACT_10	NAMELSAD_TRACT_10	PUMA5CE_20	PUMA5CE_10
11001000101	Census Tract 1.01	11001000100	Census Tract 1	106	101
11001000101	Census Tract 1.01	11001004100	Census Tract 41	106	101
11001000101	Census Tract 1.01	11001005500	Census Tract 55	106	105

In this example:

- There were three census tracts in 2010 (tract 1, tract 41, and tract 55).
- Tract 1 and tract 41 were in puma 2010 = 00101. Tract 55 was in puma 2010 = 00105
- For 2020, those tracts were merged in tract 1.01; now, they are in puma 00106.

This is the summary of the identification problem. Census 2020 created 206 tracts in Washington DC:

- 191 2020-tracts match a unique PUMA 2010.
- 14 2020-tracts overlap with two PUMA 2010.
- 1 2020-tract overlaps with 3 PUMA 2010.

unique matches tracts to pumas	1	2	3	Total
# tracts	191	14	1	206

5. Finding a relational file with unique Tract-PUMA correspondence.

To identify a unique puma2010 for every tract2020,

- Find difference between tract2020 and tract2010.
- Obtain absolute values of the difference: abs(tract2020 and tract2010): this is the distance in notation.
- Finally, filter the tract2020 with the min abs(tract2020 and tract2010): the minimum distance in notation is the closest geography in tracts.

The final crosswalk is the document: 2020_Tract_to_2010_PUMA.csv and described in the table below.

Crosswalk from 2010 DC PUMAS to 2020 DC PUMAS		
2020 PUMA	**Add tracts**	**Remove tracts**
00101	NA	NA
00102	From 00103 (6): 92.01, 93.01, 94.00, 95.03, 95.04, 95.09	To 00105 (8): 27.02, 27.03, 27.04, 28.01, 28.02, 29.00, 30.00, 31.00
00103	From 00105 (2): 72.03, 106.02	To 00102 (6): 92.01, 93.01, 94.00, 95.03, 95.04, 95.09
00104	NA	NA
00105	From 00105 (8): 27.02, 27.03, 27.04, 28.01, 28.02, 29.00, 30.00, 31.00	To 00103 (2): 72.03, 106.02
00106	From 00101 (1): 1.01 From 00104 (3): 73.01, 104.00, 109.00 From 00105 (32): 46.00, 47.02, 47.03, 47.04, 48.01, 48.02, 49.02, 50.03, 50.04, 52.03, 55.01, 55.02, 55.03, 56.01, 56.02, 58.01, 58.02, 59.00, 64.00, 72.01, 72.02, 101.00, 102.01, 102.02, 105.00, 106.01, 106.03, 107.00, 108.00, 110.01, 110.02, 9800	

References

MAPS: https://www.census.gov/geographies/reference-maps/2010/geo/2010-pumas.html

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