Producing County-level MDI Rates Using Public Use Data: 2010 to 2019

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Abstract

The Multidimensional Deprivation Index (MDI) is a measure of economic well-being that is broader than traditional unidimensional poverty measures in that it takes both monetary and non-monetary deprivations into account. There are six dimensions in the MDI: standard of living, education, health, economic security, housing, and neighborhood. Nation and state-level MDI rates have been produced for the years 2010 through 2019. MDI rates cannot currently be produced at the county level using American Community Survey (ACS) 1-year data for several reasons: the ACS is not representative of any areas with less than 65,000 people, due to disclosure avoidance the Census Bureau does not allow the release of new estimates using internal Census data for populations smaller than the smallest U.S. congressional district, and public use data includes states and public use microdata areas (PUMAs) as the lowest level of geography. PUMAs are non-overlapping statistical geographic areas that partition a state into no fewer than 100,000 people. As such, there are PUMAs that span multiple counties and there are counties that span multiple PUMAs. The purpose of this paper is twofold. First, a methodology is explained that creates county-level MDI rates from PUMA MDI rates using public use data. Second, these new estimates are used to explore how county MDI rates differed throughout the country and changed from 2010 through 2019.

[1] This paper is released to inform interested parties of ongoing research and to encourage discussion of work in progress. Any views expressed are those of the author and not necessarily of the U.S. Census Bureau. The Census Bureau reviewed this data product for unauthorized disclosure of confidential information and has approved the disclosure avoidance practices applied to this release. CBDRB-FY22-SEHSD003-024.

I. Introduction

The Multidimensional Deprivation Index (MDI) is a measure of economic well-being that is broader than traditional unidimensional poverty measures, such as the official poverty measure (OPM) or supplemental poverty measure (SPM), in that it takes both monetary and non-monetary deprivations into account. There are six dimensions in the MDI: standard of living, education, health, economic security, housing, and neighborhood.

MDI rates have previously been produced at the state and national level for the years 2010 through 2019. However, no sub-state estimates have been produced due to the representativeness of the data and Census Bureau disclosure policies. County-level MDI rates are produced for the years 2010 through 2019 in this paper for two reasons. The first is that a number of researchers have expressed interest to the Census Bureau in using county-level MDI rates in research projects. The second is that there is a wealth of public-use county-level outcomes data available to be compared to county-level MDI rates.

There have been a number of papers that have produced county-level data from PUMA-level data. When converting PUMAs to counties, there are three possibilities: the PUMA is equal to the county, the county spans multiple PUMAs, or the PUMA spans multiple counties. In the first case, county estimates are simply equal to PUMA estimates. For the second case, the literature has used a weighted average of the PUMA estimates to create a county estimate (Pierannunzi et al. 2016). Several different methodologies have been used to address the third case in which multiple counties are located within a PUMA:[2]

1) All counties are assigned the same PUMA estimate (Gilbert et al. 2020; Flynn et al. 2021)[3]
    - While this method is easiest to implement and the most straight forward to explain, its accuracy and usefulness are questionable due to heterogeneous counties within PUMAs having the same MDI estimate.
2) PUMA estimate is apportioned across the counties based on overall 2010 census populations (Office of the Assistant Secretary for Planning and Evaluation 2021)
    - This is an improvement from the first method. However, it has a major assumption that the estimate in question, the uninsured population in this case, is distributed across counties the same as the population as a whole.
3) Person weights were adjusted based on overlapping county and PUMA population sizes (Pierannunzi et al. 2016)
    - The Census weighting adjustments are based on many factors and should not be adjusted without careful research.

[2] Though not done in this paper, it is also possible to go in the opposite direction. King, Furukawa, and Buntin (2013) convert county-level data to PUMA data. If a PUMA spanned multiple counties, the PUMA was assigned the estimate of the county in which the majority of the population of the PUMA was located.

[3] Both papers use methodology developed by the Michigan population studies center. See Creating County-Level Statistics from Public Use Microdata Areas (PUMAS) (umich.edu) for more information.

4) PUMAs were split into counties based on share of and racial composition of renter households (Hepburn, Louis, and Desmond 2020)[4]
    - This method is time and computationally intensive and, similar to method 2, it is based largely on the county population rather than local conditions.
5) Use the relationship between PUMA and county for the poverty rate to estimate the county health uninsurance rates given a PUMA health uninsurance rate. They created county-level uninsurance rates from PUMA uninsurance rates by using the relationship between uninsurance rates and poverty rates at the PUMA level and the relationship between poverty rates at the county level and the PUMA level (Graven and Turner 2011)
    - This is the method used throughout the paper. County-level poverty data is available on data.census.gov. Unlike method 2, this method allows county estimates within PUMAs to vary based on local economic conditions rather than populations.

The paper is organized as follows. In Section 2, the data and methodology used in this paper are described in detail. In Section 3, some MDI results are examined by year and by state in order to validate the methods used. County maps and persistent MDI rates are explored in Section 4. Section 5 concludes.

II. Data and Methods

The MDI consists of six dimensions as defined in Table 1: Standard of living, Education, Health, Economic security, Housing, and Neighborhood. A person must be deprived in at least two dimensions to be considered deprived according to the MDI.[5]

The data used to construct the MDI comes from the ACS 1-year survey. The ACS is a nationwide household survey designed to provide communities with reliable and timely demographic, social, economic, and housing data for the nation, states, congressional districts, counties, places, and other localities every year. It has an annual sample size of about 3.5 million addresses across the United States and Puerto Rico and includes both housing units and group quarters (e.g., nursing facilities and prisons).[6] The ACS is the best source of sub-national economic, social, and employment characteristics and its large sample size allows for analyses and breakdowns by demographic characteristics and small geographical areas.

MDI rates cannot currently be produced at the county-level using ACS 1-year data for several reasons: the ACS is not representative of any areas with less than 65,000 people, due to disclosure avoidance the Census Bureau does not allow the release of new estimates using internal Census data for

[4] The authors used 5-year ACS tract-level race/ethnicity data of head of renting households. Then they used a tract-to-PUMA crosswalk to identify tracts that were in the same county and PUMA. They found fractions of households in each PUMA belonging to a given county.

[5] See https://www.census.gov/library/working-papers/2021/demo/SEHSD-WP2021-03.html for more details on the MDI methodology.

[6] While people living in group quarters are sampled in the ACS, those living in institutional group quarters (e.g., nursing homes or correctional facilities) are not included in the poverty universe. Homeless populations are not included in the sample universe unless they are living in shelters at the time of the survey.

populations smaller than the smallest congressional district (~527,000 people), and public use data includes states and public use microdata areas (PUMAs) as the lowest level of geography.[7] PUMAs are non-overlapping statistical geographic areas that partition a state into no fewer than 100,000 people. As such, there are PUMAs that span multiple counties and there are counties that span multiple PUMAs. Therefore, public use data is used to create county-level MDI rates from PUMA-level MDI rates.

The ACS PUMS (public use microdata sample) is a subset of the full ACS sample (referred to as internal file in this paper) and, as such, PUMS estimates may differ slightly from estimates created using the full ACS sample.[8] Due to some data and geographic differences between the internal and public use file, two adjustments to the MDI methodology were necessary.[9] For the housing dimension, there is no way to distinguish between specific types of noninstitutional group quarters in the public use data. Therefore, people living in transitional or emergency shelters cannot be identified.

For the neighborhood dimension, although the ADI (Area Deprivation Index) is available at the block group level (ideal size of 1,500 people), the lowest level of geography available in the public use file is the PUMA (no fewer than 100,000 people). The number of block groups located in a PUMA range from a low of 14 to a high of 210.[10] In order to determine if a PUMA is deprived, a ratio of the number of deprived block groups in a PUMA according to the ADI to the number of total block groups in a PUMA is created. If this ratio is greater than 25 percent, than the PUMA is identified as a deprived neighborhood.[11]

[7] The 1-year ACS is used despite the prevalence of many small counties. While the internal 5-year ACS could be used in order to be representative of small counties, disclosure rules still prevent the release of any estimates for geographies smaller than the smallest U.S. congressional district. There is no advantage to using the 5-year public use ACS as PUMAs are the lowest level of geography identified here as well.

[8] The internal file is used to create estimates on data.Census.gov, while the PUMS is used for all analysis in this paper. See https://www.census.gov/programs-surveys/acs/microdata.html for more information about the ACS PUMS.

[9] See Appendix Table A1 for dimension deprivation rate comparisons between the internal and public use data for 2019 and Appendix Table A2 for MDI comparisons between the internal and public use data over time.

[10] Use a block group to PUMA crosswalk to calculate this relationship: https://mcdc.missouri.edu/applications/geocorr2014.html

[11] The 25 percent cutoff was chosen to align public use neighborhood quality results with internal neighborhood quality results.

Table 1: The Multidimensional Deprivation Index		
Dimensions	Internal file	Public Use file
Standard of living	In poverty according to the official poverty measure.	Same definition
Education	Aged 19 or older and without a high school diploma or GED. For people under age 19, the householder's education is used.	Same definition
Health	**For people under age 65:** Lacked health insurance. **For people age 65 and over:** Lacked health insurance or reported at least two disabilities.	Same definition
Economic security	**For people under age 65:** • Aged 18 and older and unemployed at the time of the survey OR • Lived in a household in which average household hours worked OR average household weeks worked for working-age adults (age 18 to 64, not currently enrolled in school) was less than 20 hours a week or less than 26 weeks a year, respectively.[12] **For people age 65 and over:** • Unemployed at the time of the survey OR • Worked less than 20 hours a week OR less than 26 weeks a year AND had minimal retirement income.	Same definition
Housing	Lived in a housing unit with more than two people per bedroom or lived in a shelter.	Lived in a housing unit with more than two people per bedroom.
Neighborhood	Lived in a deprived block group as measured by the Area Deprivation Index: all block groups with an ADI score greater than 90.	Lived in a PUMA in which at least 25 percent of block groups had an ADI score greater than 90.
MDI	Person is deprived in at least two dimensions.	Same definition
Note: Minimal retirement income = retirement income plus Social Security plus Supplemental Security Income for the household is less than the minimum Social Security benefit assuming 30 years of work experience. The ADI score includes block group measures of education, income, housing, household composition, and household resources. The ADI measure is constructed by ranking the ADI score from low to high for the nation and grouping the block groups into bins corresponding to each 1 percent range of the ADI score. The ADI ranks block groups from 1, least disadvantaged, to 100, most disadvantaged in the U.S. See Glassman (2021) for more details.		

The first step in this methodology is to create MDI rates at the PUMA-level for the entire country. For the conversion of PUMAs to counties, a PUMA-county crosswalk is used from the Geographic Correspondence Engine created by the Missouri Census Data Center.[13] There are three different possibilities for PUMA-county relationships as shown in Table 2.[14] The first is that the PUMA is exactly identical to a county. This is the case for 196 PUMAs. In this case, the county MDI rate is equal to the PUMA MDI rate. The standard errors for county MDI rates are equal to the standard errors for the PUMA MDI rates.

The second possibility is that the county spans multiple PUMAs. In other words, there are multiple PUMAs in a county. This is the case for 1,628 PUMAs which combine together to form 364

[12] Those with zero weeks/hours worked were included in the hours and weeks calculations.

[13] See https://mcdc.missouri.edu/applications/geocorr2014.html.

[14] The table and the following breakdown in counties and PUMAs apply to the years 2012 through 2019. Prior to 2012, there were a smaller number of PUMAs.

counties. In this case, the PUMA MDIs in the same county are averaged together by population to create the county MDI. Standard errors for county MDI rates are calculated using the formula:

$$SE(a+b+\ldots) = sqrt(SE(a)^2 + SE(b)^2+\ldots)$$

The third possibility is that the PUMA spans multiple counties. In other words, there are multiple counties within a PUMA. If you simply map these 527 PUMAs to 2,582 counties, you are left with many groups of counties that have the same MDI rate. Alternatively, a methodology is used which is adapted from a method created to model health insurance coverage in Minnesota counties (Graven and Turner 2011). In their case, they were creating county-level uninsurance rates from PUMA uninsurance rates by using the relationship between uninsurance rates and poverty rates at the PUMA level and the relationship between poverty rates at the county level and the PUMA level.[15]

The methodology used for this third group occurs in three steps. The first step is to calculate PUMA-level MDI rates and PUMA-level poverty rates from the ACS 1-year public use file and find a linear relationship between the two. In this paper, the correlation between the two PUMA-level rates is used, ρ.[16] The second step is to download county-level poverty rates, using the 5-year ACS, from data.census.gov.[17] Then for each PUMA, calculate the difference between the poverty rate in the PUMA and the poverty rate in the county:

$$POV\_diff = POV_{county} - POV_{PUMA}$$

For the third step, the estimates calculated in the first two steps are used to calculate a county-level MDI rate:

$$MDI_{county} = MDI_{PUMA} + (\rho/2) * POV\_diff$$

The standard errors for the MDI rates and the poverty rates at the PUMA level and the 5-year poverty rates at the county level are calculated using replicate weights. Standard errors for 1-year county MDI rates are calculated using the following formula:

$$MDI\_SE_{county} = MDI\_SE_{PUMA} * (\rho/2) * sqrt(POV\_SE_{county} / POV\_SE_{PUMA})$$

Table 2: PUMA to County Mapping Details

2019	PUMA equal to a county	Multiple PUMAs in a county	Multiple counties for a PUMA	Total
Number of PUMAs	196	1,628	527	2,351
Number of counties	196	364	2,582	3,142
Population (in millions)	29.8	218.5	71.8	320.1

Source: U.S. Census Bureau, 2019 American Community Survey Public Use 1-year Estimates.

[15] For more information, see Small Area Estimation with SEM: 2009 Minnesota Uninsurance Rates (shadac.org).

[16] Graven and Turner use a simple regression rather than a correlation. The slope from the regression of two variables is equal to the correlation coefficient multiplied by the ratio of the standard deviations of the variables. This ratio is assumed to be 1 to 2 for the purposes of this paper's methodology.

[17] County-level poverty rates for all counties is only available back to 2012.

III. Validations of Methodology

Using the PUMA-to-county methodology, MDI rates and standard errors are produced for all 3,142 counties in the U.S. for each year from 2010 through 2019. Since it is not possible to validate the results using actual county-level MDI rates, a practical option is to see what happens to national MDI rates when the newly produced county-level MDI rates are used. In Table 3, the U.S. MDI rate is calculated prior to the calculation of any county-level MDI rates. It is simply the national MDI rate. The county-weighted U.S. MDI rate is calculated by taking a county population weighted average of all the newly produced MDI rates in the U.S. The differences between the two rates are small and not statistically significant at the 90 percent confidence level for each year.

Table 3: Validation of County MDI Rates by Year

	U.S. MDI		County-weighted U.S. MDI		Difference	
Year	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.
2019	14.69	0.07	14.97	0.46	0.28	0.47
2018	15.13	0.07	15.30	0.47	0.17	0.48
2017	15.25	0.07	15.34	0.46	0.09	0.47
2016	16.12	0.07	16.08	0.48	-0.04	0.49
2015	16.78	0.07	16.74	0.49	-0.04	0.49
2014	18.37	0.07	18.25	0.52	-0.12	0.52
2013	19.82	0.07	19.66	0.52	-0.16	0.52
2012	20.18	0.07	19.97	0.52	-0.21	0.52
2011	20.70	0.07	20.47	0.52	-0.23	0.52
2010	21.08	0.07	20.89	0.49	-0.19	0.49

Source: 2010 through 2019 American Community Surveys Public Use 1-year Estimates.

The same two MDI rates in Table 3 are produced in Table 4 for each state for the year 2019. None of the differences in the rates are different from zero at the 90 percent confidence level. Based on the results in Tables 3 and 4, the PUMA-to-county methodology appears to perform well.

Table 4: Validation of County MDI Rates by State: 2019						
	U.S. MDI		County-weighted U.S. MDI		Difference	
State	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.
Alabama	18.75	0.32	19.34	0.60	0.59	0.68
Alaska	11.65	0.82	11.78	0.61	0.13	1.03
Arizona	15.70	0.29	15.73	0.32	0.03	0.43
Arkansas	17.12	0.44	17.75	0.68	0.63	0.81
California	16.62	0.13	16.65	0.33	0.02	0.36
Colorado	8.28	0.25	8.37	0.41	0.09	0.48
Connecticut	9.39	0.23	9.45	0.31	0.06	0.39
Delaware	10.42	0.72	10.52	0.49	0.10	0.87
District of Columbia	11.15	0.81	10.73	0.30	-0.42	0.86
Florida	15.54	0.16	15.68	0.38	0.15	0.41
Georgia	18.83	0.28	19.67	0.61	0.84	0.67
Hawaii	9.76	0.48	9.69	0.37	-0.07	0.60
Idaho	10.04	0.52	10.67	0.56	0.63	0.77
Illinois	11.84	0.21	12.10	0.36	0.26	0.42
Indiana	13.96	0.30	14.37	0.56	0.42	0.63
Iowa	7.96	0.37	8.21	0.56	0.25	0.67
Kansas	10.12	0.45	10.43	0.57	0.31	0.73
Kentucky	17.81	0.35	18.51	0.71	0.69	0.79
Louisiana	21.44	0.32	21.42	0.65	-0.02	0.72
Maine	8.59	0.45	8.81	0.49	0.22	0.66
Maryland	10.08	0.27	10.10	0.38	0.02	0.46
Massachusetts	7.55	0.17	7.59	0.25	0.04	0.30
Michigan	13.71	0.21	14.20	0.46	0.49	0.51
Minnesota	7.29	0.29	7.55	0.44	0.26	0.53
Mississippi	27.35	0.55	28.24	0.78	0.89	0.96
Missouri	13.81	0.31	14.19	0.56	0.38	0.64
Montana	8.88	0.55	9.54	0.57	0.66	0.80
Nebraska	8.97	0.49	9.30	0.57	0.33	0.75
Nevada	17.27	0.51	18.17	0.33	0.90	0.61
New Hampshire	6.20	0.40	6.42	0.31	0.22	0.51
New Jersey	11.40	0.21	11.43	0.34	0.03	0.40
New Mexico	23.58	0.54	23.82	0.68	0.25	0.87
New York	17.41	0.18	17.41	0.34	0.00	0.39
North Carolina	14.59	0.23	15.06	0.54	0.48	0.59
North Dakota	7.78	0.76	8.29	0.65	0.51	1.00
Ohio	14.92	0.24	15.30	0.49	0.38	0.54
Oklahoma	17.99	0.37	18.17	0.60	0.18	0.70
Oregon	10.87	0.36	11.35	0.47	0.47	0.59
Pennsylvania	12.10	0.19	12.28	0.42	0.18	0.46
Rhode Island	8.83	0.66	8.97	0.38	0.14	0.76
South Carolina	16.01	0.32	16.58	0.51	0.58	0.60
South Dakota	10.12	0.65	10.91	0.67	0.78	0.94
Tennessee	15.53	0.27	16.19	0.55	0.65	0.61
Texas	21.60	0.19	22.02	0.48	0.42	0.52
Utah	8.33	0.32	8.63	0.39	0.30	0.50
Vermont	7.08	0.61	7.63	0.43	0.54	0.75
Virginia	9.31	0.18	9.67	0.46	0.37	0.49
Washington	9.73	0.24	10.06	0.40	0.33	0.47
West Virginia	13.95	0.51	14.64	0.61	0.69	0.80
Wisconsin	9.50	0.23	9.97	0.46	0.48	0.52
Wyoming	7.99	0.56	8.45	0.47	0.46	0.73
Source: U.S. Census Bureau, 2019 American Community Survey Public Use 1-year Estimates.						

IV. Results[18]

In order to view county results over time, county MDI rates were grouped in two different ways. First, counties were grouped into five deprivation categories based upon their MDI rate and 90% confidence intervals in relation to the national MDI value: Very Low, Low, National, High, and Very High. The five categories were defined as follows:[19]

- **Very Low**: Less than half the national MDI (90% confidence interval upper limit was less than half the national MDI).
- **Low:** Lower than the national MDI (90% confidence interval ranged from just above half the national MDI to just below the national MDI).
- **National:** Not statistically different from the national MDI.
- **High:** Above the national MDI (90% confidence interval limits ranged from just above the national MDI to twice the national MDI).
- **Very High:** At least two times the national MDI (90% confidence interval lower limit was more than twice the national MDI).

Table 5 shows the number and percent of counties falling into each category in 2019 as well as the average MDI rate for each of the categories. The majority of counties fall into the low category, but a sizeable number of counties have MDI rates less than half the overall MDI rate or more than double the overall MDI rate. The average county population is also shown for each category. The largest counties are in the high and low categories, while the smallest counties are in the national and very high categories.

Table 5: Counties and MDI Rates by Category: 2019

	Number of counties	Percent of counties	Average county population	MDI rate	Standard error
Very Low	270	8.6%	90,070	5.56	0.37
Low	1411	44.9%	116,400	10.35	0.54
National	377	12.0%	65,090	14.71	0.73
High	799	25.4%	107,500	20.03	0.83
Very High	285	9.1%	78,970	50.47	0.98
Overall	3142	100%	104,500	14.69	0.07

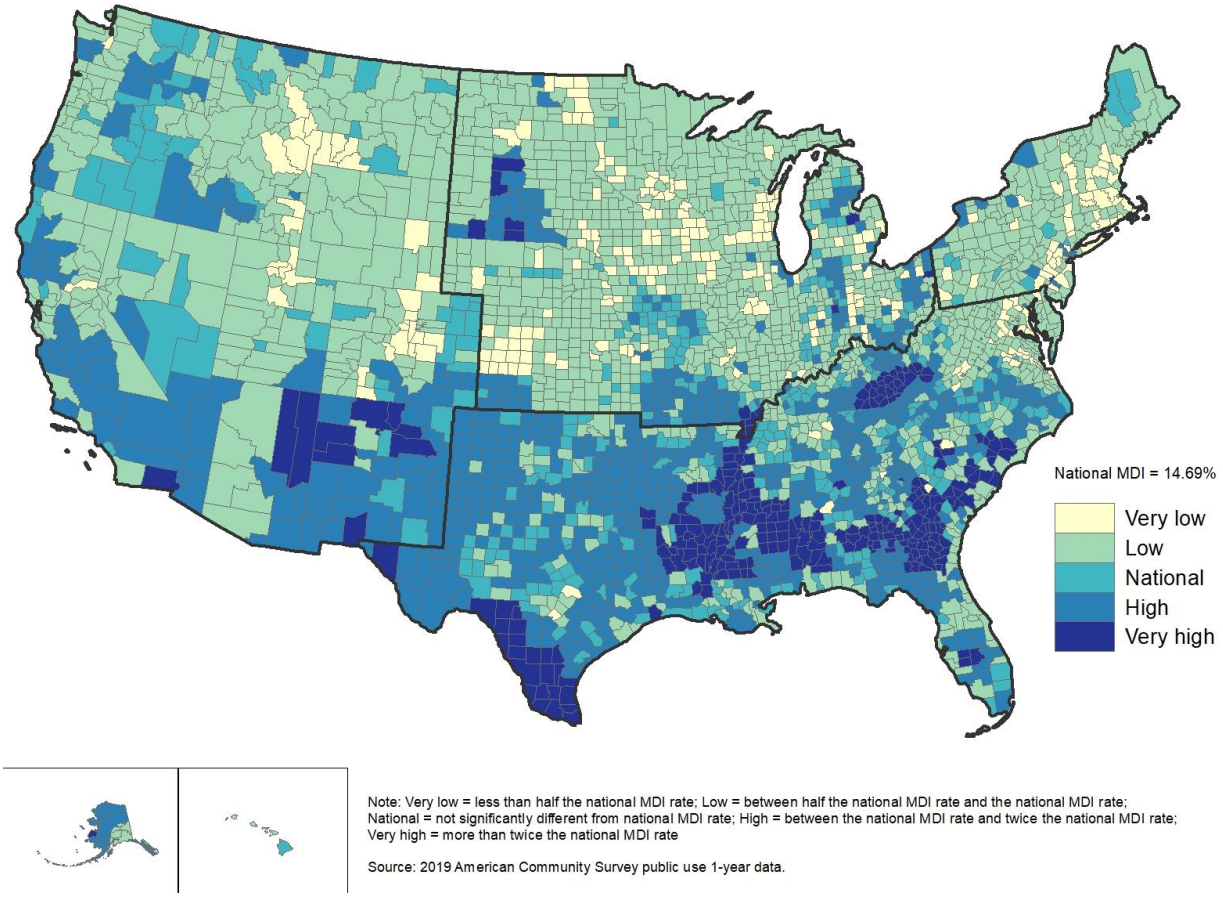
Source: U.S. Census Bureau, 2019 American Community Survey Public Use 1-year Estimates.

[18] The majority of the analysis in this paper is done using the 2019 ACS. Although the 2020 ACS was available, data collection for the 2020 ACS was interrupted in Spring 2020 due to Covid-19 restrictions. The Census Bureau found that respondents to the ACS differed significantly from non-respondents on social, economic, and housing characteristics. The normal weighting adjustment was found to be inadequate to deal with these issues. Therefore, an experimental weighting method was used. The Census Bureau advises users to view 2020 estimates with caution.

[19] Four of the categories were the same as ones used in Flynn et al. 2021. Very Low was added for this paper.

In Figure 1, counties are shown on a map, with regions outlined in black, by each of these five categories. The first thing to notice is that nearly all Very high MDI counties are located in the South and in South Dakota. Second, they tend to be bunched together. There are groupings in Southwest Texas along the Mexico border, along the border between Arizona and New Mexico, in Kentucky, and in large groupings throughout Alabama, Louisiana, Mississippi, and Georgia. Conversely, Very low MDI counties are rarely found in the South, but are more commonly found throughout the Northeast and in some groupings in the Midwest and West.

Figure 1: MDI Rates by County: 2019

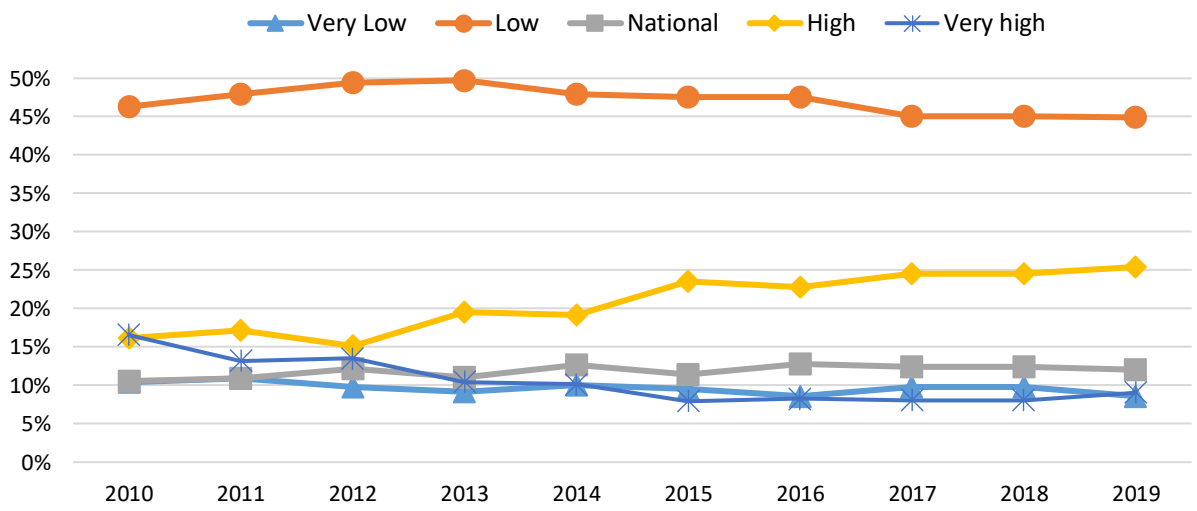


Note: Very low = less than half the national MDI rate; Low = between half the national MDI rate and the national MDI rate; National = not significantly different from national MDI rate; High = between the national MDI rate and twice the national MDI rate; Very high = more than twice the national MDI rate

Source: 2019 American Community Survey public use 1-year data.

In Figure 2, the percent of counties that were in each category are shown over time from 2010 to 2019. The percent of counties in the High category increased between 2010 and 2019 while the percent of counties in the Very High category decreased.

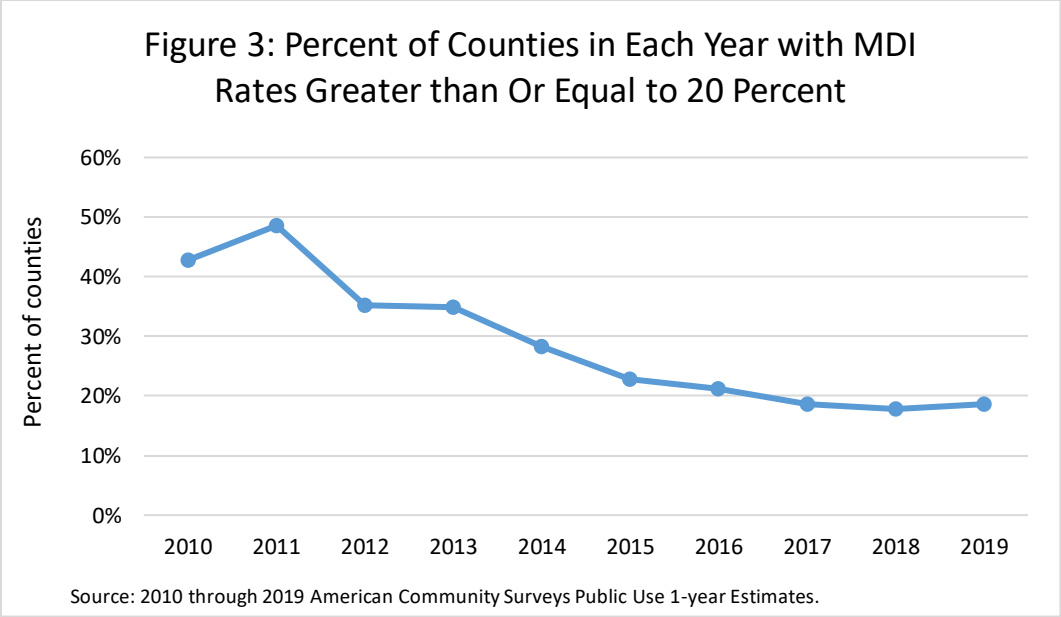
Figure 2: Percent of Counties in Each Category Over Time



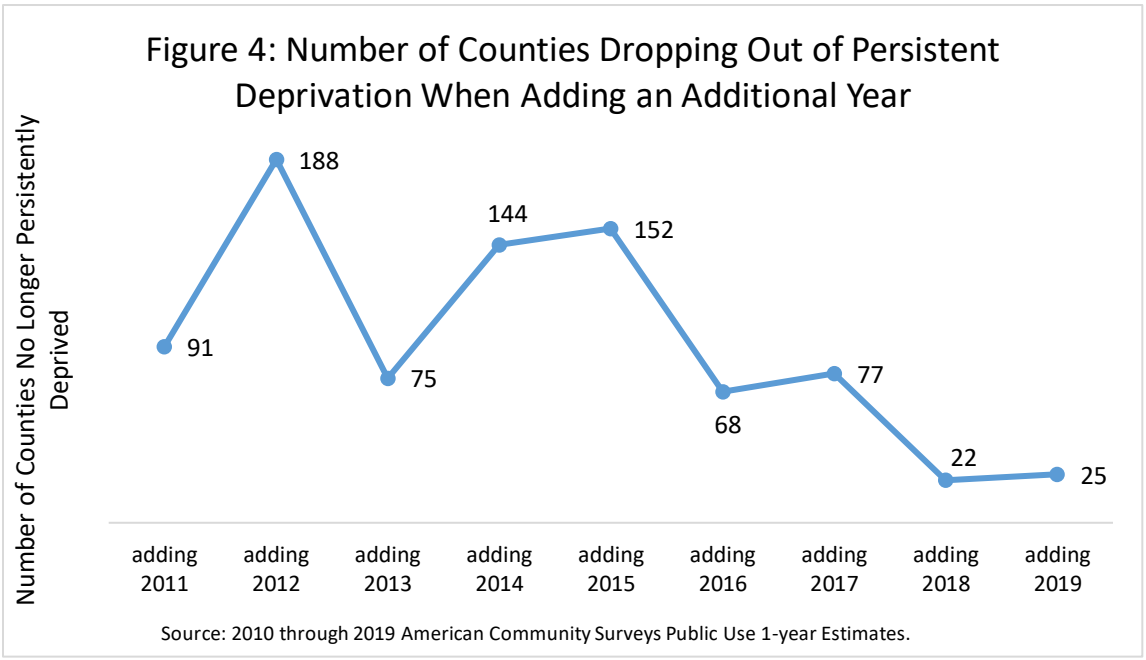
Note: County MDI rates for counties 42101 and 10003 are suppressed in 2018 due to data collection errors. See https://www.census.gov/programs-surveys/acs/technical-documentation/errata/120.html and https://www.census.gov/programs-surveys/acs/technical-documentation/errata/121.html for more information. County MDI rates for county 35039 are suppressed in 2017 and 2018 due to data collection errors. See https://www.census.gov/programs-surveys/acs/technical-documentation/errata/125.html for more information.
Source: 2010 through 2019 American Community Surveys Public Use 1-year Estimates.

Second, counties were categorized as persistently deprived if the MDI rate for the county was at least 20 percent for each year from 2010 through 2019.[20] Before examining persistently deprived counties, the percent of counties with MDI rates of at least 20 percent are shown in Figure 3.[21] Nearly 50 percent of counties hit this mark in 2011 before falling to below 20 percent of counties by 2017. The percent of counties with MDI rates of at least 20 percent fell each year until 2018 before inching back up in 2019.

[20] Persistent poverty is generally defined as having a poverty rate of at least 20 percent for 30 years. However, persistence has been used in the literature to describe poverty or deprivation over a period of time (See Whelan et al. 2001). The definition of persistence in this paper follows in this vein.
[21] A county's MDI point estimate must be at least 20 percent to be included. Counties with MDI point estimates less than 20 percent but not significantly different from 20 percent are not included.



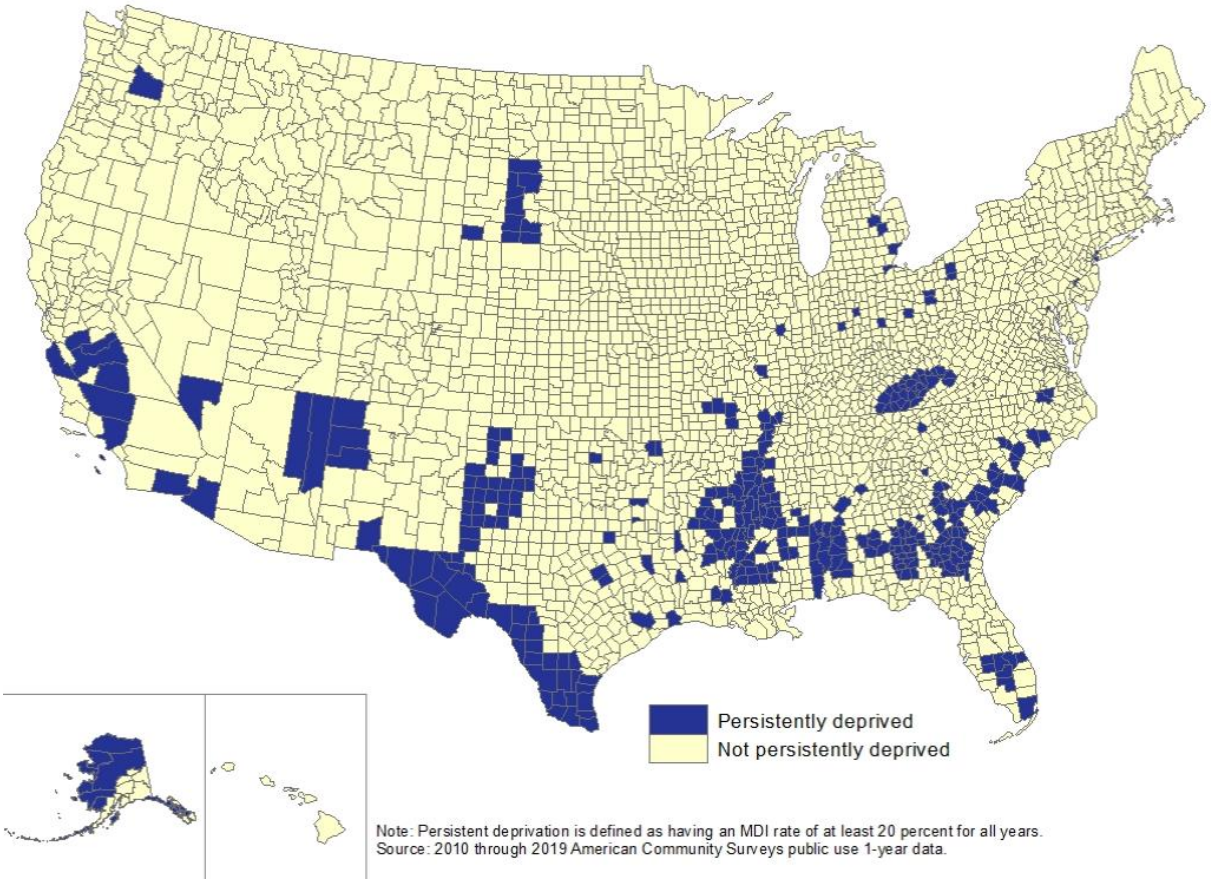
In Figure 4, the number of counties that were no longer considered persistently deprived are shown when an additional year is added. For example, when changing the definition of persistent deprivation from 2010 through 2018 to 2010 through 2019, 25 counties had MDI rates fall below 20 percent which means they were no longer considered persistently deprived.



Based on the main definition of persistent deprivation which says that the county must have an MDI rate of at least 20 percent for all years from 2010 through 2019, there were 370 counties that were persistently deprived. Figure 5 is a map that shows where those counties were located across the United States. The dark blue areas on Figure 5 match up quite well with the dark blue areas on Figure 1: 239 out of the 285 counties that were very high in 2019 were also persistently deprived.

No counties are persistently deprived in 22 states and the District of Columbia. Three states, Georgia, Mississippi, and Texas, account for nearly 50 percent of all persistently deprived counties in the United States. In 11 states, at least ten percent of the counties in the state are persistently deprived counties. Furthermore, in 3 states, Alaska, Georgia, and Mississippi, at least 40 percent of the counties in the state are persistently deprived.

Figure 5: Counties in Persistent Deprivation: 2010 through 2019

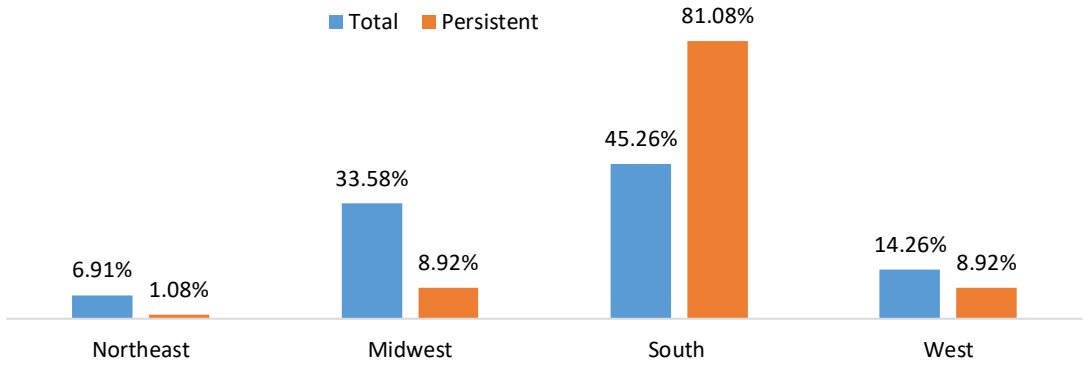


Note: Persistent deprivation is defined as having an MDI rate of at least 20 percent for all years.
Source: 2010 through 2019 American Community Surveys public use 1-year data.

In Figure 6, the percent of total counties that are located in each region is compared to the percent of persistent counties that are located in each region. While a plurality of total counties are

located in the South, the vast majority of persistently deprived counties are located in the South. Persistently deprived counties are significantly under-represented in the other three regions.

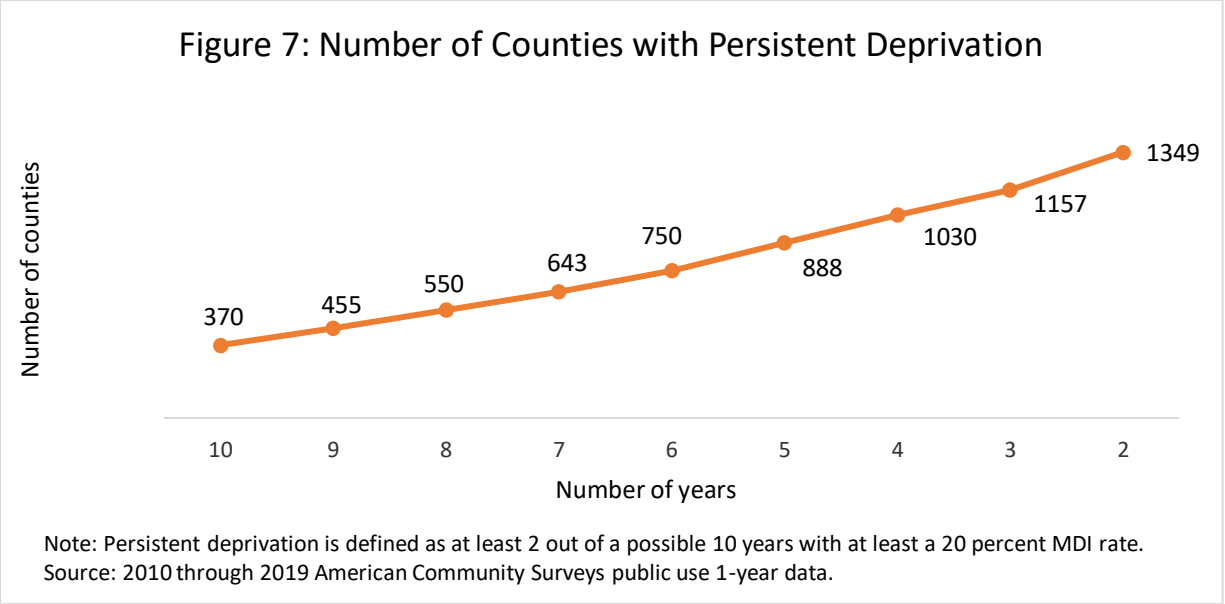
Figure 6: Percent of Persistent Counties vs. Percent of Total Counties in Each Region



Source: U.S. Census Bureau, 2010 through 2019 American Community Surveys 1-year data.

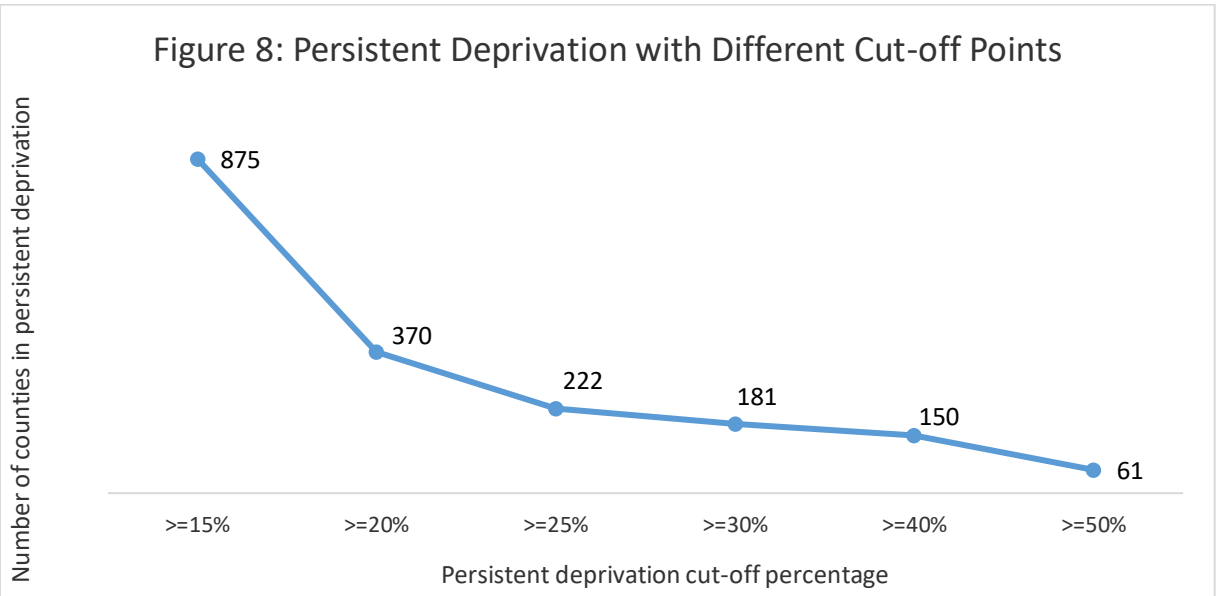
There are two parts to the persistent deprivation definition: the cutoff percentage (20 percent) and the number of years above the cutoff (10 years). In Figures 7 and 8, the two parts of the persistent deprivation definition are adjusted to see what happens to the number of counties categorized as persistently deprived.

In Figure 7, each number on the horizontal axis represents a different number of years that a county has to have an MDI rate of at least 20 percent in order to be considered persistently deprived. For instance, if persistent deprivation is defined as an MDI rate of at least 20 percent for at least 6 out of 10 years, then 750 counties would be considered persistently deprived.



Note: Persistent deprivation is defined as at least 2 out of a possible 10 years with at least a 20 percent MDI rate.
Source: 2010 through 2019 American Community Surveys public use 1-year data.

In Figure 8, the horizontal axis represents different MDI rate cutoff percentages for a county to be considered persistently deprived. As in Figure 5, when the cutoff percentage is 20 percent, there are 370 persistently deprived counties. If the cutoff is lowered to 15 percent, then the number of counties in persistent deprivation more than doubles. If the cutoff is increased to 50 percent, there are still 61 counties that are in persistent deprivation.



Note: Persistent deprivation is defined as being above the cut-off percentage for all ten years.
Source: 2010 through 2019 American Community Surveys 1-year data.

There is a large variance in county size. The 3,142 counties range in size from less than 100 people to over ten million people. The mean county size in 2019 was 104,500 people and the median county size was 25,730 people. In Table 7, counties were broken down into three sizes: small counties have populations less than 250,000 people; medium counties have populations between 250,000 and 1 million people; and large counties have populations over 1 million people.[22]

The average MDI rate is higher in large counties than it is in medium counties.[23] The last two columns of Table 6 show two things: persistently deprived counties account for a larger percentage of total counties in large counties than in small or medium counties and most persistently deprived counties are small counties.

Table 6: MDI Rates by County Size: 2019

County size category	Number of counties	MDI Rates		Persistence of deprivation	
		Est.	Std. Err.	Percent of size category	Percent of persistent counties
Small	2,867	14.70	2.35	11.65	90.27
Medium	230	13.36	0.32	10.87	6.76
Large	45	17.31	0.18	24.44	2.97
Total	3,142	14.69	0.07	11.78	100.00

Note: Small counties have populations less than 250,000 people; medium counties have populations between 250,000 and 1,000,000 people; large counties have populations over 1,000,000 people.
Source: 2019 American Community Survey public use 1-year data.

[22] Size delineations were taken from Data Access - Urban Rural Classification Scheme for Counties (cdc.gov).
[23] There is no significant difference in MDI rates between large and small counties and between medium and small counties.

V. Conclusion

In this paper, a methodology is outlined that allows for the creation of not previously released county-level estimates using all public-use data. While the estimates in this paper are MDI rates, the process may be generalizable to the creation of other estimates of interest. Two important related benefits of the approach in the paper are outlined below.

The first benefit is that this allows for the release of previously unreleased new estimates for counties. Using internal data without this approach, estimates for approximately 132 counties could be released each year. With this paper's method, estimates for all 3,142 counties can be released each year.

The second benefit is that it allows for the release of already published estimates for more areas using 1-year data. Other estimates using internal 1-year ACS data, such as OPM estimates, can only be released for approximately 820 counties each year. To get OPM estimates for all 3,142 counties, 5-year ACS data would need to be used. With this method, estimates for all 3,142 counties can be released using 1-year data. An important exception is the SAIPE program which releases modeled county OPM estimates on an annual basis.

In the future, the plan is to use this methodology to do three main things. First, to continue to produce and release county-level MDI estimates on an annual basis. County MDI rates and standard errors for the years 2010 through 2019 are being published along with this working paper. Second, to compare county-level MDI estimates to other county-level outcomes such as internet access, health outcomes, migration patterns, and income inequality. Also, to compare county MDI rates to SAIPE county OPM rates. This would be an important validation of this methodology. Third, to produce other estimates using the same methodology. The ACS OPM is currently only released for PUMAs and for approximately 820 counties using 1-year data.[24] This method would allow for the release of OPM estimates for all counties using 1-year data. The ACS SPM can only currently be calculated using states and PUMAs. This methodology would allow for the release of SPM estimates for all 3,142 counties.

[24] The SAIPE program does produced modeled ACS OPM estimates.

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APPENDIX

In Table A1, deprivation rates are shown using the internal and the public use files. Public use ACS data is a sample of the internal data. In 2019, there were about 4.6 million respondents in the internal file and 3.1 million respondents in the public use file. This explains why the estimates for standard of living, education, health, and economic security are not exactly the same, though the difference between the internal and public use estimates is not different from zero at the 90 percent confidence level. For the housing dimension, people living in transitional or emergency shelters cannot be identified in the public-use data and are therefore excluded. For the neighborhood dimension, the definition was changed due to the lack of block group identifiers on the public-use data. These two differences in dimension definitions led to statistically significant differences in estimates as well as a small but statistically significant difference in the national MDI rate.

Table A1: Percent of People Deprived in Individual Dimensions: Internal vs. Public Use for 2019

	Internal		Public Use		Difference	
Dimension	**Percent**	**Standard error**	**Percent**	**Standard error**	**Percent**	**Standard error**
Standard of living	12.34	0.05	12.31	0.06	0.03	0.07
Education	11.18	0.04	11.12	0.05	0.06	0.07
Health	12.13	0.05	12.11	0.05	0.02	0.07
Economic security	10.86	0.03	10.85	0.03	0.02	0.04
Housing	6.27	0.04	5.81	0.05	*0.46	0.07
Neighborhood	6.58	0.03	7.13	0.02	*-0.56	0.03
MDI	14.95	0.06	14.69	0.07	*0.26	0.09
N	4,571,000		3,107,000		1,464,000	

* difference is statistically different from zero at the 90 percent confidence level.
[1] Details may not sum to totals due to rounding.
Note: The deprivation universe excludes children under age 15 who are not related to the householder, people living in institutional group quarters (e.g., nursing homes or correctional facilities), and people living in college dormitories or military barracks.
Source: U.S. Census Bureau, 2019 American Community Survey public use 1-year data internal 1-year data.

Since Table A1 is only shown for the year 2019, national MDI rates are displayed in Table A2 for the years 2010 through 2019. While there are significant differences in MDI rates between the internal and public use data for each year other than 2010 and 2011, all differences are 0.50 percentage points or less and all but one difference are 0.30 percentage points or less.

Table A2: Percent of People Deprived: Internal vs. Public Use: 2010 through 2019						
Year	**U.S. MDI – internal**	**Std. Err.**	**U.S. MDI – public use**	**Std. Err.**	**Difference**	**Std. Err.**
2019	14.95	0.06	14.69	0.07	*-0.26	0.09
2018	15.36	0.06	15.13	0.07	*-0.23	0.09
2017	15.75	0.05	15.25	0.07	*-0.50	0.09
2016	16.40	0.05	16.12	0.07	*-0.28	0.09
2015	17.08	0.05	16.78	0.07	*-0.30	0.09
2014	18.59	0.05	18.37	0.07	*-0.22	0.09
2013	20.00	0.05	19.82	0.07	*-0.18	0.09
2012	20.34	0.05	20.18	0.07	*-0.16	0.08
2011	20.76	0.05	20.70	0.07	-0.06	0.09
2010	20.95	0.06	21.08	0.07	0.13	0.09

Note: * difference is different than zero at the 90 percent confidence level.
Source: 2010 through 2019 American Community Surveys public use 1-year data and internal 1-year data.