



# **True Living Cost (TLC) Index Methodology**

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Purpose

The purpose of the Ludwig Institute for Shared Economic Prosperity's True Living Cost (TLC) Index is to determine the change throughout time in costs necessary to satisfy the basic needs of an American household. The hypothetical person or family that makes up an "American household" meeting basic needs is difficult to define in either qualitative or quantitative terms. The Ludwig Institute for Shared Economic Prosperity (LISEP) attempts to solve this issue by using real world data as well as supplementing it with academic research. Throughout this methodology, LISEP notes each expenditure allocated to this household in each year of the sample (2001-2020). The term used throughout this methodology is "minimal adequate needs." The meaning of this standard for each expense category is defined in each section.

The TLC Index is intended to illuminate the change in costs throughout time faced by an American household who meets the barebone standard to function in and be a part of American society.<sup>1</sup>

## i. Brief Explanation of the Consumer Price Index and its shortcomings as a cost-of-living metric

Currently, the most common way to adjust for prices throughout time is through the Consumer Price Index (CPI). The CPI takes a basket of goods and services consumed by the *average urban* household and tracks the price of this basket over time. This provides a metric of the dollar amount needed to maintain a household's consumption. Every two years, the basket is reassessed based on the government-issued Consumer Expenditure Survey (CE), which tracks spending of households across the United States. The Bureau of Labor Statistics (BLS) recognizes that "the CPI only approximates a cost-of-living index. The CPI is sometimes called a

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<sup>1</sup> LISEP would like to thank Dr Hal Hershfield, Dr Noelle Chesley, and Dr Tammy Leonard for their invaluable contributions to the formulation of this methodology.

conditional cost-of-living index, since the factors that affect the cost of living that aren't in scope are implicitly held constant” and that “The CPI is constructed using a set of surveys, and it is fundamentally a measure of price change.” LISEP recognizes that the CPI is a laudable measure of price changes, but we seek to address some of the issues in using the CPI as a true cost-of-living metric. It is flawed when it is applied to measure cost of living, especially for low- to middle-income households.

First, the CPI is mathematically biased towards the consumption patterns of higher-income individuals and households. Because spending from the wealthier portion of the population is more than lower income portions, high-income households have a larger influence on average spending. So even while LMI households are completely unaffected by the price changes of, for example, luxury watches, these changes influence the CPI.

Second, the CPI is actually the CPI-U, where the U stands for urban. This means only the urban population is considered, and for those living in rural areas, the CPI does not account for the price changes they might face. In spite of this shortcoming, the CPI does include suburban areas and manages to account for approximately 93% of the U.S. population – but this still excludes about 23 million Americans.

Third, the CPI does not adequately allow for the addition of completely new items to the basket unless an old item is replaced. For example, from 1990 to 2020 mobile phones and cellular spending became a part of the budget for a vast majority of Americans. But due to the CPI being a bundle where all the goods and services add up to 100%, these costs displaced other costs. But logically, purchasing a cell phone does not mean that one needs less housing – a key flaw in this approach to measuring consumer costs.

There are further anomalies that result from the construction of the CPI. One is the failure for the CPI to represent the cost of shelter. Because the CPI measures housing costs as imputed rents (what someone thinks that their current dwelling would rent for) the CPI often does not react to market changes in current rents or housing prices. People are less likely to change their estimation of their house from year to year even if someone looking for rent that year will face different prices. This discrepancy was made clear during the Great Recession where home prices tumbled but the CPI for housing went up about 3% from November 2007 to November 2008.<sup>2</sup> A similar discrepancy arises in medical costs versus medical CPI. From 2013 to 2019, the CPI for Medical Care went up only 17.2%<sup>3</sup> whereas the average spending for medical care as reported by the Consumer Expenditure survey<sup>4</sup> went up more than 43% during the same period. There is a misalignment between the cost of medical care (implicitly suggested by spending) and the CPI for this item.

While the CPI remains a good measure of inflation – that is, how prices change – when it is applied as a cost-of-living metric, the CPI shows a distorted reality. LISEP’s goal is to construct a more accurate cost-of-living metric for LMI Americans by assessing the cost of meeting their “minimal adequate needs” each year. If defined specifically for each good, this will generally align to the spending needed to maintain a household’s socioeconomic level. To develop this metric, an assessment is made for “minimal adequate needs” in the categories of housing, food, transportation, medical care, childcare, and transportation. A final category

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<sup>2</sup> U.S. Bureau of Labor Statistics, Consumer Price Index for All Urban Consumers: Housing in U.S. City Average [CPIHOSNS], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/CPIHOSNS>, December 20, 2021.

<sup>3</sup> U.S. Bureau of Labor Statistics, Consumer Price Index for All Urban Consumers: Medical Care in U.S. City Average [CPIMEDSL], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/CPIMEDSL>, December 20, 2021.

<sup>4</sup> *Consumer Expenditure Survey*. (2021, October 8). United States Census Bureau. Retrieved December 20, 2021, from <https://www.bls.gov/cex/tables/calendar-year/mean/cu-all-multi-year-2013-2020.pdf>

includes miscellaneous expenses deemed necessary for an adequate standard of living, including apparel and personal care.

## ii. Brief Literature Review

There have been past attempts to adjust the CPI for different populations. The BLS publishes a CPI for the elderly,<sup>5</sup> which analyzes price changes relevant to the U.S. population aged 62 and above. Further, BLS economists Thesia Garner, David Johnson, and Mary Kokoski (1996) developed a CPI for low-income households,<sup>6</sup> which addresses the first problem outlined above but not the latter two. A current working paper by two other BLS economists, Josh Klick and Anya Stockburger,<sup>7</sup> finds different results. The former paper finds that there is no significant difference in the inflation faced by poorer segments of the population, whereas the Klick and Stockburger paper finds that poorer segments face faster inflation.

The BLS also publishes the CPI For Urban Wage Earners and Clerical Workers (CPI-W), which measures the change in retail prices faced by households working in clerical and wage occupations (29% of the population).<sup>8 9</sup> The CPI-W places more weight on “retail” prices facing those consumers, such as food, transportation, and apparel and less weight on housing, medical

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<sup>5</sup> Consumer Price Index Group. (n.d.). *R-CPI-E Homepage*. U. S. Bureau of Labor Statistics. Retrieved December 20, 2021, from <https://www.bls.gov/cpi/research-series/r-cpi-e-home.htm>

<sup>6</sup> Garner, T. I., Johnson, D. S., & Kokoski, M. F. (1996). An experimental consumer price index for the poor. *Monthly Lab. Rev.*, 119, 32.

<sup>7</sup> Klick, J., & Stockburger, A. (2021, March 8). *Experimental CPI for lower and higher income households* [Working paper in preparation]. U. S. Bureau of Labor Statistics.

<sup>8</sup> Consumer Price Index Group. (n.d.). *News room Frequently Asked Questions*. U. S. Bureau of Labor Statistics. Retrieved December 20, 2021, from <https://www.bls.gov/cpi/additional-resources/chained-cpi-questions-and-answers.htm>

<sup>9</sup> Those households must meet two requirements: “more than one-half of the household's income must come from clerical or wage occupations, and at least one of the household's earners must have been employed for at least 37 weeks during the previous 12 months”: <https://www.bls.gov/cpi/questions-and-answers.htm>

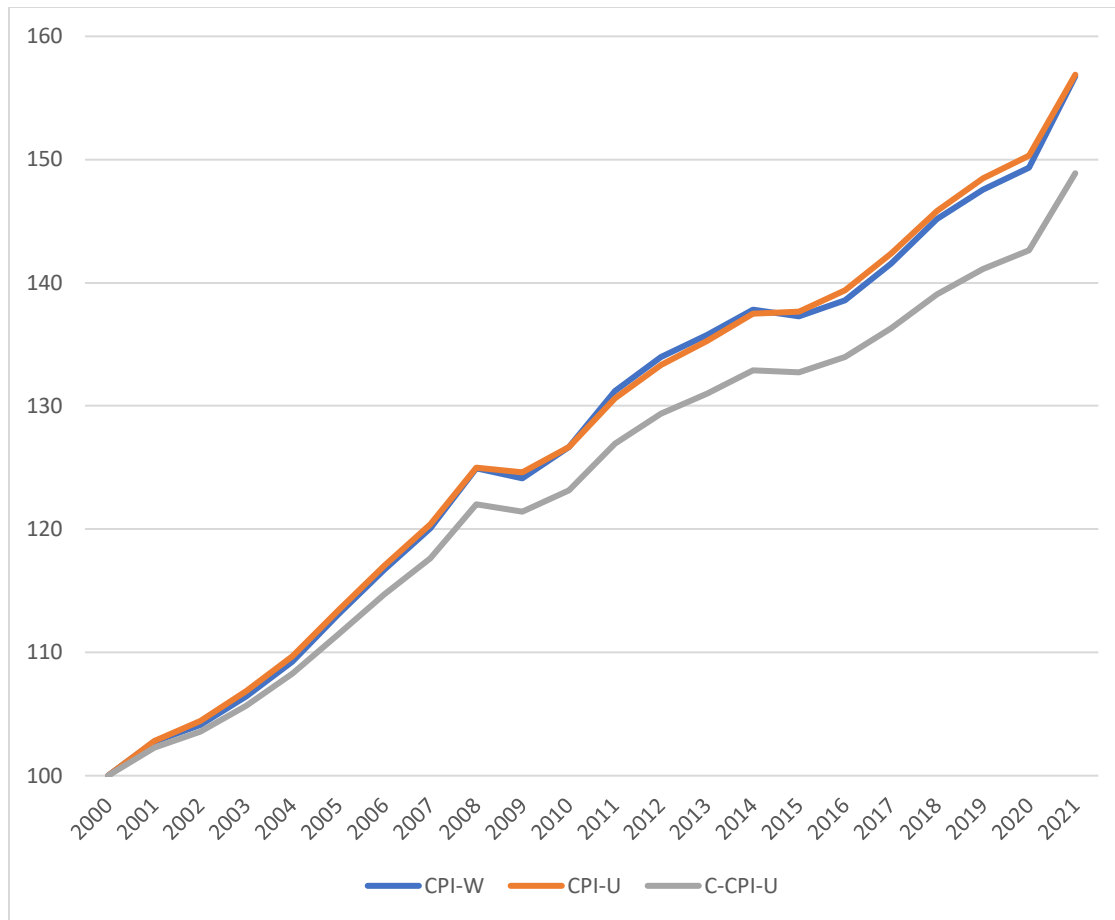
care, and recreation.<sup>10</sup> A fourth measure that the BLS constructed is the Chained Consumer Price Index (C-CPI-U). It differs from the CPI-U and the CPI-W by using a formula that allows for substitution across the categories of the goods basket and by updating the expenditure weights monthly as opposed to biennially.<sup>11</sup> What both these metrics have in common is that they measure inflation of prices rather than cost of living – an important distinction from the LISEP TLC Index.

***Figure 1: Change of CPI-U, CPI-W, and C-CPI-U, 2001-2020***

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<sup>10</sup> Consumer Price Index Group. (n.d.). *News room Frequently Asked Questions*. U. S. Bureau of Labor Statistics. Retrieved December 20, 2021, from <https://www.bls.gov/cpi/additional-resources/chained-cpi-questions-and-answers.htm>

<sup>11</sup> Consumer Price Index Group. (n.d.). *News room Frequently Asked Questions*. U. S. Bureau of Labor Statistics. Retrieved December 20, 2021, from <https://www.bls.gov/cpi/additional-resources/chained-cpi-questions-and-answers.htm>



### iii. Implications of using the CPI as a cost-of-living metric

The implications of using the CPI as a cost-of-living metric for lower- and middle-class American families are numerous. The BLS recognizes that “[t]he CPI is used to adjust income eligibility levels for government assistance, federal tax brackets, federally mandated cost of living increases, private sector wage and salary increases, and consumer and commercial rent escalations. Consequently, the CPI directly affects hundreds of millions of Americans.”<sup>12</sup>

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<sup>12</sup> *Consumer Price Index: Concepts*. (2020, November 24). U.S. Bureau of Labor Statistics. Retrieved December 20, 2021, from <https://www.bls.gov/opub/hom/cpi/concepts.htm>

More than 15 federal assistance programs are indexed to some iteration of the CPI in part or full. Two prominent categories are programs pertaining to children and veterans. The first category is important because 51% of households in the U.S. have children and the second due to the societal responsibility of ensuring the wellbeing of those who served in the armed forces.

First, there is the Child Tax Credit (CTC). Even though the \$1,000 amount per child itself is not indexed to the CPI, the refundability threshold was tied to the CPI-U intermittently between 2001 and the present, which has a dramatic impact on the number of families in difficulty qualifying for the tax credit.<sup>13</sup> Secondly, portions of the Supplemental Nutrition Assistance Program (SNAP), which keeps millions of children away from food insecurity, is also subject to the CPI trajectory. Families are eligible to receive SNAP benefits if they meet the income thresholds set by the federal poverty guidelines, which are directly indexed to the CPI-U.<sup>14</sup> Thirdly, Child Nutrition Programs are also greatly influenced by the CPI-U fluctuations. In addition to the eligibility thresholds set by the federal poverty guidelines, the per-meal subsidies participating schools receive are indexed to the Food Away from Home component of the CPI-U.<sup>15</sup>

Programs aimed at veterans suffer from the same issue. Military Retirement, Veterans Disability Compensation, Veterans Pensions, and the Subsistence Allowance for Veterans Vocational Rehabilitation and Employment Participants are all indexed to the Cost-of-Living Adjustment (COLA) issued by the Social Security Administration (SSA), which uses a statutory

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<sup>13</sup> <https://sgp.fas.org/crs/misc/R42000.pdf>

<sup>14</sup> Ibid.

<sup>15</sup> Ibid.



formula based on the CPI-W.<sup>16</sup> This means that veterans receive benefits that are not commensurate with the cost of living they face and thus are worse off over time.

## I. Population Determination

To calculate the overall TLC Index, the population is separated in two different ways and then estimates for the specific strata are aggregated. These strata are sorted first by region and then by family type. LISEP determines the cost-of-living change throughout time to be the average change of each person's cost of living from year to year rather than the cost-of-living change of the average person. Of course, each American is different, and nobody is average, and thus assessing the change of the average person is a useless exercise.

### A. Regional Breakdown

To obtain regional estimates of the population, data from the U.S. Census Bureau Population Estimates Program is used.<sup>17</sup> This produces intercensal (not on Census years) estimates of population by state and region. The Census defines four different census regions: Northeast, Midwest, South, and West. The table below lists the states in each region.

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<sup>16</sup> Ibid.

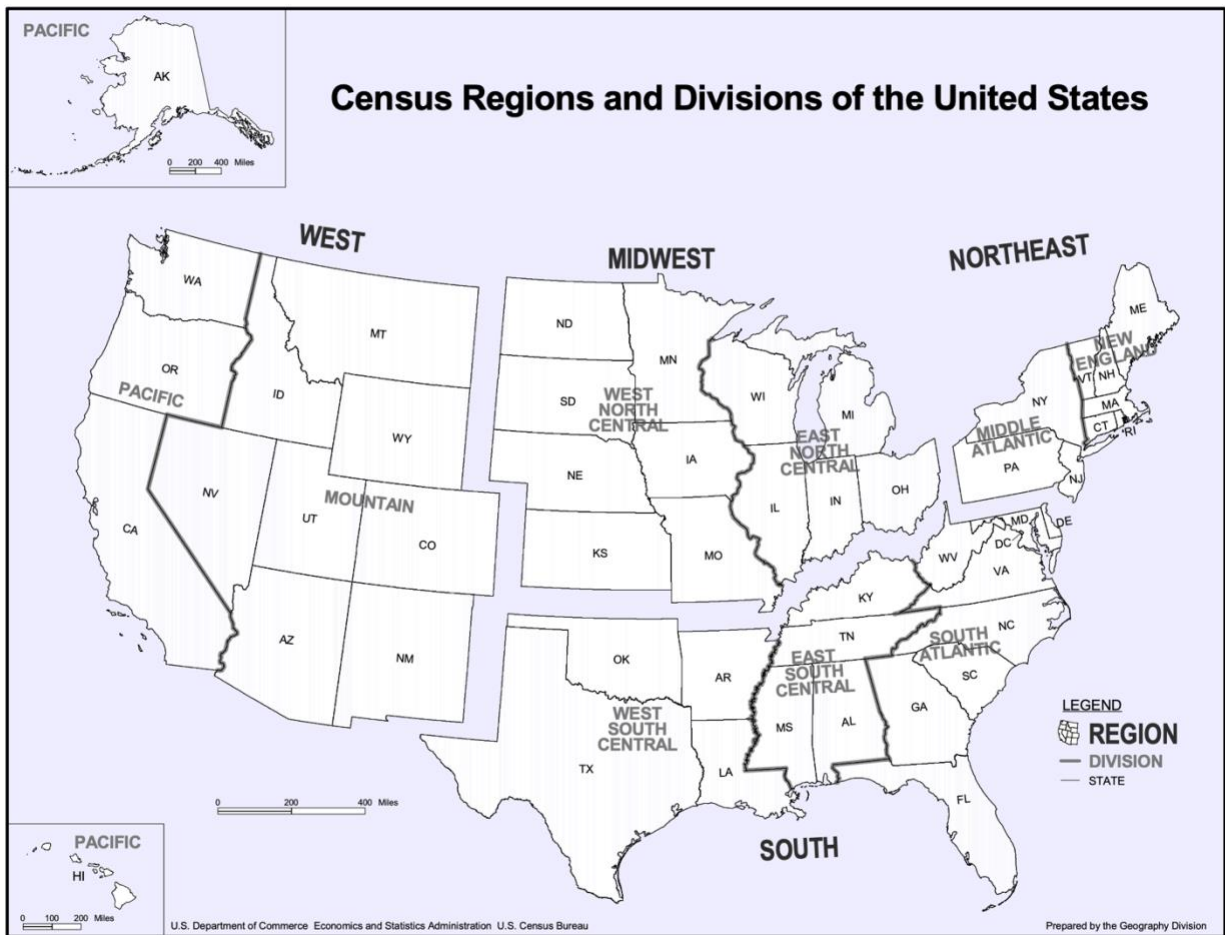
<sup>17</sup> (United States Census Bureau)

**Table 1: Census regions state composition**

<b>Northeast</b>	<b>Midwest</b>	<b>South</b>	<b>West</b>
Connecticut	Indiana	Delaware	Montana
Maine	Illinois	District of Columbia	Utah
Massachusetts	Michigan	Florida	Nevada
New Hampshire	Ohio	Georgia	Wyoming
Rhode Island	Wisconsin	Maryland	Alaska
Vermont	Iowa	North Carolina	California
New Jersey	Kansas	South Carolina	Hawaii
New York	Minnesota	Virginia	Oregon
Pennsylvania	Missouri	West Virginia	Washington
	Nebraska	Alabama	Arizona
	North Dakota	Kentucky	Colorado
	South Dakota	Mississippi	Idaho
		Tennessee	New Mexico
		Arkansas	
		Louisiana	
		Oklahoma	
		Texas	

Census regions are graphically depicted here: <sup>18</sup>

**Figure 1: United States regions as defined by the U.S. Census Bureau**



Source: *Census Regions and Divisions of the United States*. (n.d.). U.S. Census Bureau.  
[https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us\\_regdiv.pdf](https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf)

The population is estimated in the intercensal annual estimations in two ways. First, state-by-state data is aggregated into regional data with the correct state weights. Second, regional data is weighted appropriately when nationally aggregating the data from the regional to the national level.

## B. Family Structure Breakdown

<sup>18</sup> (United States Census Bureau Cartographer)

After sorting the data into different regions, the data is further stratified by family structure. This is because different family sizes imply different minimal adequate living needs. For example, when renting an apartment, LISEP has determined that the minimal needs of a family of three to be a two-bedroom apartment, one for the parents and one for the child. But these are the same needs for a family of four, as the children can share a room. Thus, the numbers are not exactly scalable in all instances, and each family structure's minimal needs must be considered individually. But, because LISEP is seeking to determine the average cost-of-living change, the population proportions for each family type were determined and used to weigh the differing family type's costs and these cost's respective impact on the aggregate.

### i. Definition of Families

LISEP used the Integrated Public Use Microdata Series (IPUMS) American Community Survey (ACS) Dataset found on IPUMS USA.<sup>19</sup> As defined on the IPUMS website: "Data includes decennial censuses from 1790 to 2010 and American Community Surveys (ACS) from 2000 to the present."<sup>23</sup> Because data is only being considered from 2001-2020, LISEP has the full range of necessary ACS data.

Family types are defined using the available variables in the ACS on household composition: *hhtype*, *nchild*, *ncouples*, *nmothers*, *nfathers*, *gq*, and *pernum*. Each of these variables is defined fully in the variable dictionary in the Appendix and brief definitions are given throughout this section. Those living in institutions are disqualified<sup>20</sup> using the *gq* (group quarters) variable. Eight different types of families are then established without assuming the gender of the parent or the children for any of the eight family types.

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<sup>19</sup> (Ruggles et al. 2021)

<sup>20</sup> Military barracks, retirement homes, mental institutions etc.

The first four family types are based on a single-adult household. The first type is the single adult with no children. Second, is a single parent with one child. Third, is a single parent with two children; fourth is a single parent with three children<sup>21</sup>. An explanation for why families with more than three children aren't considered separately is found below.

The next set of four family types are based on couples. Couples aren't assumed to be married, but it is assumed they are both equally responsible for the children as well as the well-being of the household. The fifth family type is couples with no children. Sixth is couples with one child; seventh is couples with two children. Last are couples with three children.

Single parents or couples with more than three children are not considered for two reasons. The first reason deals with robust data samples needed for making budgetary estimates. Three parts of the budget calculation are generated based on the spending of real households. These parts use the CE Survey, and this process is detailed in a later section. Grouping together households with more than three children in the CE Survey leads to very small sample sizes that do not allow for robust cost estimates. For example, to obtain valid cost estimates for a family of seven children living in the northeast in 2018, one would need to use a sample of five families from the entire CE Survey. In this calculation, if LISEP is too specific about the size of the family, then the values calculated from the CE Survey will be extremely inaccurate and vary widely from year to year. Further, the estimates remain largely unchanged if you keep households with three children or three and greater in the sample. The percentage of families that are single parents with more than three children is 0.8% of the population. The percentage of families that are two adults with more than three children is larger, but still only 4.1% of the

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<sup>21</sup> For the purposes of expense calculations, LISEP considers only three children for the fourth and eighth family type. But for the purpose of aggregation, LISEP weights the expenses of three children family types by the representative population proportions of families with three or more children.

population. Further, there always would need to be a cutoff to the number of families considered because LISEP wouldn't be able to consider every single family in the hypothetical allotments. So, if the cutoff was to be four children, only 0.5% more single-parent families and 2.7% more two-parent families are accounted for.

**Table 2: Family types used to calculate the cost of living and their corresponding proportion of the U.S. population from the American Community Survey (ACS)**

LISEP description	Proportion of total population
Single person	20.4%
Single parent one child	3.7%
Single parent two children	3.0%
Single parent three children	2.3%
Couple	28.3%
Couple one child	12.5%
Couple two children	17.1%
Couple three children	12.7%

## ii. Necessary Assumptions

These eight family types are used to establish the relative proportions of each family in the United States. But because there are specific necessary purchases for different ages, especially childcare, a “standard family” for each type is set. For families that are couples, LISEP has assumed that each couple is made up of two adults that are both 40 years old. For families made up of one couple and one child, it is assumed the couple is 40 years old and the child is 4 years old. For families of a couple and two children, the couple is 40 years old, and the children are 4 and 8 years old. For families consisting of a couple and three children, the couple is 40 years old, and the children are 4, 8, and 12 years old. For the families of a single parent and one child, the single parent is 40 years old, and the child is 4 years old. For families of a single parent and two children, the parent is 40 years old, and the children are 4 and 8 years old respectively. For the families of a single parent and three children, the parent is 40 years old, and

the children are 4, 8, and 12 years old. For the single adult, the person is 40 years old. This is summarized in Table 3.

**Table 3: An outline of the age structure of family types used in the calculation of cost of living**

Family Type	Age of Adult(s)	Age of Child(ren)
Single	40	
Single Parent with one child	40	4
Single Parent with two children	40	4, 8
Single Parent with three children	40	4, 8, 12
Couple	40, 40	
Couple with 2 children	40, 40	4, 8
Couple with 3 children	40, 40	4, 8, 12

An important feature is that these families are static, and these are the ages of their members for each year. LISEP is not trying to analyze these households' evolving costs throughout the period of interest. The goal of the exercise is to determine the change in the cost of these static needs every year of the period 2001-2020. Thus, any intertemporal saving/borrowing or any other time activity is null. Each year, LISEP reevaluates the costs of the household given that year's median income and starting from no assumptions about the previous year's saving or borrowing.

### iii. Implications of Necessary Assumptions

There are several implications for these age assumptions on the budgetary needs of each household. The first affected budgetary item is food. The average adult aged 40 consumes more calories than the average elderly adult. The same is true for the average male versus the average female. An older child also consumes more than a younger child. However, because the goal of this exercise is to determine the cost-of-living change for set family structures throughout time, these assumptions are not as crucial as if the main goal was to estimate the exact cost for a specific family. The number of calories needed by a 4-year-old child is the same in 2019 as it was in 2002. Where this will have a very slight impact, though, is on food price changes for a family. Because an older child will need more food than a younger child, if food prices increase, the family with an older child will face a larger budgetary strain. But LISEP argues that this is unimportant because the main goal of this exercise is to determine the change in the minimal needs for adequate living of a household throughout time. Because almost every household with an older child had to live through a point when the child was younger, the unequal effects of cost of living should cancel out throughout time. The converse is true for families with a younger child; they will most likely live through a time where they have an older child and need to meet the minimal needs for adequate living of that specific household composition. Thus, taking one set of ages and keeping them constant will provide an adequate metric for the change in cost of living no matter the age as long as the changes are relatively equal for each age group.

One exception, however, is sex. In a household made up of a same-sex, male couple, rather than a heterosexual couple, this “timing equalizer” will not come to fruition. Thus, for all periods of time, the family will have to meet a higher caloric need. This being said, the impact of this assumption regarding food should be negligible for three reasons. First, is that households



have been stratified into eight different categories, so the overall impact of a family type will not affect the aggregate to any extreme. Second, each family still must meet a food requirement, and the difference in each sex's needs for food is small when compared to the baseline need, no matter the sex. Last, because same-sex couples are relatively evenly split between same-sex, female and same-sex, male couples,<sup>22</sup> the impact of this assumption is negligible. The extra cost needed to feed a same-sex male couple will be exactly made up by the lower cost needed to feed a same-sex female couple.

The second affected budgetary item is medical care. The assumptions regarding the ages of adults and children in the household affect the amount of aid from the Affordable Care Act (ACA), which is carefully considered in a later robustness check.<sup>23</sup>

Next, there is the cost of childcare, which is affected by the assumption of the children's ages. LISEP has assumed that the cost of childcare stops influencing the family's budget at 12 years old. It is assumed that the 4-year-old is in all-day childcare and the 8-year-old is in before- and after-school care and full-time summer care. Childcare for the 12-year-old is not determined to be a minimal adequate need. For LISEP's purposes, it is assumed that at least two children (in each family type that has children) are in childcare, while the additional children are not. Again, the long-term effect of this assumption is negligible because most families that have children not in childcare needed at one time to pay for childcare.

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<sup>22</sup> (U.S. Census Bureau, 2021)

<sup>23</sup> Although the ACA forbids discrimination based on sex and age, there are still different premiums that are offered based on a person's age. Because we assume that the adult(s) in each family are 40 years old, this affects the health premium they will be offered, and the respective assistance offered by the ACA. Again, as the main thrust of this exercise is to determine the effect of changes in needs throughout time rather than precisely estimating the one-year need of a household, this will have a smaller effect on the deviation of the final estimates than if we were trying to present a precise budgetary amount. Furthermore, the amount paid for health insurance increases monotonically with age, but each age is based off the amount that is paid by a 21-year-old. Thus, assuming 40 years old will have no effect on the long-term price trend of medical care. The same can be said for any specific age if that age is held constant throughout the analysis.

## C. Aggregation

To come up with a final number for the overall TLC, there are several ways in which we could have aggregated the data. In an attempt to standardize, we use the most granular data possible before combining family types. We first take state level data for each family type and combine these into national costs by taking the total proportion of the nation that each family type for each state accounts for. For example, if Texas single parents with one child are 1% of the national population, then they will have 1% of an impact on the national number. We were able to do this for childcare, healthcare premiums and food costs. For the other costs (housing, transportation, healthcare out of pocket costs, dental costs, technology, and miscellaneous costs) we were able to do this same process, but only regionally.

We then combine the changes using the percent changes rather than the dollar value. This allows us to produce more robust estimates of percent changes in cost of basic necessities that aren't skewed by demographic changes, such as a relative rise of single and couple households without children over time, or household size since larger households have higher spending needs. Finally, we weigh the percent changes by the prevalence of the family type within the population to get the aggregated overall costs for each category as well as the total.

## Citations

Anderson, L., & Scherer, Z. (2021, April 1). *Larger Share of People in Same-Sex Couples Have Graduate or Professional Degrees Than People in Opposite-Sex Couples*. United States Census Bureau. Retrieved November 3, 2021, from <https://www.census.gov/library/stories/2021/04/how-people-in-same-sex-couples-compare-to-opposite-sex-couples.html>

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## II. Expenses

### A. Housing

#### i. Aim

LISEP aims to include the dollar amount needed for adequate housing by family size. Adequate is defined using the definition of adequate housing by the United Nations (UN)<sup>24</sup> It states that “for housing to be adequate, it must, at a minimum, meet the following criteria:

- Security of tenure: housing is not adequate if its occupants do not have a degree of tenure security which guarantees legal protection against forced evictions, harassment, and other threats.
- Availability of services, materials, facilities and infrastructure: housing is not adequate if its occupants do not have safe drinking water, adequate sanitation, energy for cooking, heating, lighting, food storage or refuse disposal.
- Affordability: housing is not adequate if its cost threatens or compromises the occupants’ enjoyment of other human rights.
- Habitability: housing is not adequate if it does not guarantee physical safety or provide adequate space, as well as protection against the cold, damp, heat, rain, wind, other threats to health and structural hazards.
- Accessibility: housing is not adequate if the specific needs of disadvantaged and marginalized groups are not taken into account.
- Location: housing is not adequate if it is cut off from employment opportunities, health-care services, schools, childcare centers and other social facilities, or if located in polluted or dangerous areas.

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<sup>24</sup> The UN provided an unbiased source that also had a very explicit definition for adequate housing. We thus could trust it and transparently compare its standards to our allocation. (Office of the United Nations High Commissioner for Human Rights & UN Habitat, 2009)

- Cultural adequacy: housing is not adequate if it does not respect and take into account the expression of cultural identity.”

Critically, our estimation of costs for minimal adequate housing excludes those who are homeless, those who do not have adequate housing, and those who have adequate housing but additionally pay for housing goods that provide supernumerary benefits.

## i. High-Level Methodology<sup>25</sup>

This level of housing is approximately equal to the Fair Market Rent (FMR) as determined by the U.S. Department of Housing and Urban Development (HUD). The HUD states that “the FMR for an area is the amount that a tenant would need to pay the gross rent (shelter rent plus utilities) of privately owned, decent, and safe rental housing of a modest (non- luxury) nature with suitable amenities.... In addition, all rents subsidized under the HCV program must meet reasonable rent standards.”<sup>26</sup>

By this definition, the FMR meets the first, second, fourth, and sixth criterion. The third criterion is met by nature of the FMRs being at the 40<sup>th</sup> percentile of housing prices, which is critical because affordability is at the heart of LISEP’s investigation. The fifth and the seventh are not assured by this definition. But, for housing to be offered in the United States, it must satisfy the requirements of the Fair Housing Act, which “prohibits this discrimination because of

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<sup>25</sup> We used similar methodology to the MIT Living Wage Calculator and the EPI Family Budget Calculator (cited in footnote 6 and 7). We varied in the fact that we excluded the fair market rents that were not the 40<sup>th</sup> percentile.

<sup>26</sup> (Regulations.gov, 2021)

race, color, national origin, religion, sex, familial status, and disability.”<sup>27</sup> Thus, the FMR definition meets the adequate housing definition by the UN.

Mathematically, the FMR is roughly equal to the 40<sup>th</sup> percentile price for a specific sized unit (based on number of bedrooms). For the specific family types, Table 1 details what level accommodations are attributed to their needs.<sup>28</sup>

**Table 1: Housing allocation for LISEP’s eight family types used in the calculation of cost of living<sup>30</sup>**

<b>Family Type</b>	<b>Housing Needed</b>
Couple	One Bedroom
Couple with One child	Two Bedroom
Couple with Two Children	Two Bedroom
Couple with Three children	Three Bedroom
Single	Studio/Efficiency
Single Parent with One child	Two Bedroom

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<sup>27</sup> (U.S. Department of Housing and Urban Development)

<sup>28</sup> A different way of approaching this would be to use the Affordable Housing Online database that helps to connect low-income Americans seeking housing with HUD sponsored programs throughout different areas. We do not use this approach because often these programs have income qualifiers in which median earners would not be eligible. Second, there are often waitlists for these programs, and being on a waitlist for housing does not satisfy the minimal adequate need benchmark.

<sup>30</sup> The Affordable Housing Online approach would allow children of different sexes to have different bedrooms once they are of an older age. But we chose not to use it because this is not the baseline for every single program, so it is inconsistent. Second, we are taking a conservative approach, and allowing for more bedrooms depending on the sex of child raises the cost of living while also unnecessarily complicating the family types.

Single Parent with Two Children	Two Bedroom
Single Parent with Three Children	Three Bedroom

## i. Data

LISEP used the Fair Market Rents data by county found on the website for HUD’s Office of Policy Development and Research (PD&R).<sup>31</sup> FMR is defined as “[T]he 40th percentile of gross rents for typical, non-substandard rental units occupied by recent movers in a local housing market.”<sup>32</sup> For each year, HUD publishes the county-level FMRs. For years 2001 and 2002, there are specific MSAs in which the HUD does not collect county data and only records that data at the MSA level. For these, we tracked the MSAs until 2003 and then connected the counties in the MSAs with the counties as they were listed in 2003. For state-level aggregation, the county intercensal population estimates on the Census Bureau website are used.<sup>33</sup> These provide population estimates year by year from 2001 to 2022.

## i. Specific Calculation

To calculate the specific FMR for each state, the average FMR weighted by county population is generated. For some counties, especially in earlier years, the recorded FMR was the 50<sup>th</sup> percentile of a given housing unit prices.

### a. Fair Market Rents of the 50<sup>th</sup> Percentile

An issue faced in constructing consistent housing cost estimates throughout time is that several counties and MSAs used the 50<sup>th</sup> percentile FMR for some years in the sample and then switched

to the traditional 40<sup>th</sup> percentile used by a vast majority of counties and years in the sample. This was especially prevalent in early years.

**Step 1:** To correct for this variation in these counties, we take the 40<sup>th</sup> percentile FMRs for all of the years in which there was data for the 40<sup>th</sup> percentile. For the years in which the 50<sup>th</sup> percentile FMR was recorded, we have the advantage of knowing the 50<sup>th</sup> percentile FMR in at least two consecutive years, which allows us to extrapolate linearly into the years in which data for the 40<sup>th</sup> percentile was recorded. We make the assumption that during these years, the 40<sup>th</sup> and 50<sup>th</sup> percentile FMRs moved in parallel to each other. We apply this linear trend of the 50<sup>th</sup> percentile rents to the locality for each year in which the 40th percentile was not available.

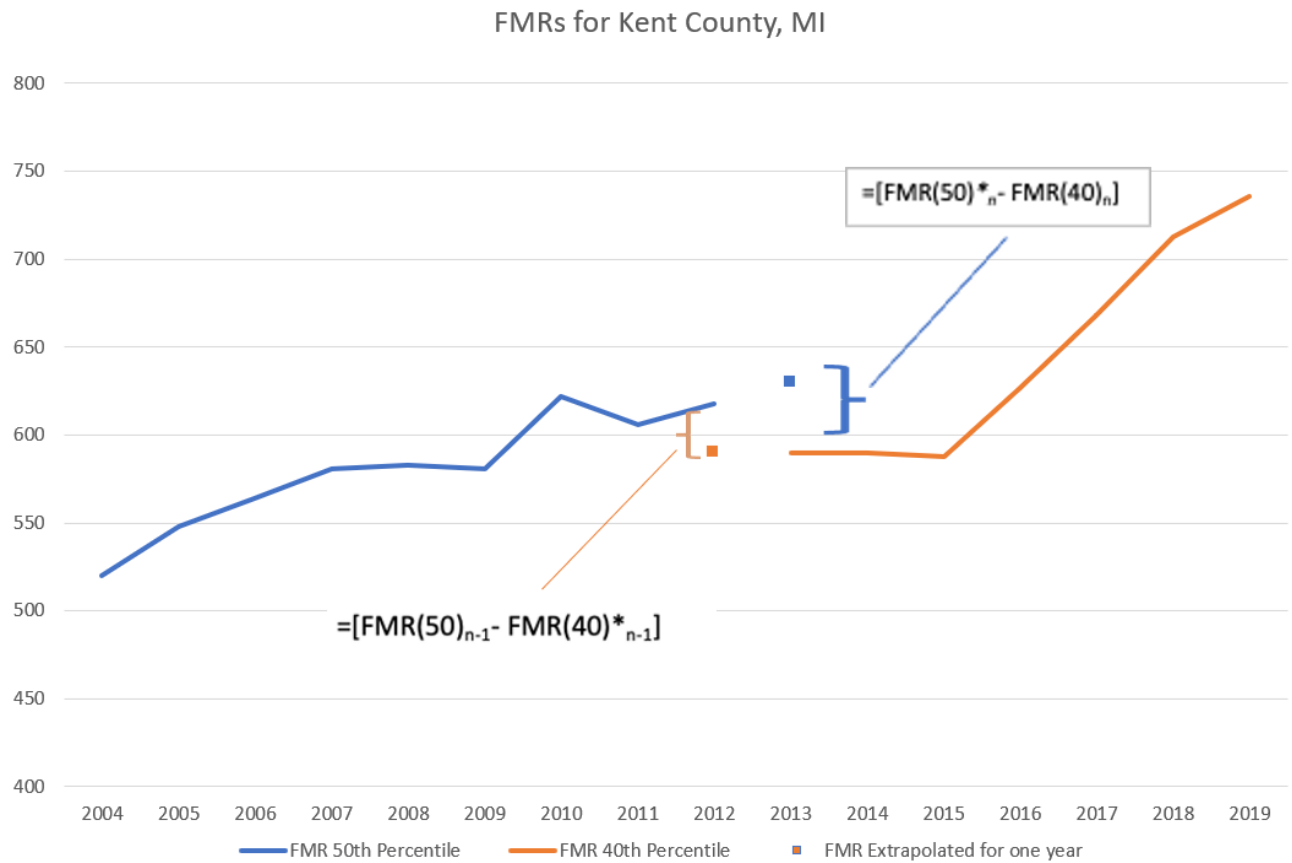
To illustrate this calculation, this is an example from Kent County Michigan which switched from 50th percentile FMRs to 40th percentile FMRs in 2013.

**Table 1: Homogenization of FMR estimates for Kent County, MI**

<b>Year</b>	<b>FMR 50th Percentile (step 1)</b>	<b>FMR 40th Percentile (step 1)</b>	<b>FMR Extrapolated one year (step 2)</b>
2004	520		
2005	548		
2006	564		
2007	581		
2008	583		
2009	581		



2010	622		
2011	606		
2012	618		590 (extrapolated from 40th trend)
2013		590	630 (extrapolated from 50th trend)
2014		590	
2015		588	
2016		627	
2017		668	
2018		713	
2019		736	



**Step 2:** Following the extrapolation, we are still confronted with the problem of not knowing the first point of our constructed time series. In other words, what is the difference between the 40th and 50th percentile FMR during the years in which we only have the 50th percentile? Mathematically, there are two options. For simplicity, we will call the first year in which 40<sup>th</sup> percentile rents were recorded year  $n$ . First, we could extrapolate the time trend of the 40<sup>th</sup> percentile FMRs created in year  $n$  and year  $n+1$  to year  $n-1$  and then adjust further back in time ( $n-2$ ,  $n-3$ , etc.) using the time trend of the 50<sup>th</sup> percentile rents as discussed above. This could be problematic if there was a shift in the FMR trend at year  $n-1$  or at year  $n$ . For example, if there was a peak at  $n-1$ , and we chose to linearly interpolate onto the year  $n-1$  using  $n$  and  $n+1$ , the assumed 40<sup>th</sup> percentile rent could be higher than the observed 50<sup>th</sup> percentile rent. For

example, suppose that the 50<sup>th</sup> percentile rent is \$500 for year  $n-2$ , \$600 for year  $n-1$ , \$500 for year  $n$  and \$300 for year  $n+1$ . This would cause the assumed rent at  $n-1$  to be \$700, higher than the observed 50<sup>th</sup> percentile FMR (\$600) which is illogical.

To avoid this, we take a combination of the trends before and after the switch in percentiles of FMRs. We extrapolated the 50<sup>th</sup> percentile rent trend onto year  $n$  and took the difference between  $(FMR(50)^*_n)$  and the observed 40<sup>th</sup> percentile FMR at year  $n$   $[FMR(40)_n]$ . We also took the difference between the extrapolated 40<sup>th</sup> percentile trend at year  $n-1$   $[FMR(40)^*_{n-1}]$  and the observed 50<sup>th</sup> percentile recorded FMR at year  $n-1$   $[FMR(50)_{n-1}]$ . We then calculated the average of this difference and subtracted it from the observed 50<sup>th</sup> percentile FMR for year  $n-1$ . We used this point as an anchor and then applied the linear trends of the 50<sup>th</sup> percentile FMRs to this anchoring point to obtain our theoretical 40<sup>th</sup> percentile FMRs so that we could have a consistent time series. In the example, the anchor point would be  $618 - [(630 - 590) + (618 - 590)] / 2 = 584$ .

Mathematically, the anchor point is defined as:

$$FMR_{\text{anchor}} = FMR(50)_{n-1} - [ [FMR(50)^*_n - FMR(40)_n] + [FMR(50)_{n-1} - FMR(40)^*_{n-1}] ] / 2$$

and the first point in the linear interpolation is:

$$FMR_{(n-1)} = FMR_{\text{anchor}} - (FMR(50)_{n-1} - FMR(50)_{n-2})$$

To aggregate the county FMRs to the regional level, we use a direct county to region aggregation to keep the MSA's intact since some MSAs cross state boundaries, but none cross regional boundaries.

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## B. Food

### i. Aim

LISEP sought to estimate the cost of food to meet a minimal adequate standard of living. For the definition of adequate diet, the definition of the Centers for Disease Control and Prevention

(CDC)<sup>29</sup> is used. In its Dietary Guidelines for Americans, 2020-2025,<sup>30</sup> the CDC lists the key components of a healthy diet:

- i. Emphasizes fruits, vegetables, whole grains, and fat-free or low-fat milk and milk products*
- ii. Includes a variety of protein foods such as seafood, lean meats and poultry, eggs, legumes (beans and peas), soy products, nuts, and seeds.*
- iii. Is low in saturated fats, trans fats, cholesterol, salt (sodium), and added sugars*
- iv. Stays within your daily caloric needs*

Because the minimal adequate need of food is being estimated, LISEP wants to assure that the family is meeting the CDC guidelines. Groups of people that do not meet minimal adequate needs are also identified. First, individuals who do not adequately meet nutritional needs. This could be those who are not eating a healthy diet, do not have access to fresh foods, or are malnourished.

Second, individuals who do not spend minimally. The point is not an organic, locally sourced, or any other type of special diet that might be more expensive. Third, dietary restrictions are not taken into consideration. Unfortunately, these are too varied to be able to adequately account for all of them; further, some are more cheaply and easily accounted for, whereas others are more expensive and more difficult to account for.

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<sup>29</sup> The CDC is recognized as a trustworthy source by academia and government. More information about CDC quality can be found on their website (<https://www.cdc.gov/os/quality/support/info-qual.htm>). They state that “CDC routinely seeks the input of highly qualified peer reviewers on the propriety, accuracy, completeness, and quality (including objectivity, utility, and integrity) of its materials.”

<sup>30</sup> (Centers for Disease Control and Prevention, 2021)

## ii. High-Level Methodology

LISEP utilized the cost of the Low-Cost Food Plan as defined by the U.S. Department of Agriculture (USDA).<sup>31</sup> Each month, the USDA publishes four different levels of food plans. These plans are the Thrifty, the Low-Cost, the Moderate, and the Liberal. For reference, SNAP benefits are given to match the complete cost of the Thrifty plan, while the basic allotment of all U.S. servicemembers is the Liberal plan.<sup>32</sup> The second-cheapest plan was selected, as the cheapest plan may require families to travel to cheaper grocers farther away, thus requiring more travel than LISEP is allotting in the transportation budget. Research shows that SNAP benefits, formulated around the Thrifty plan, leads recipients to compromise on nutrition, and leaves some recipients in need of frequenting food pantries.<sup>33</sup> The Low-Cost plan shows the monthly cost of eating for many different types of people based on age and sex. Data from Map the Meal Gap is used to determine regional differences in food prices. The average cost per meal for each region from 2009 to 2018 is compared and this proportional price difference between the different regions is applied to the Low-Cost plan. LISEP uses the average difference in the available years to adjust the years where there is no cost per meal available data by region. The final number is the necessary food expenditure to meet an adequate standard of living by family type.

This approach satisfies the requirements of minimal adequate needs of food. First, by design, the Low-Cost plan more than meets the less-stringent CDC nutrition guidelines. The USDA plans are designed to meet such standards. Those standards include “(1) the 1997-2005

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<sup>31</sup> (U.S. Department of Agriculture)

<sup>32</sup> (U.S. Department of Agriculture, 2007)

<sup>33</sup> U.S. Department of Agriculture, Food and Nutrition Service, Office of Research and Analysis, “SNAP Food Security In-Depth Interview Study,” by Kathryn Edin, Melody Boyd, James Mabli, Jim Ohls, Julie Worthington, Sara Greene, Nicholas Redel, Swetha Sridharan. Project Officer: Sarah Zapolsky, Alexandria, VA: March 2013.

Recommended Dietary Allowances (RDAs), Adequate Intakes (AIs), and Acceptable Macronutrient Distribution Ranges (AMDRs); (2) the 2005 Dietary Guidelines for Americans; and (3) the 2005 MyPyramid food intake recommendations.”<sup>34</sup> The first standard above outlines specific macro and micronutrient needs for each sex and age group. This would satisfy the *iii* and *iv* points of the CDC list. The second and third USDA standards outline how Americans can meet their daily nutritional needs, satisfying point *ii* of the CDC guidelines.

The Low-Cost plan also meets the *minimal* aspect of minimal adequate needs in that it only provides a budget for foods cooked at home. Unlike the Thrifty food plan, though, (which is the lowest-cost USDA plan), the Low-Cost plan allows for prepared foods, such as “boxed macaroni and cheese, frozen fruits and vegetables, prepared sauces, ready-to-eat breads and cereals, canned soups, chicken parts, canned dry beans, boxed mashed potatoes, and stove-top meals.”<sup>35</sup> Furthermore, the Low-Cost plan allows for 10% waste of foods. LISEP deems this a reasonable allotment for a budget-constricted family. Fresh foods expire, there will be accidental cooking mistakes, etc. Each successive plan increases the waste allotment by 10%. LISEP recognizes that this is a subjective judgment, so a robustness check is later conducted with the only other plan that is lower in cost, the Thrifty plan.<sup>36</sup>

### iii. Data

LISEP uses data from the USDA Center for Nutrition and Policy Promotion (CNPP) monthly Cost of Food reports. Each month the CNPP publishes the cost of food for the four different food plans: Thrifty, Low-Cost, Moderate, and Liberal. The food in each plan is set

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<sup>34</sup> (U.S. Department of Agriculture, Center for Nutrition Policy and Promotion, 2007).

<sup>35</sup> (U.S. Department of Agriculture, Center for Nutrition Policy and Promotion, 2007).

<sup>36</sup> See robustness checks at end of section

while the prices of the foods in the plan vary, thus giving different costs for the plans.<sup>37</sup> For reference, the U.S. Department of Defense uses the Liberal Food Plan, two steps above the one that we chose, to determine the food budget needed to subsidize servicemembers.<sup>38</sup> The cost for the plan is determined from the average monthly expenditures on food for those in the second quartile, and then are adjusted to assure that adequate nutrition is met. The nutrition profiles are based on three different sources. Further information can be found in the CNPP's *The Low-Cost, Moderate-Cost, and Liberal Food Plans*, 2007.<sup>39</sup>

To account for regional differences in food prices, data is used from Feeding America's Map the Meal Gap database.<sup>40</sup> Using data for prices of food that were collected by Nielson, the Map the Meal Gap database calculates the average meal cost for a food secure person at the county level.

#### iv. Specific Calculation

The annual cost of food included in each family type's budget is calculated using that specific year's June monthly report for the Low-Cost plan and then multiplying that cost by 12 to get the annual cost. For the couple without children, LISEP used the exact number listed for a male and female couple aged 19-50.<sup>41</sup> For the couple with one child, the respective amounts for a male aged 19-50, a female aged 19-50, and a child aged 2-3 (we are assuming that the child is aged 3) were used. The sex of the child does not impact food spending at all. LISEP multiplied this allotment by 1.05 to reflect the note in the USDA data that says: "The costs given are for

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<sup>37</sup> More detailed information on the specific foods included in the Low-Cost plan can be found here: [https://fns-prod.azureedge.net/sites/default/files/usda\\_food\\_plans\\_cost\\_of\\_food/FoodPlans2007AdminReport.pdf](https://fns-prod.azureedge.net/sites/default/files/usda_food_plans_cost_of_food/FoodPlans2007AdminReport.pdf).

<sup>38</sup> (U.S. Department of Agriculture, Center for Nutrition Policy and Promotion, 2007).

<sup>39</sup> (U.S. Department of Agriculture, Center for Nutrition Policy and Promotion, 2007).

<sup>40</sup> Feeding America is a leading researcher of hunger in America. They conduct research and advocacy around a variety of hunger related issues: <https://map.feedingamerica.org/>.

<sup>41</sup> See Section I, Part B.iii for impact of heterosexual assumption on the estimate.



individuals in 4-person families. For individuals in other size families, the following adjustments are suggested: 1-person—add 20 percent; 2-person—add 10 percent; 3-person—add 5 percent; 4-person—no adjustment; 5- or 6-person—subtract 5 percent.”<sup>42</sup>

The couple amount for the first family type is already adjusted in the given data. For the family of four, the respective amounts for a male aged 19-50, female aged 19-50, child aged 3-5, and a child aged 6-8 were used. No adjustment is needed for families of four. For the single parent with one child, the average of the male and female aged 19-50 was taken and the child aged 3 was added to this sum, then adjusted by 1.1. For the single parent with two children, the average cost given for a male and female aged 19-50 was taken and a child aged 1-3 and a child aged 6-8 were added. No adjustment was needed. Finally, for a single adult, the average cost of a male and a female aged 19-50 was taken and adjusted by a factor of 1.2. For the families with three or more children (whether a dual- or single-parent household), the amount used for the family of four was used again, with the addition of a child aged 9-11 and then multiplied this by 0.95 as the given adjustment factor. All of these values were multiplied by 12 to get the average annual budget needed for each family to meet the minimal standard for adequate living.

To adjust these final numbers by region, Map the Meal Gap data was used. LISEP first calculated the average cost of a meal by region each year and then the average cost of a meal for the nation as a whole. Using the available data from 2009 to 2019, we then calculated the proportion of a meal’s cost for each of the specific regions compared to the nation for the entire sample. Each year was adjusted by this proportion. For 2001-2008, where the Map the Meal Gap data is not available, LISEP uses the average proportion from 2009 to 2019 to adjust the food cost regionally.

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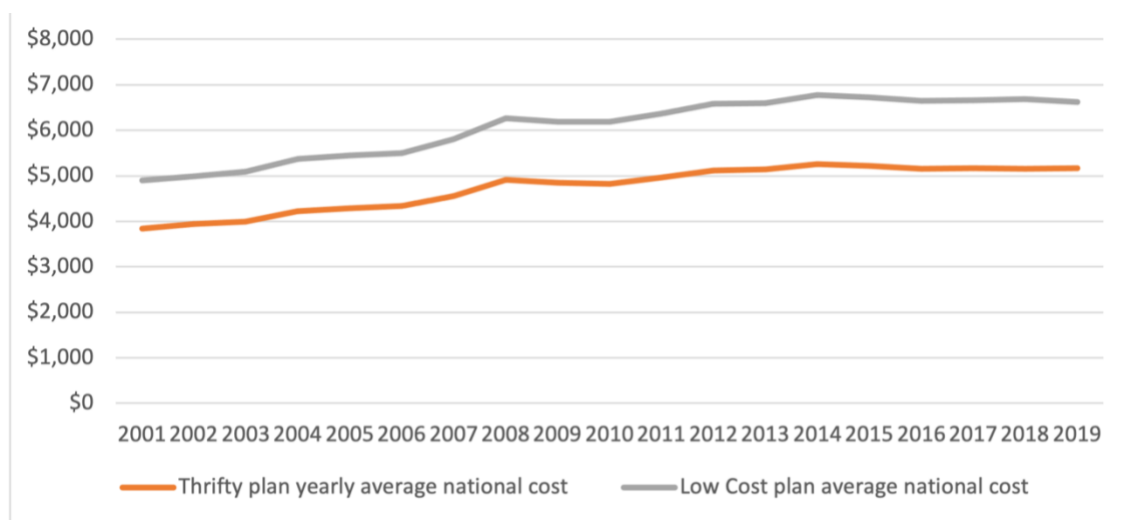
<sup>42</sup> (U.S. Department of Agriculture, 2012)

## v. Robustness

LISEP compared the annualized food budget using the Low-Cost plan with the food budget using the Thrifty plan. To do this, the food cost is taken from the Thrifty report in June of a given year and then tracked throughout time for each of the representative family types. Thus, it is the same method used above for the regular index except with the Thrifty plan. We also did not adjust this using the Map the Meal Gap data because the adjustment would be the same for both the Low-Cost and the Thrifty plans.

Throughout the period, the Thrifty plan increased by 34.7% while the Low-Cost plan increased by 35.1%. The graph below compares these plans. Thus, the change in the Thrifty plan is 0.988 of the change in the Low-Cost plan. This difference is not statistically significant and thus our approach is robust.

**Figure 1: Thrifty versus Low-Cost Food Plan annual prices**



Source: Authors' calculations. Data source: USDA Food Plans: Cost of Food Reports (monthly reports) | Food and Nutrition Service. (n.d.). U.S. Department of Agriculture. <https://www.fns.usda.gov/cnpp/usda-food-plans-cost-food-reports-monthly-reports>

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## C. Transportation

### i. Aim

We aim to estimate a minimal adequate level of transportation that enables a median-wage worker to live a lifestyle that allows for a full-time job, access to childcare, and to purchase all needed food from the grocery store. LISEP argues that having a car in today's United States is not a luxury in most circumstances, and if a car is a necessity, those living in the middle class will purchase one. There is ample research evidence showing that public transportation is inadequate for many populations in the US, both based on ability and geography.

First, research has established that time scarcity means less time to follow a nutritious

diet, exercise, and build relationships.<sup>43</sup> Second, time constraints significantly worsen mental health, leading to lower levels of subjective well-being. Researchers have found that “[p]ublic transport users tend to be less happy with their commute than pedestrians, cyclists and car users” because of long waiting time, infrequent departure times and inefficient routes.<sup>44</sup> Third, parents with inflexible schedules who commute for long hours are significantly less likely to find adequate childcare options for their children, which can have serious developmental consequences. Regarding childcare arrangements, the Urban Institute established that “[w]hen weighing their options, most parents take into account the location, cost, quality, and availability or schedule of the provider, [and] their own employment schedules.”<sup>45</sup> To avoid a paternalistic bend, we assume that households make productive decisions about their need for a car. Thus, we take the middle of the US income distribution by household (25<sup>th</sup> to 75<sup>th</sup> percentile) and allow households a car based on the proportion of households that buy a car in that specific family type.

## ii. High-Level Methodology

We determined the ratio of private transportation by the prevalence of vehicles<sup>46</sup> in the middle of the income distribution. We then supplemented this cost with the cost of buying a used car; that is, we added the fractional cost of buying a used car (fractional because one does not need to buy a car each year) to the cost of owning a car. For those who used public

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<sup>43</sup> (Strazdins, L., Griffin, A. L., Broom, D. H., Banwell, C., Korda, R., Dixon, J., Paolucci, F., & Glover, J., 2011).

<sup>44</sup> (Lunke, E. B., 2020).

<sup>45</sup> (Sandstrom, H., Giesen, L., & Chaudry, A., 2012)

<sup>46</sup> Defined to be a car, van, truck, or motorcycle.

transportation to get to work, we added the cost of public transportation to their budget. This is because they still own a car for other means, and the costs of this ownership do not decrease based on the household's prevalence to drive to work. We did not allocate any transportation costs to children, given that we are not accounting for any recreation expenses. Thus, children are assumed to use free, district-provided transportation to get to school.

## 1) Data

### A. Regional proportions of transit mode used

We used the ACS, to estimate the number of cars in a household as well as the household's place in the income distribution. The number of cars is coded under the variable *veh* and the income variable we used was personal income aggregated within the household, so the sum of all *pincp* in the household to get the households income.

### B. Cost of car ownership

We used the data provided by the American Automobile Association (AAA) for the cost of owning a car by year. This data is published by the Bureau of Transportation Statistics (BTS).<sup>47</sup> We modified this data slightly to adjust for the fact that older cars need more maintenance, and thus the cost of maintenance correlates with mileage.<sup>48,49</sup> We use the data provided by Yourmechanic.com,<sup>50</sup> an online service that connects car owners and mechanics, to adjust the price of maintenance for cars that have more mileage. Yourmechanic.com has information on all the maintenance that has been done on its website, and from this, has constructed a dataset of over 600,000 data points of real-life car service, thus providing a robust

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<sup>47</sup> (Wheel, 2016)

<sup>48</sup>(Popular Mechanics, 2016)

<sup>49</sup>(Consumer Reports, 2021)

<sup>50</sup> (Your Mechanic, 2016)

sample.

This adjustment is necessary because the AAA cost of owning a car by year assumes that the car is new and has less than 75,000 miles. LISEP assumes that the car is used and has between 50,000 and 100,000 miles.

To calculate the cost of buying a used car, data from CarGurus “Used Car Price Trends” was used.<sup>51</sup> CarGurus data is only used to get the price level for a used car at the current moment (August 2021). To extend this price further back, the TA02 Elementary Level Index (ELI)<sup>52</sup> from the Bureau of Labor Statistics Consumer Price Index (CPI) was used, which is the index for used cars and trucks published monthly to track used car inflation.<sup>53</sup> LISEP adjusted the prices of used cars back until 2001.

## **C. Cost of public transit**

LISEP used the data provided by the BTS on the average cost of public transportation throughout time to estimate the cost of riding public transit to work.<sup>54</sup>

### **iii. Specific Calculation**

To calculate the yearly cost of owning a vehicle, we assumed that people would drive 10,000 miles a year.<sup>55</sup> LISEP first adjusted the BTS data, which assumes a car has less than 75,000 miles and is new. The Yourmechanic.com data gives the average cost of maintenance for cars for each 25,000 miles of the car’s life. Using the average cost of maintenance for cars with

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<sup>51</sup> (CarGurus: Used Cars)

<sup>52</sup> (Bureau of Labor Statistics)

<sup>53</sup> (Bureau of Labor Statistics)

<sup>54</sup> (Bureau of Transportation Statistics)

<sup>55</sup> The average car owner drives between 10 and 15 thousand miles per year. If we are not allowing for recreation or leisure activities, then we are assuming less than the average. In 2018 it was 13,476 miles per year (Bureau of Transportation Statistics: Federal Highway Administration)

mileage from 50,000 – 100,000 miles (the LISEP car's lifetime) and comparing that with 0-75,000 miles (the lifetime of the car that AAA [used by BTS] uses to estimate its costs), LISEP found that its car has approximately 1.75 times higher maintenance costs than the BTS's assumed car. We thus adjust the BTS-provided maintenance costs by this factor.

Moreover, the BTS car ownership cost data assumes that a car is driven 15,000 miles annually. LISEP reasons that this mileage includes driving for recreation purposes and driving children to school occasionally. Since LISEP is concerned with the minimal adequate need for transportation, the assumption that the median-wage worker drives 10,000 miles annually is maintained, which is the lower end of the mileage for which AAA calculates driving costs.<sup>56</sup> LISEP reasons that if AAA considers this to be the minimum mileage an American could drive, then this is probably the minimum mileage required to satisfy basic needs. Thus, to estimate the cost of owning a vehicle, LISEP uses the fixed costs of owning a car from the BTS in addition to 2/3 of the variable costs.<sup>57</sup> Since the choice of 10,000 miles annually might seem arbitrary, a robustness check is conducted later assuming 15,000 miles annually and assess the comparability of the results.

For the cost of buying a car, LISEP assumes that purchasing a used car when one's car is

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<sup>56</sup> (American Automobile Association, 2020)

<sup>57</sup> This is the note from the BTS on the changes in the calculations of the fixed cost: Prior to 1985, the cost figures are for a mid-sized, current model, American car equipped with a variety of standard and optional accessories. After 1985, the cost figures represent a composite of three current model American cars. The 2004 fuel costs are based on average late-2003 U.S. prices from AAA's Fuel Gauge Report: [www.fuelgaugereport.com](http://www.fuelgaugereport.com). Insurance figures are based on a full-coverage policy for a married 47-year-old male with a good driving record living in a small city and commuting three to 10 miles daily to work. The policy includes \$100,000/\$300,000 level coverage with a \$500 deductible for collision coverage and a \$100 deductible for comprehensive coverage. Depreciation costs are based on the difference between new-vehicle purchase price and its estimated trade-in-value at the end of five years.

AAA's analysis covers vehicles equipped with standard and optional accessories including automatic transmission, air conditioning, power steering, power disc brakes, AM/FM stereo, driver- and passenger-side air bags, anti-lock brakes, cruise control, tilt steering wheel, tinted glass, emissions equipment, and rear-window defogger.

obsolete is an adequate minimal need. J.D. Power established that for a used car to service its owner well and be worth its cost, it should be no more than five years old with mileage of 50,000. Given this, we use CarGurus data and average the price of four mid-size affordable cars for 2021. These cars are the Honda Accord, Toyota Camry, Ford Fusion, and Chevy Malibu. All of these cars are very popular (and thus easy to find used versions of them),<sup>58</sup> affordable, and approximately the same size. The Honda Accord and the Toyota Camry are among the best-selling cars in the U.S. for 2001-2020.<sup>59</sup> The Ford Fusion and the Chevrolet Malibu are comparable models from two very popular American car manufacturers. LISEP included the latter two to give the median-wage worker choice while remaining within the affordability criteria. LISEP uses the cost of all these cars given the base model from 2013 with 50,000 miles. Using this composite average, the price is adjusted back to 2001 with the used cars and trucks CPI. A car replacement rate of 10 years is assumed. As discussed before, a used car is assigned 50,000 miles. J.D Power asserts that the maximum lifespan of a car is when it carries a mileage of 150,000-200,000.<sup>60</sup> Since J.D. Power deems that 200,000 miles is “a threshold where even modern cars begin to succumb to the years of wear and tear,” we consider 150,000 miles to be the lifespan of a car. This means a person needs to put 100,000 on the used car, which takes 10 years given our assumption of driving 10,000 miles annually. Since a replacement (used) car is needed every 10 years, we added  $1/10^{\text{th}}$  of this cost to each person who uses a car to drive to work to smooth the cost over time. LISEP later conducts a robustness check assuming a car lifetime of 100,000 miles and then a lifetime of 200,000 miles, with an annual driving rate of

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<sup>58</sup> (MotorTrend, 2014)

<sup>59</sup> (The Zebra)

<sup>60</sup> (J.D. Power, 2021)



10,000 and 15,000 miles, respectively, as per the previous robustness check. These lifespans take into account that the car is not new and already comes with 50,000 miles.

To determine each household's number of cars and their necessary costs to apply to our basket, we first break the distribution into family types. We then take the middle 50% of each family type, from 25 to 75<sup>th</sup> percentiles as our sample. For each household within the sample, we cap the cars in the households by the number of adults in the family type, either 1 for family type 1-4 or 2 for family type 5-8. We then take the average of each family type to get the average number of cars for each family type and we allocate this value and its applicable costs to the basket.

If the person takes public transportation to work, the public transit cost from the BTS is added to his or her budget. Because we assume so little driving in the first place, we keep the 10,000 mile per year assumption even for those commuters who use public transit.

#### iv. Robustness

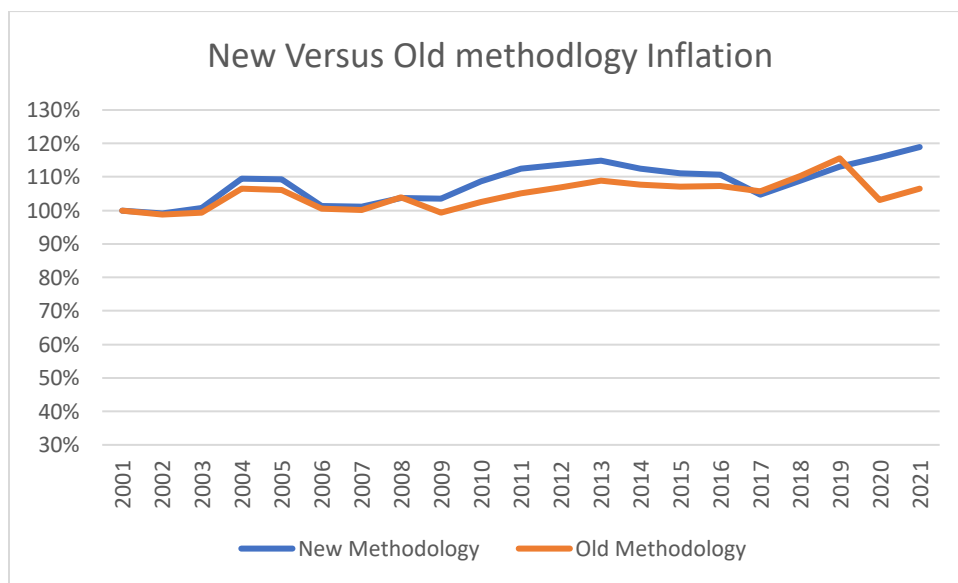
Here, a robustness check is conducted assuming that LISEP's median-wage worker drives 15,000 miles. The difference is shown between LISEP's assumption, and the annual miles driven assumed by the BTS data. One could fear that if maintenance or fuel costs were particularly high at a certain point in time, for example, then the changed mileage assumption would cause a particular increase in costs that is statistically significantly different from the trend based on a different mileage assumption. The year-over-year percentage change trend is greatly similar across the two assumptions for each of the four regions (see figures 2A-2D). Thus, LISEP concludes that the annual miles driven assumption does not alter trends in the data and that the transportation costs are robust. Addendum: these robustness checks are done on the same underlying assumptions as the 2023 method and thus show the same trends that year over year

changes do not statistically change with more mileage.

### Addendum 2023 Edition:

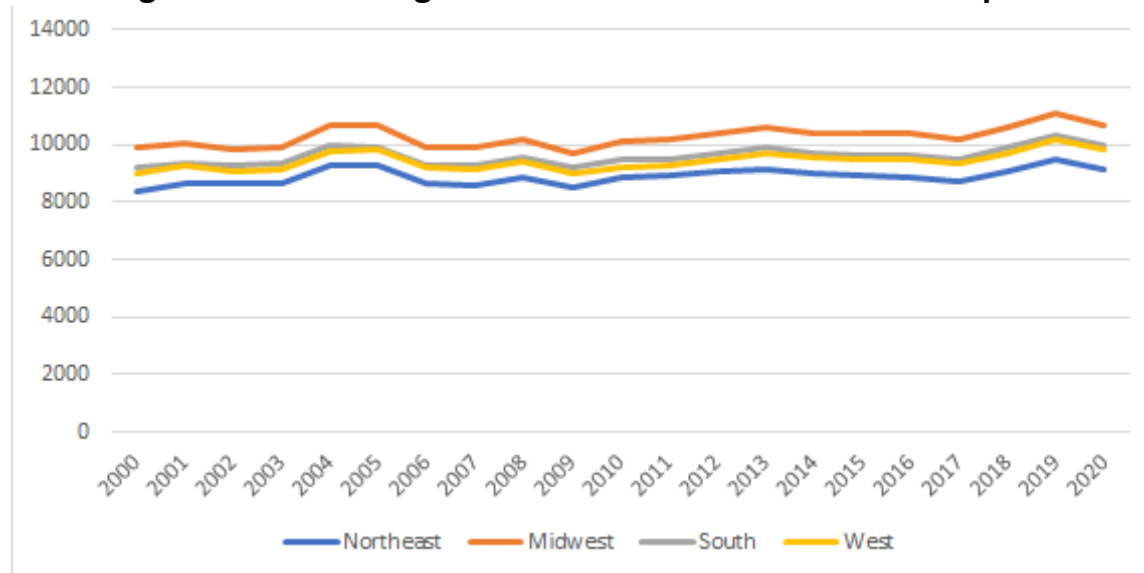
Here we compare the Transportation cost aggregate from the old method to the transportation costs versus the new method using a year over year percentage change. We track this in figure 1 below. We can see here that these costs are more stable in the new method over time, which makes sense in a family that cannot immediately cut down on spending for a car that they already own and utilize. Furthermore, the price changes of our basket align better with a basket of average spending on used cars, gas and insurance in the bottom 30 quantiles in the Consumer Expenditure survey. Our new method correlates with this spending at a .68 whereas the old method correlated at .56. , but better reflect actual spending on cars and transportation costs as reported in the CE.

**Figure 1) Comparison of Price changes with old and new method**

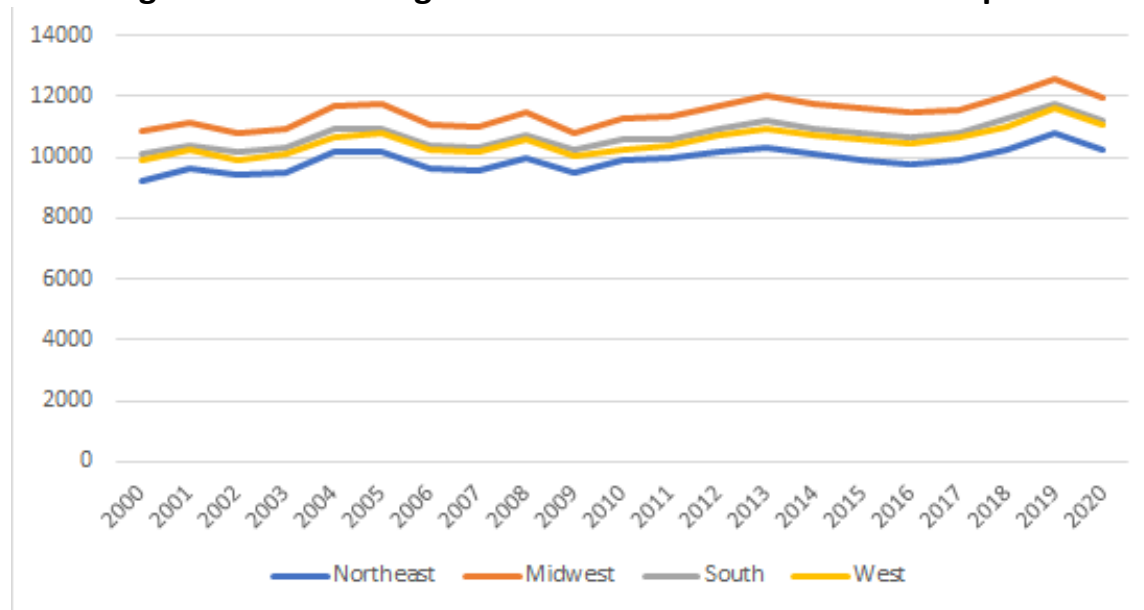




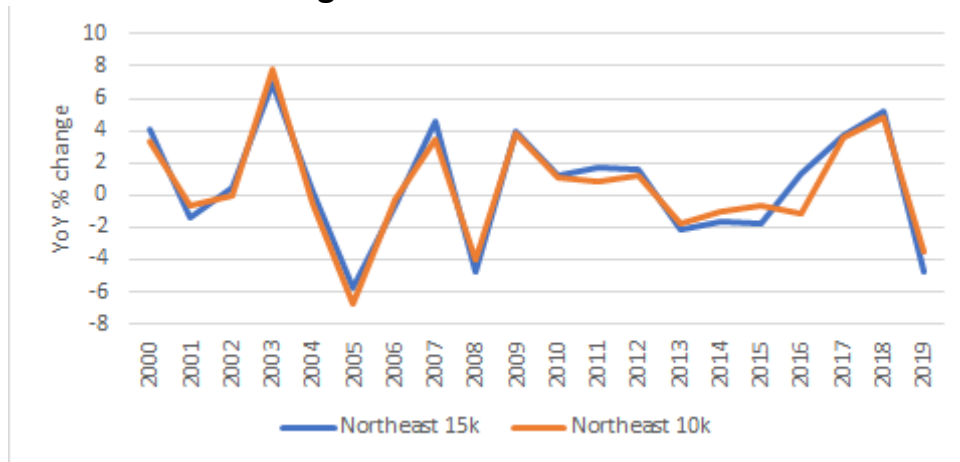
**Figure 2A: Annual transportation costs by region weighted by family-type proportions assuming an annual driving rate of 10k miles for the car owner portion of the population**



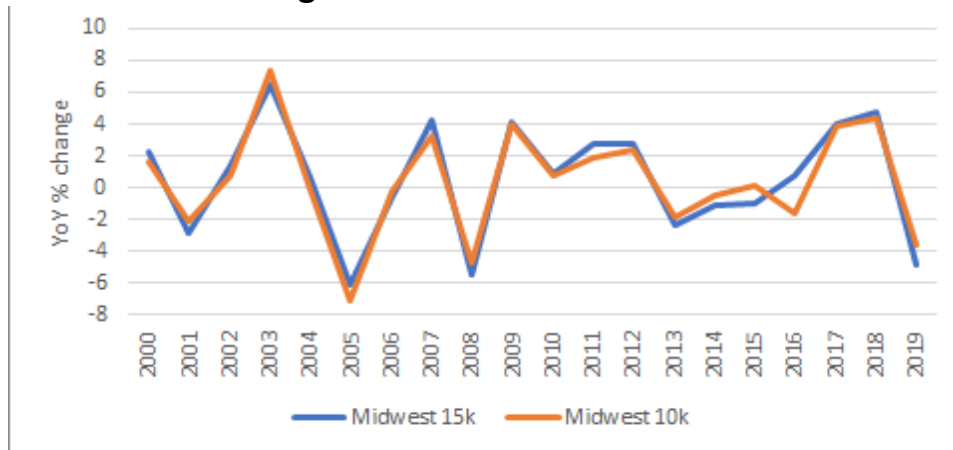
**Figure 2B: Annual transportation costs by region weighted by family-type proportions assuming an annual driving rate of 15k miles for the car owner portion of the population**



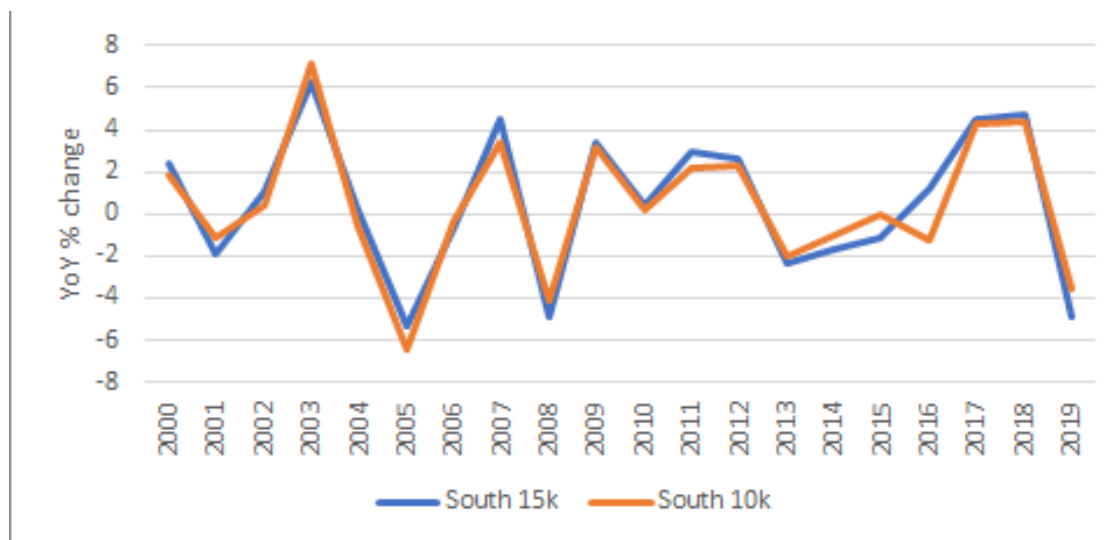
**Figure 3A: Year-over-year percentage change in family-type- weighted transportation costs for the Northeast region**



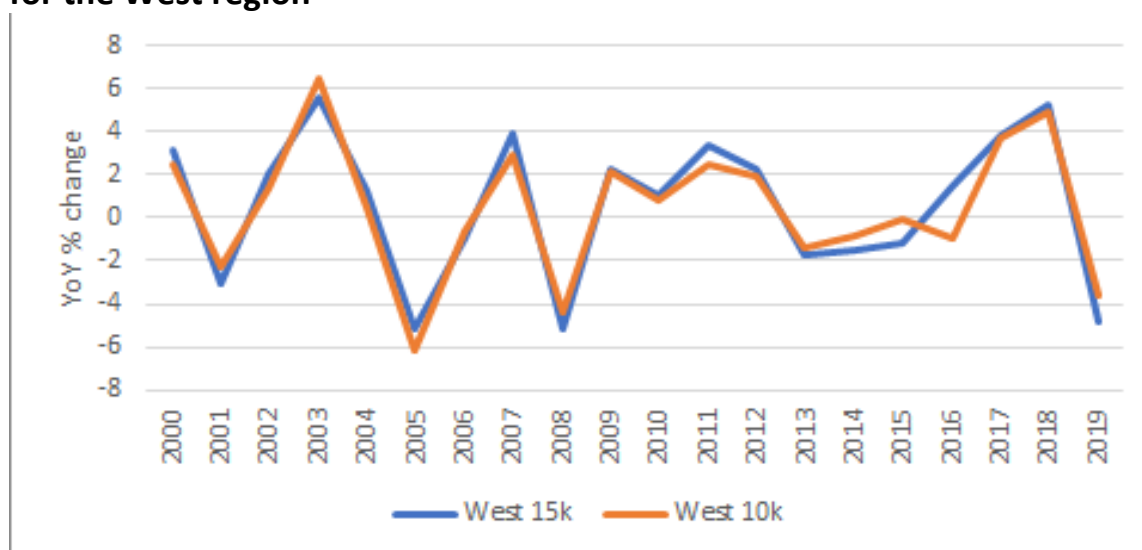
**Figure 3B: Year-over-year percentage change in family-type- weighted transportation costs for the Midwest region**



**Figure 3C: Year-over-year percentage change in family-type- weighted transportation costs for the South region**



**Figure 3D: Year-over-year percentage change in family-type- weighted transportation costs for the West region**



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## D.Healthcare<sup>61</sup>

### i. Aim

LISEP's aim for healthcare is to provide adequate healthcare both through insurance and out-of-pocket expenses. Adequate healthcare is defined as not being underinsured. LISEP is interested in working families that are socioeconomically in the general middle class. Taking this into consideration, the healthcare allocation should not leave these people underinsured and without adequate health coverage.

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<sup>61</sup> The MEPS microdata that we use to estimate out-of-pocket expenses has not yet been released for the 2020 year. Because of this, we linearly interpolate the data from the 2018 to 2019 cost trend. We will adjust this to be 100% accurate when the MEPS microdata is made available.



The definition provided by the Commonwealth Fund defines “underinsured”. The Commonwealth fund is an unbiased source that promotes independent research. Furthermore, it provides explicit definitions of the meaning of underinsured, a useful and transparent comparison tool for the TLC Index.<sup>62</sup> The Commonwealth Fund defines someone as underinsured if:

*1) their out-of-pocket costs, excluding premiums, over the prior 12 months are equal to 10 percent or more of household income; or*

*2) their out-of-pocket costs, excluding premiums, over the prior 12 months are equal to 5 percent or more of household income for individuals living under 200 percent of the federal poverty level; or*

*3) their deductible constitutes 5 percent or more of household income.*

It is important to note who is excluded from the TLC Index. LISEP does not intend to capture the medical expenses of those who have government-subsidized insurance. The qualifications for the Affordable Care Act (ACA) are that a household must be 400% above the poverty level and not have access to employer-provided insurance. Because LISEP is most focused on people with approximately median-wage, full-time jobs, employer healthcare is allocated to the families included in the TLC index, a decision explained in more depth later. LISEP also does not include those who have extremely comprehensive private insurance, as this would not meet the “minimal” qualification. LISEP is much more focused on the working-class American family facing stricter budgetary limitations than those who can afford very comprehensive private

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<sup>62</sup> (Collins, Aboulafia, Gunja 2020)

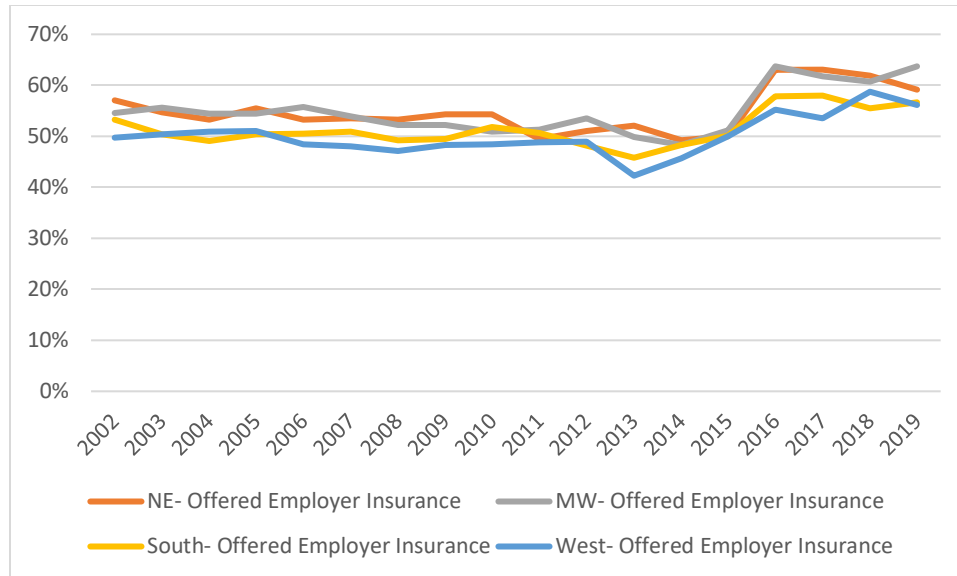
insurance. Lastly, we are not including the uninsured, nor underinsured, as they do not meet the “adequate” criteria of minimal adequate needs.

## ii. High-Level Methodology

LISEP assumes that each family has access to employer-sponsored health insurance. This assumption provides an extremely conservative estimate of costs for an insured family. Without this assumption, the family would be responsible for covering the entirety of a healthcare premium. We made this choice because American Community Survey (ACS) data shows that roughly 67% of people who work for wages were on employer-provided health insurance in 2019. Going back from this year, the percentage remains relatively level and was 68.4% in 2008 when the ACS first started to record this question. We confirm these results with a different data source, the Medical Expenditure Panel Survey (MEPS) data, for robustness.

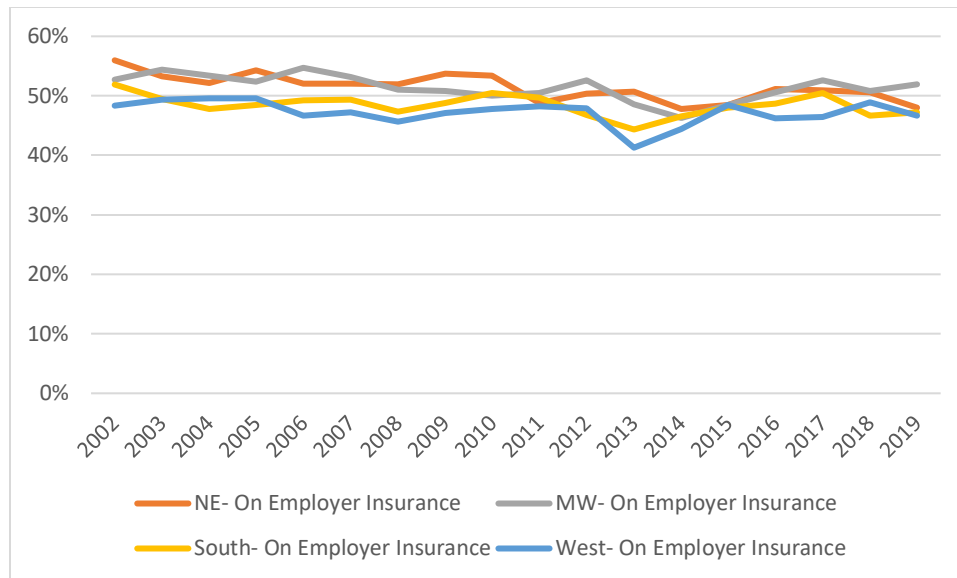
To make sure that LISEP is examining workers similar to those at the median wage, the percentage of workers in the 25<sup>th</sup> to 75<sup>th</sup> percentile wage range with employer-provided health insurance is calculated. The next two graphs show the percentage of workers offered employee healthcare and the percentage of employees currently on employer-provided health care respectively.

Figure 1A: Employer Insurance Offer Rates for Workers in the 25th-75th Percentile Wage Range by Census Region



Source: Agency for Healthcare Research and Quality (AHRQ). (n.d.). *Household Component Consolidated Files* [Unpublished raw data]. Medical Expenditure Panel Survey. <https://meps.ahrq.gov/me>

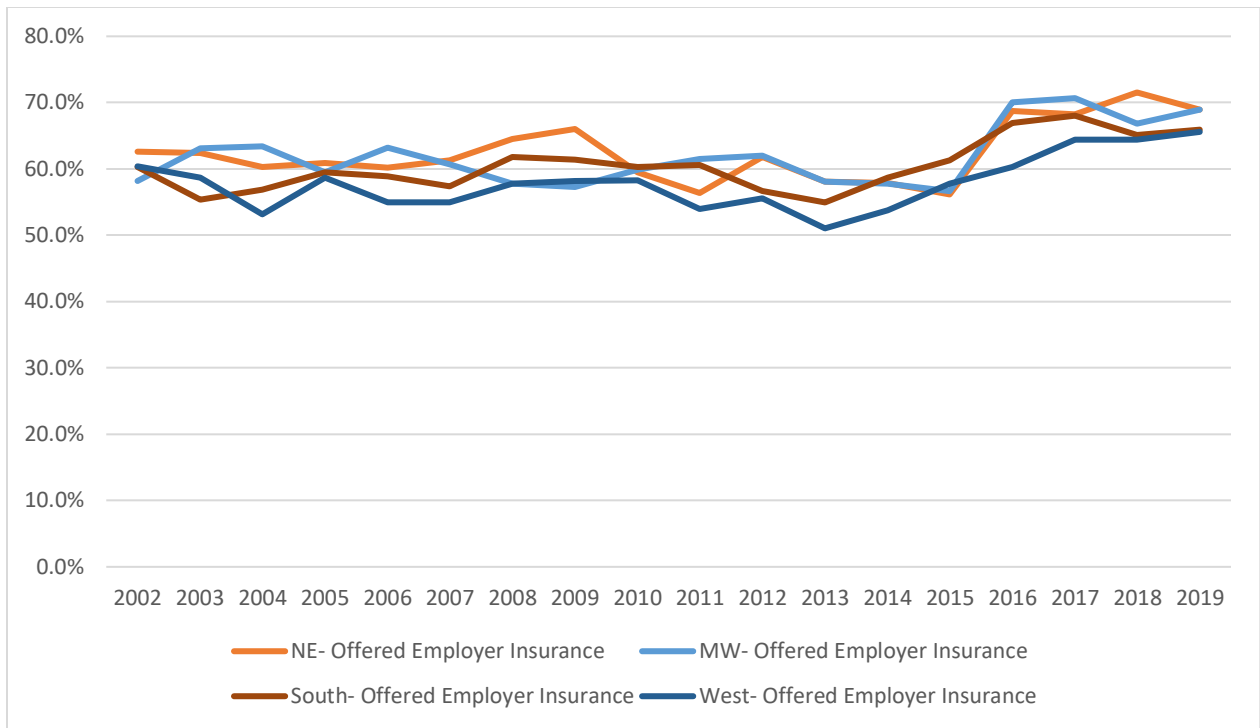
Figure 1B: Percentage of Workers on Employer-Provided Insurance in the 25th-75th Percentile Wage Range by Census Region



Source: Agency for Healthcare Research and Quality (AHRQ). (n.d.). *Household Component Consolidated Files* [Unpublished raw data]. Medical Expenditure Panel Survey. <https://meps.ahrq.gov/me>

Further filtering the data to include only those who are in the 40<sup>th</sup> to 60<sup>th</sup> percentile wage range to make sure that we are looking at workers similar to those at the median wage, we find similar results. Below is a graph of the percentage of workers in the 40<sup>th</sup> to 60<sup>th</sup> percentile wage range on employer-provided health insurance.

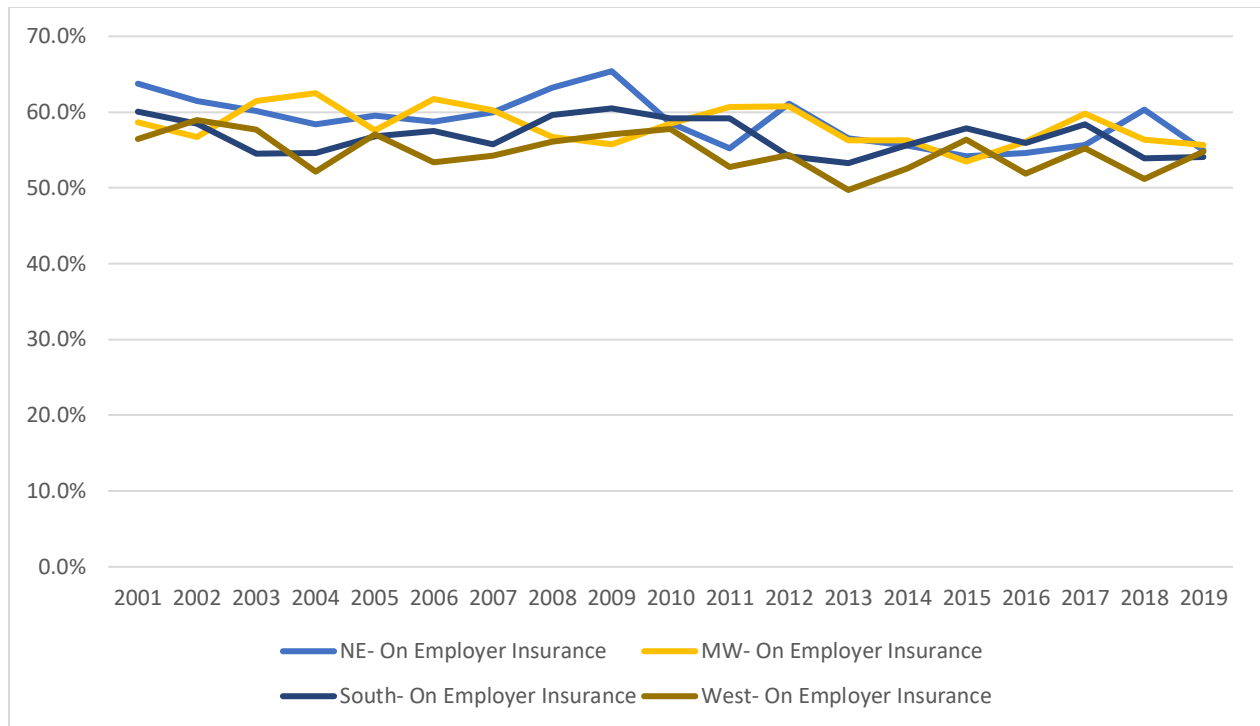
Figure 2A: Employer Insurance Offer Rates for Workers in the 40th-60th Percentile Wage Range by Census Region



Source: Agency for Healthcare Research and Quality (AHRQ). (n.d.). *Household Component Consolidated Files* [Unpublished raw data]. Medical Expenditure Panel Survey. <https://meps.ahrq.gov/me>

Furthermore, the next graph shows the number of workers in the 40<sup>th</sup> to 60<sup>th</sup> percentile with employer-provided health care.

Figure 2B: Percentage of Workers on Employer Insurance in the 40th-60th Percentile Wage Range by Census Region



Source: Agency for Healthcare Research and Quality (AHRQ). (n.d.). *Household Component Consolidated Files* [Unpublished raw data]. Medical Expenditure Panel Survey. <https://meps.ahrq.gov/me>

These graphs provide support for our decision to allocate employer-provided healthcare to workers. They show that the median worker, not just the average worker, has a high offer rate for employer insurance. Further, this rate is generally similar across the distribution (at least from the 25<sup>th</sup> percentile upwards). Last, 99% of large firms and 97% of small firms that provide health insurance for their employees extend that possible coverage to families.<sup>63</sup> These facts support our decision to allocate employer-provided healthcare to families in the TLC Index under the assumption that both workers are median-wage, full-time employees. Figure 2A shows that roughly 60% of workers are offered employee healthcare. This means that for dual-income earners, there is a 16% chance that neither are offered healthcare. For single earners there is a

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<sup>63</sup> (Claxton et al. 2018)

40% chance. This chance remains relatively steady throughout the sample and by region, so we do not think that attempting to implement an adjustment by year for changes in the offer would provide any significant insights.<sup>64</sup> Moreover, this is likely an underestimation for full-time employees, who are much more likely to receive healthcare than their part-time counterparts.<sup>65</sup> Thus, we take the more conservative approach and assume that employer-provided healthcare is a reality. Because of this, they are ineligible for the ACA subsidy.<sup>66</sup>

Because LISEP assumes that the members of the household are covered under employer-provided healthcare, the only costs for which the employee is responsible for is the employee contribution and the out-of-pocket expenditures after the premium is paid. These two costs are assigned to the family based on the household size using the corresponding relevant statistics provided by the MEPS. Moreover, tax subsidies don't have to be adjusted for because the family is not eligible for ACA tax subsidies. A robustness check is conducted with the other assumption in the appendix.

For out-of-pocket costs, the out-of-pocket expenses are used for workers on employer-provided health insurance from the 25<sup>th</sup> to 75<sup>th</sup> percentile of wage earners. LISEP viewed it as unfair to look at the out-of-pocket expenses for a different set of the population that might not have the insurance level that we are also using for premiums. The exact median isn't used, rather

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<sup>64</sup> Trying to adjust this would also be problematic. Unfortunately, workers who are likely to lose their health benefits are lower-wage workers, thus using the proportion of total workers with employer-based insurance is not an accurate indicator of the insurance status of the median worker. For example, if 90% of the workforce has employer-provided insurance in 2000 and then 80% of the workforce has employer-provided insurance in 2001, for us to be able to use this information to adjust the predictability of the median worker having employee-provided insurance, 5% of the decline would have to have come from the bottom half of wage earners and 5% from the top half of wage earners. This is unlikely to be true in practice. More likely is that the bottom half of the earners lost access to employer-provided healthcare in a disproportionately large amount. Thus, using the total percentage of the workforce as an indicator for the likelihood of the median worker is inaccurate. So, we are left with the binary choice – employer-provided healthcare or not, and we chose the former.

<sup>65</sup> (Bureau of Labor Statistics – Employee Benefits Survey 2021)

<sup>66</sup> This is only untrue if the contribution for employer-provided insurance exceeds roughly 9.5% of their income, which is highly unlikely.

just this range, because tracking the exact median earner would give us a non-robust sample of a single person. A different level of out-of-pocket costs is added for children, but with the condition that they live in a household that has the previously mentioned level of health insurance and income.

Having described the allocation and the justification for this allocation, LISEP ultimately needed to validate that it meets the minimal adequate needs standard; thus, the families in the index cannot be underinsured. Combining the first and second criterion, out-of-pocket spending cannot be more than 10% of the median household income, or 5% of median income if the family is below 200% of the poverty line. For all the years, seven out of eight of the family types are outside of the 200% of the federal poverty guideline if each adult makes the median earnings as provided by the BLS's Usual Weekly Earnings report.<sup>67</sup> The one family type that does not meet this is a single parent with three children. This family type is generally about 175% of the poverty line. The graphs below show the out-of-pocket expenses as a percent of household income for each family type sorted by region.

Figure 4A: Northeast Out-of-Pocket expenses as a percent of household income by family type

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<sup>67</sup> (Bureau of Labor Statistics – Current Population Survey 2021)



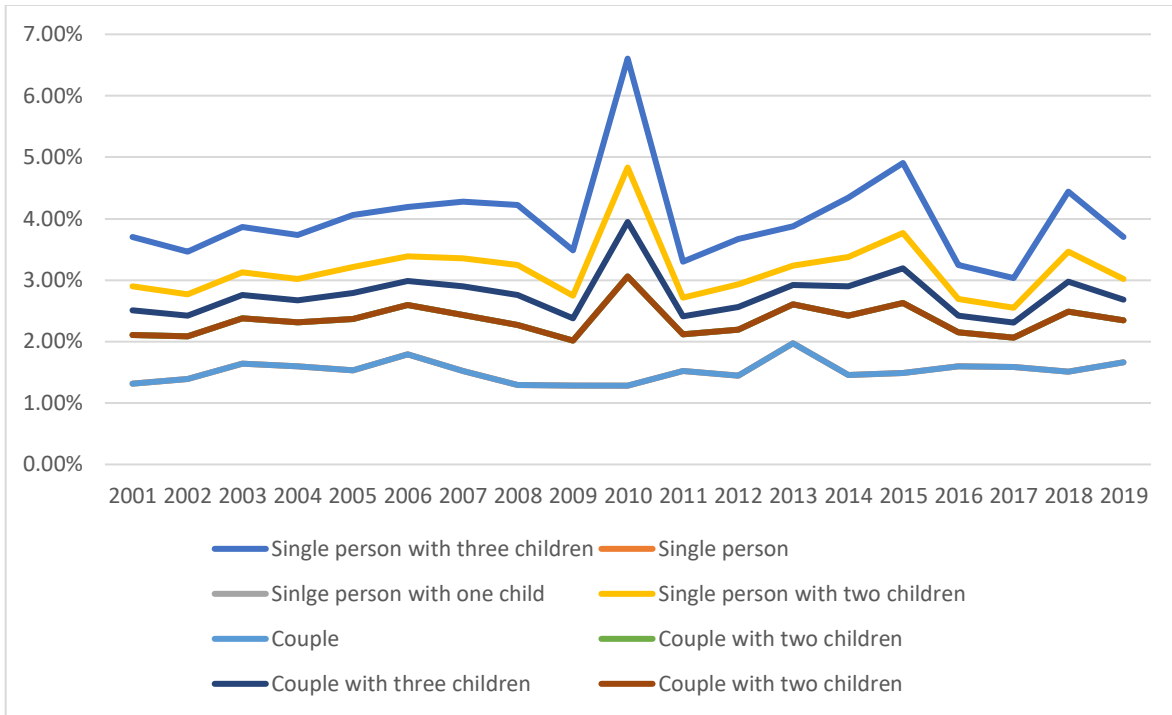


Figure 4B: Midwest Out-of-Pocket expenses as a percent of household income by family type

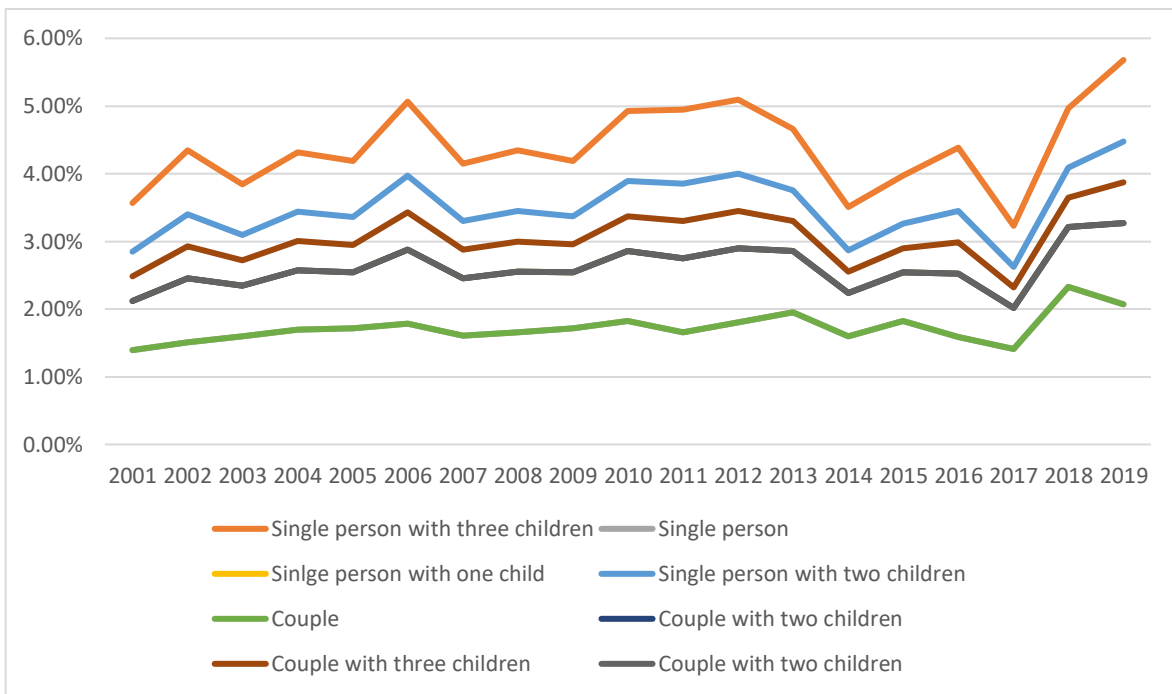


Figure 4C: South Out-of-Pocket expenses as a percent of household income by family type

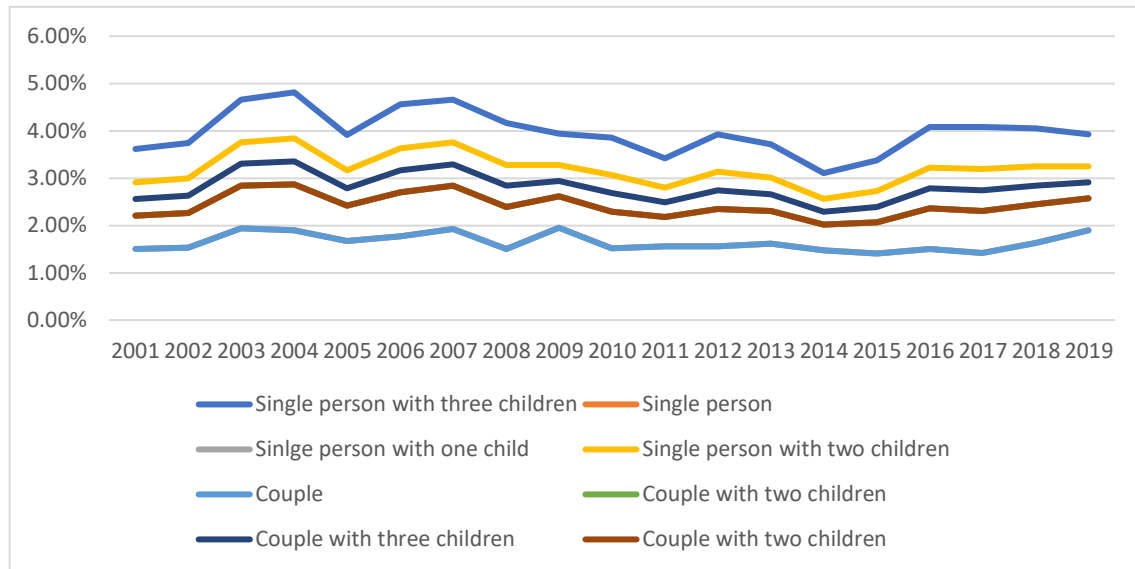
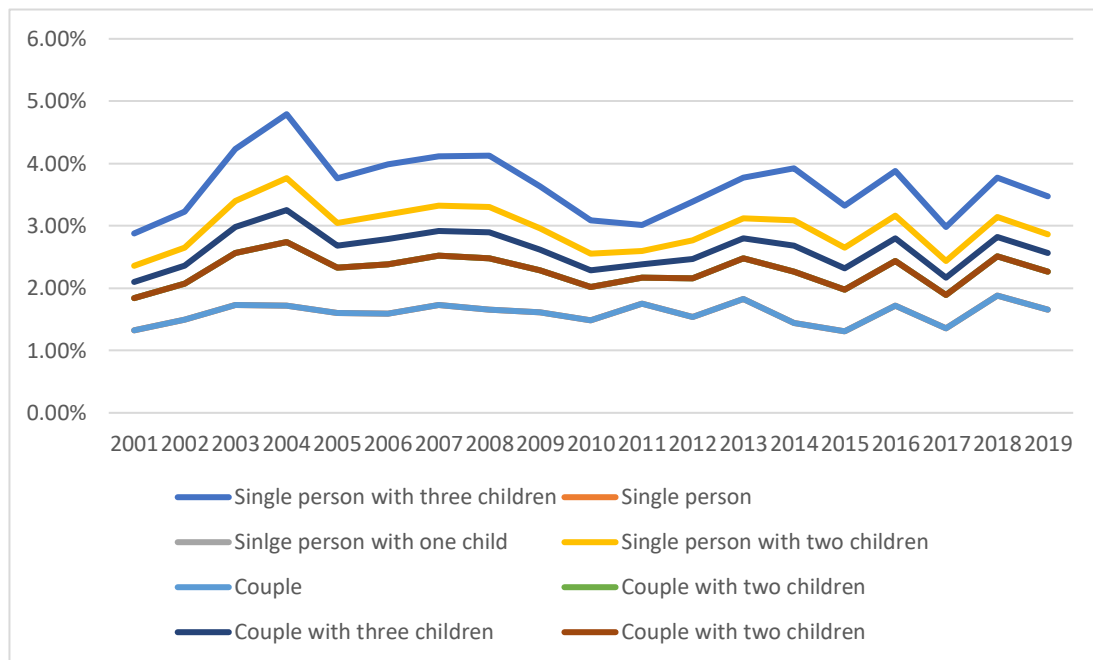


Figure 4D: West Out-of-Pocket expenses as a percent of household income by family type



Source of Figure 4A-4D: Agency for Healthcare Research and Quality (AHRQ). (n.d.). *Household Component Consolidated Files* [Unpublished raw data]. Medical Expenditure Panel Survey. <https://www.ahrq.gov/data-research/data-researchers/meps/>

These figures illustrate that throughout this period, for each year, region, and family combination, none of the families are above spending 10% of their household income on out-of-pocket medical expenses. For the one family type that is within 200% of the poverty threshold, there are two distinct points in the last two decades where their spending was more than 5% of the income of the household. The first was in the Northeast during 2010, and it immediately fell to below 5% the next year. Second was in the Midwest in 2019. These are very exceptional cases; in an extreme majority of the time, all the family types for each region in LISEP's allocation are not underinsured. The last criterion isn't used – 3) *their deductible constitutes 5 percent or more of household income* – because deductibles are not available by income percentiles by state. But we can assume that most of the sample's deductible was not 5% or more of income because at the most extreme point, families are barely spending 6% of their income on medical expenses (which include deductibles, copayments, and other expenses paid by an individual). It is highly probable that during this period, deductibles are not 5%, but we cannot be certain because of data limitations.

Secondly, LISEP also surmises that this is the *minimal* adequate need level. The previous paragraph proved it is adequate. The goal was to take a conservative approach to needs. The charts convey that although, for an overwhelming majority of the time, none of the family types were underinsured, they also were not easily clearing this “uninsured” benchmark. The proximity of actual spending to the uninsured threshold suggests that this is truly a *minimal* adequate level of health insurance.

### iii. Data

## 1. Premium Calculation

The data for insurance premiums was taken from the MEPS, which is published by the Department of Health and Human Services Agency for Healthcare Research and Quality. The data used to obtain the premium calculation is taken from the Insurance/Employer Component of the survey, which asks establishments and governments the amount they pay for their employees’<sup>68</sup> insurance. LISEP used the summary level tables by state and quartile of earners (the microdata was not available) found in tables VIII.C.2, VIII.D.2, and VIII.E.2, which are the employee contribution to the premium for single coverage, family coverage, and employee-plus-one coverage respectively.

## 2. Out-of-Pocket Expenses

The second source of data from the MEPS was the Full-Year Consolidated Data file for each year from 2001 to 2019.<sup>69</sup> This provided the out-of-pocket spending data at the person level. Included is everything paid by the family, be it deductibles, copayments for over-the-counter drugs, copayments for services, etc. For the 2020 year, LISEP linearly interpolates the 2018-2019 trend to continue to 2020. The exact data from 2020 is not yet available on the MEPS website, but the LISEP data will be updated when the full 2020 data is made available (fall of 2022).

### iv. Specific Methodology

#### 1. Premium

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<sup>68</sup>(Agency for Healthcare Research and Quality- Insurance Component)

<sup>69</sup>(Agency for Healthcare Research and Quality- Microdata)

To calculate the employee contribution to their premium (single coverage, employee-plus-one, or family) the tables listed above are used. Contributions are taken for each state for the median-wage earner. A national average for the employee contribution is then generated by aggregating these values, weighted by the proportion of each state's population to the national population for each year. The intercensal county population estimates for these aggregations is used.

To calculate the total cost of health premiums faced by the family, the employee contribution for a premium for each insurance type (single, employee plus one, and family insurance) are taken, and this premium is applied to the representative family type within our framework.

## 2) Out-of-Pocket Costs

For out-of-pocket expenses, the population of workers that fall between the 25<sup>th</sup> and 75<sup>th</sup> percentile of reported earnings and that elect employer-provided health insurance are used. The variables *INSCOV*, *HELD[round number]X*, and *EMPST[round number]H*<sup>70</sup> are used to flag respondents who have employer-provided health coverage. *INSCOV* summarizes health insurance coverage for the respondent (private, public, or uninsured). *HELD[#]X* records whether health coverage was held during employment upon offer. Finally, *EMPST[#]H* records whether the respondent was employed during the time of survey round, whether they have a job to return to if they are on vacation/sick leave/etc., or whether they are unemployed.<sup>71</sup> With these variables in mind, LISEP defines being covered by employer-provided healthcare as being

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<sup>70</sup> There are three rounds in each year of the MEPS survey. More information on the survey structure can be found here: [https://www.meps.ahrq.gov/survey\\_comp/hc\\_data\\_collection.jsp](https://www.meps.ahrq.gov/survey_comp/hc_data_collection.jsp).

<sup>71</sup> Documentation associated with Full-Year Consolidated Data files on the MEPS website includes more details on these variables: [https://meps.ahrq.gov/mepsweb/data\\_stats/download\\_data\\_files.jsp](https://meps.ahrq.gov/mepsweb/data_stats/download_data_files.jsp).

recorded as having a private insurance in general, holding employer-provided healthcare, and being employed. If health insurance is attributed to these family budgets, then LISEP should also track those with the same level of insurance to measure what they paid in out-of-pocket expenses. LISEP uses the 25<sup>th</sup> to 75<sup>th</sup> percentile wage earners to provide a more robust sample rather than just using the one worker at the exact median and tracking this worker's out-of-pocket costs.

There is a slight disconnect in the median paid worker (whose spending LISEP is trying to replicate in the out-of-pocket costs) and the median worker at employers that offer health insurance (whose premium contribution LISEP is using). This disconnect is because most employers that do not offer health insurance are firms that pay lower wages. Thus, the median worker at employers that offer health insurance is probably higher in the wage distribution than the median worker at all employers. This could be problematic if the out-of-pocket expenses for the workers at the median of the entire distribution are completely different than the out-of-pocket expenses for the workers at the median of the distribution only considering employers that offer employee health insurance.

First, LISEP seeks to validate this hypothesis – that the median of the population and the median of employers offering employer-provided healthcare are different. Using the MEPS data, the workforce is broken into five quantiles based on wages. The average offer rate is then measured, which is the percentage of employers that offer employees some type of health insurance, for these quantiles. The graphs below depict these rates.

Figure 5A: Northeast offer rates by worker income quintile

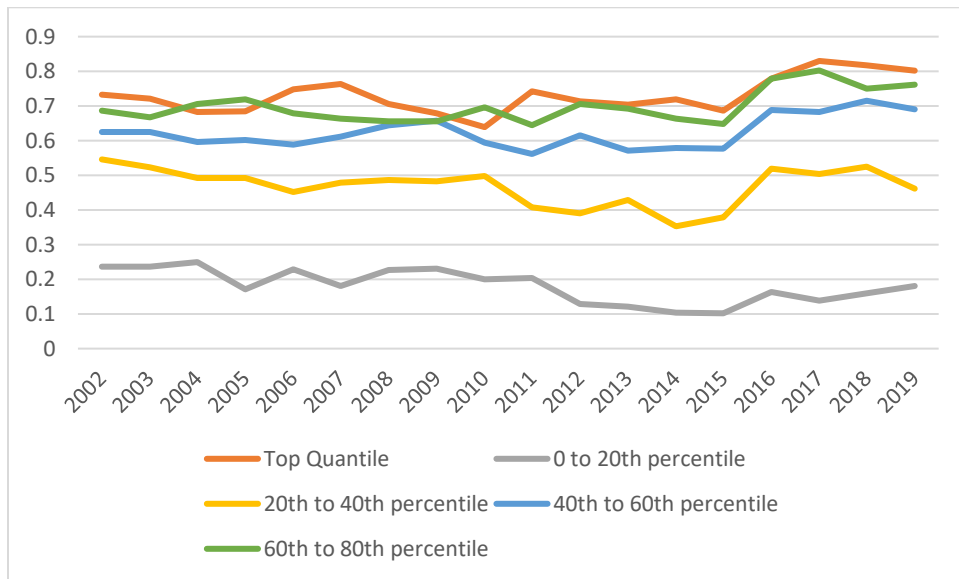


Figure 5B: Midwest offer rates by worker income quintile

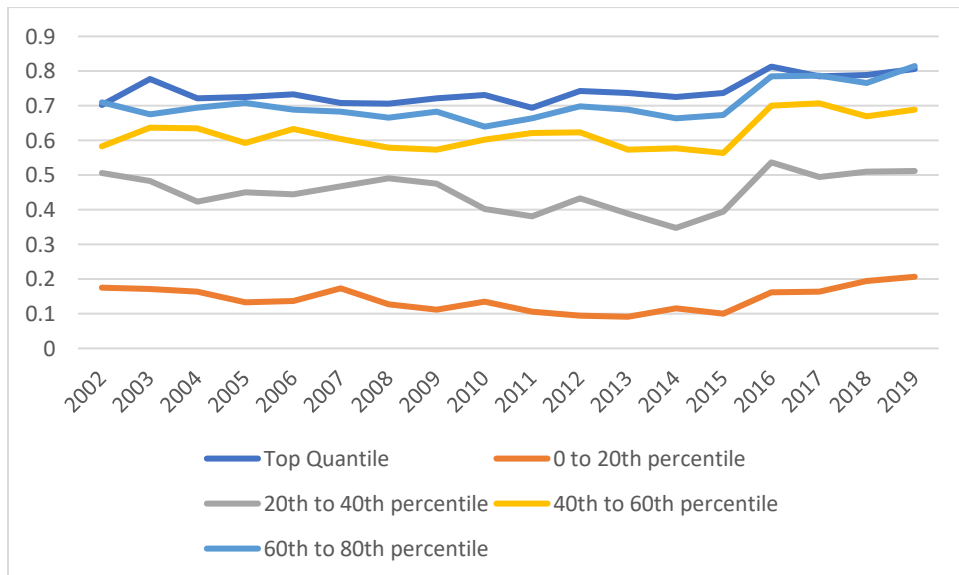


Figure 5C: South offer rates by worker income quintile

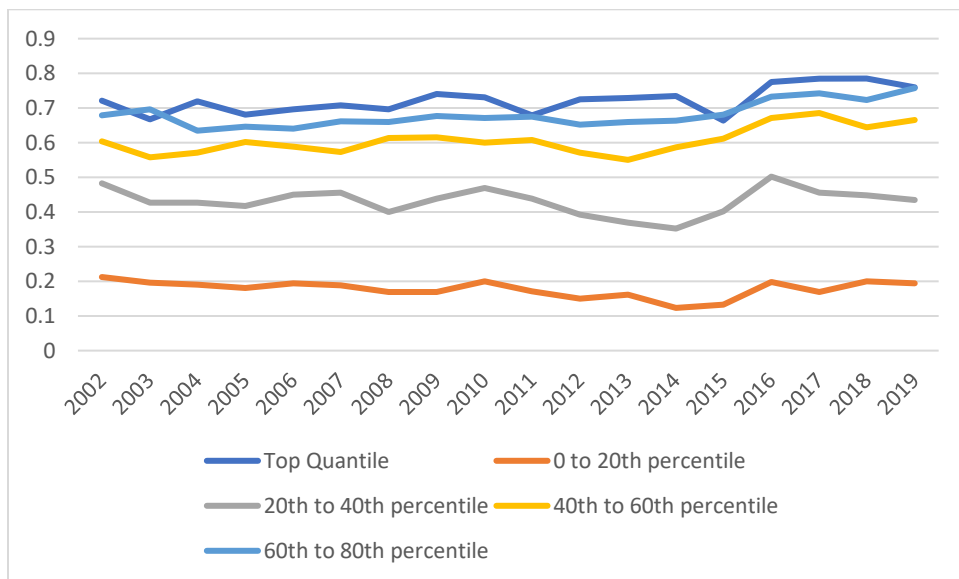
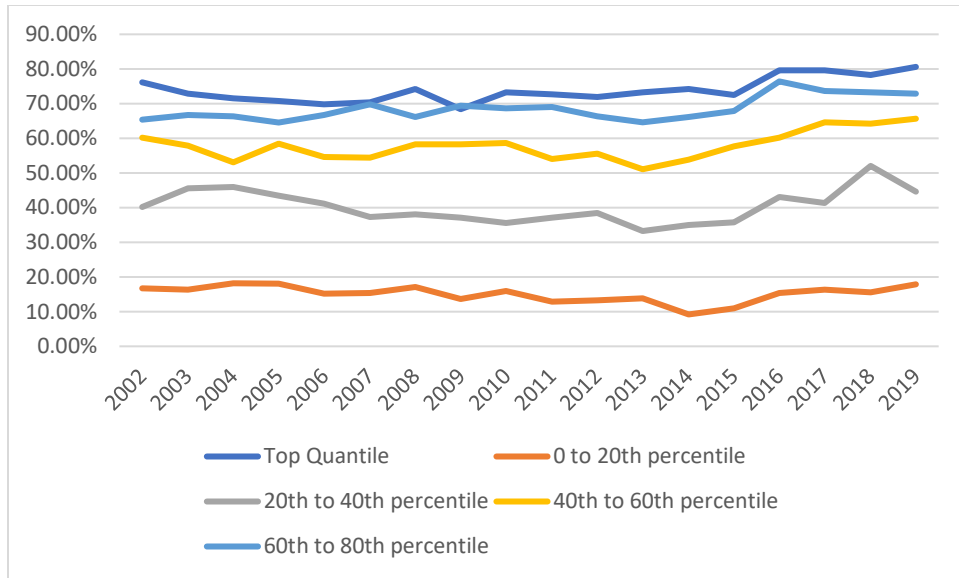


Figure 5D: West offer rates by worker income quintile

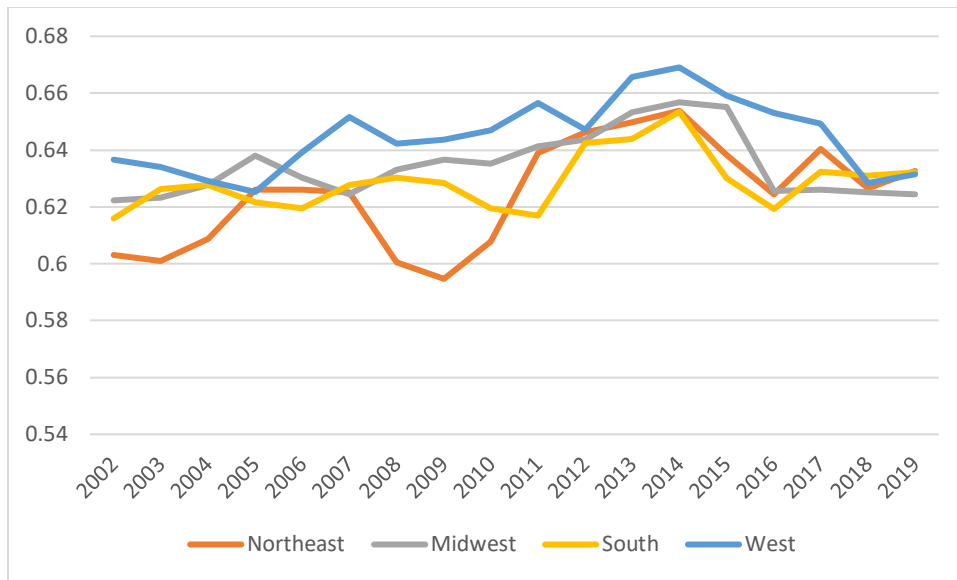




Source of Figure 5A-5D: Agency for Healthcare Research and Quality (AHRQ). (n.d.). *Household Component Consolidated Files* [Unpublished raw data]. Medical Expenditure Panel Survey. <https://meps.ahrq.gov/me>

These figures suggest that the hypothesis that employers offering health insurance also offer higher wages is correct. LISEP then found the median wage of the worker, contingent that the worker was offered healthcare, and compared that to the entire population of workers. The graph below shows, by region, where the median worker with employer-provided health insurance falls in the wage distribution.

Figure 6: Wage percentile in entire distribution of median earner with employer-provided health insurance, by region



Source: Agency for Healthcare Research and Quality (AHRQ). (n.d.). *Household Component Consolidated Files* [Unpublished raw data]. Medical Expenditure Panel Survey. <https://meps.ahrq.gov/me>

Although this worker is above the median, the worker is relatively close to the median, predominantly in the 60-65 percentile range. Thus, because the out-of-pocket costs for the average person in the 25<sup>th</sup> to 75<sup>th</sup> percentile is taken, this should not overly affect the calculations. To assure this, though, a robustness check is run to compare the average out-of-pocket expenditures for those in the 50<sup>th</sup> to 75<sup>th</sup> percentile range (in which 60-65 would be right in the middle) with those in the 25<sup>th</sup> to 75<sup>th</sup> percentile range.

Similarly, the out-of-pocket costs for children is calculated. Since children do not have wages, and thus cannot be sorted in the same manner, children are kept in households that fall into the 25<sup>th</sup> to 75<sup>th</sup> income levels and the average out-of-pocket expenses for this sample are calculated.<sup>72</sup> For both adults and children, LISEP calculated the average out-pocket-costs using person-level weights for each of the four regions.

<sup>72</sup> Access to public health programs is often determined by a household's relation to the poverty level. As noted previously, the only family below 200% of the poverty level in any given year is a family with one earner and three children. This family type accounts for less than 2% of the population in any given year and averages to be about

## v. Dental Care

LISEP also provides a basic level of dental care as a minimal adequate need. Studies show that oral health is linked to other systematic health conditions such as heart disease and diabetes.<sup>73</sup> Regular oral care can help to prevent other diseases. Moreover, diseases often manifest in the mouth, and so early identification with dental care can help prevent longer and more traumatic symptoms.<sup>74</sup>

Additionally, those without dental insurance are more likely to forgo going to the dentist, thus losing out on necessary dental care. The National Association of Dental Plans found that people without dental insurance are 2.5 times less likely to visit a dentist.<sup>75</sup> Moreover, the top reason that adults do not go to the dentist is cost (40.2%).<sup>76</sup> Thus, LISEP deemed dental insurance a necessity because it provides the ability to afford dental care.

LISEP assumes that dental insurance is provided by the employer. This is for two reasons. First, in 2005, 65% of employers offered dental insurance.<sup>77</sup> In 2014, the Society of Human Resources Management reported that the number had jumped to 95%, and then increased 1% by 2017.<sup>78</sup> Importantly, these results only hold for companies with large enough staffs to include HR professionals, thus a large number of small business employees are excluded from the report. Regardless, to maintain consistency, and considering the facts above, LISEP assumed

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1.07% of the population throughout the sample. Because we are not accounting for potential healthcare benefits that they might receive, this could result in a very slight overestimation of costs for this 1% of the population. This effect will be minimized by the fact that, at 175%, they are very close to the cutoff threshold of no longer being eligible, so any benefits diminish by income.

<sup>73</sup> (Gross, E. L.)

<sup>74</sup> (Babu, N. C., & Gomes, A. J. 2011)

<sup>75</sup> (National Association of Dental Plans 2009)

<sup>76</sup> (Yarbrough, C., Nasseh, K., & Vujicic, M. 2014)

<sup>77</sup> (Tatomir 2019)

<sup>78</sup> (Tatomir 2019)

that the employer offered benefits. Because of this assumption, the employee contribution to dental plans was taken rather than the whole cost of the premium. Out-of-pocket costs were considered in addition to the premium cost.

## 1. Dental Premiums

To calculate the dental premiums, the detailed data interview files from the Consumer Expenditure Survey were used. From 2001 to 2017, the relevant file is the IHB file, and from 2017 to 2020, the relevant file is the HHP. For 2001 to 2017, the QHI3MCX variable that records the cost spent on premiums is used. Because this records the cost on any health premium, LISEP filters this using the HHISPECT variable. The HHISPECT variable is used for special insurance (not medical health insurance) such as dental, vision, dread disease, etc., taking only the premium costs pertaining to dental insurance. The sample is then further filtered using the HHIGROUP variable that determines the channel through which insurance is obtained. Only those who receive insurance through a group with their employer are taken. This is because LISEP assumes that the dental coverage is provided through the employer. With this sample, the cost of the premium to the household (the employee-contribution portion) is calculated. To cater this calculation for LISEP's family types, the HHICOVQ variable is used. This variable specifies the number of people within the household covered by the insurance. If the plan covers only one person, then it is single coverage, two people for employee-plus-one coverage, and three or more people would be family coverage. Lastly, these costs are sorted by region using the REGION variable and applied to the specific family type for each region.

For the years from 2017 onward, the HHP file from the Consumer Expenditure Survey is used. The approach was identical to the IHB file, but the variables are just renamed in later years. The equivalent variable for the HHP for the QHI3MCX variable is the QHHP3MX. For the

IHB's HHISPECT, the HHP had SSTYPE. Both the early and later years had the variables HHIGROUP, REGION, and HHC OVQ.

## 2. Out-of-Pocket Expenses

To calculate the out-of-pocket expenses of dental care, the sample of wage earners earning an income between the 25<sup>th</sup> and 75<sup>th</sup> percentile of earnings is used. This allows us to calculate dental care expenses that are in line with the medical coverage that workers in this income bracket usually have. Among those wage earners, a subsample of workers who had private dental insurance is used. It is not possible to mirror the sample of the medical healthcare section because the MEPS makes available only one variable that flags private dental coverage (DENTIN[round #]), to which the answer is yes or no. There is no variable to indicate whether dental coverage is obtained through an employer. One could argue that LISEP could have used the HELD[round #]X and EMPST[round #]H variables to filter out the respondents who have healthcare coverage through their employer and subsequently assume that dental coverage is a part of that employer-provided package. But the American Dental Association reported in 2017 that about 15.6% of American adults had a stand-alone dental plan, which is not an insignificant number.<sup>79</sup> Since it's difficult to discriminate between employer-provided plans and those purchased in the private marketplace, LISEP considers the sample of respondents who reported having private dental insurance, which is around 40% of respondents over the 2001-2019 period.

The only discretionary exclusion LISEP makes concerns respondents who answered affirmatively to having private dental insurance and when utilized, reported amounts paid by public agencies (federal, state, or local), and no amount paid by private insurance. Such

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<sup>79</sup> (Centers for Medicare & Medicaid Services 2018)

contradictory information exists because the Agency for Healthcare Research and Quality (AHRQ), which administers the MEPS, asks respondents about their dental insurance status. It then asks providers about a percentage of those dental visits and collects detailed records on spending and use from the providers. Given this, it makes sense that respondents may provide erroneous information that contradicts with provider records.

LISEP then uses this sample to calculate the average out-of-pocket expenditures first for adults who fit the income bracket mentioned previously using person-level weights  $PERWT[year]F$ . The variable of interest is  $DVTSLF[year]$ , which reports the amount spent by the respondents for a given dental visit. LISEP does so for each of the four census regions separately and then repeats the sample process for children who live in households whose income fits the specified bracket.

## vi. Robustness check section

Here LISEP shows that the out-of-pocket costs for the 25<sup>th</sup> to 75<sup>th</sup> percentile wage earner are very similar to the out-of-pocket costs for the 50<sup>th</sup> to 75<sup>th</sup> percentile wage earner. LISEP does this because the wage percentile of the median person on health insurance was in the 60-65<sup>th</sup> percentile range (roughly halfway between 50 and 75). But here the costs are similar, proving that our decision to take the median earner's out-of-pocket expenses did not affect the overall numbers.

Figure 7A: Northeast Out-of-Pocket Spending Comparison

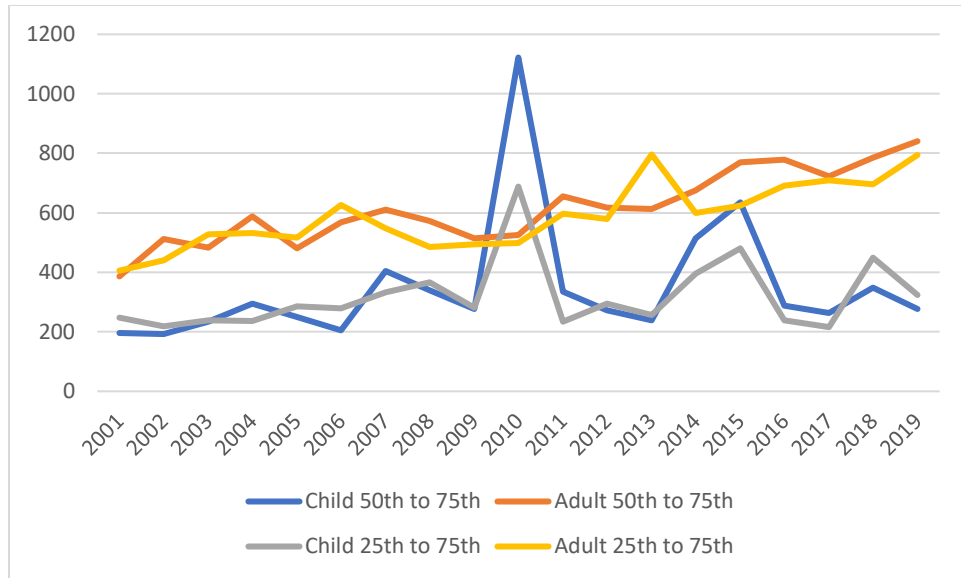


Figure 7B: Midwest Out-of-Pocket Spending Comparison

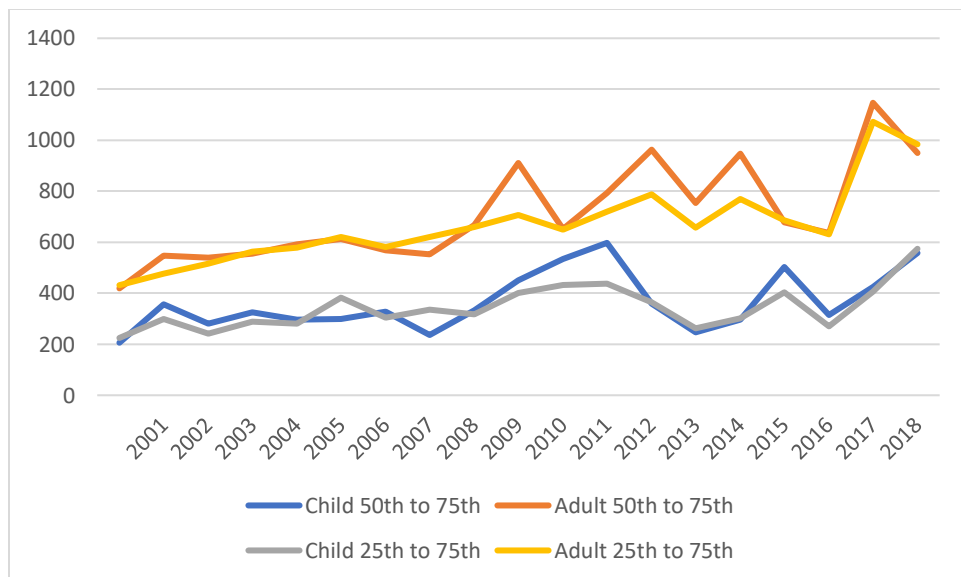


Figure 7C: South Out-of-Pocket Spending Comparison

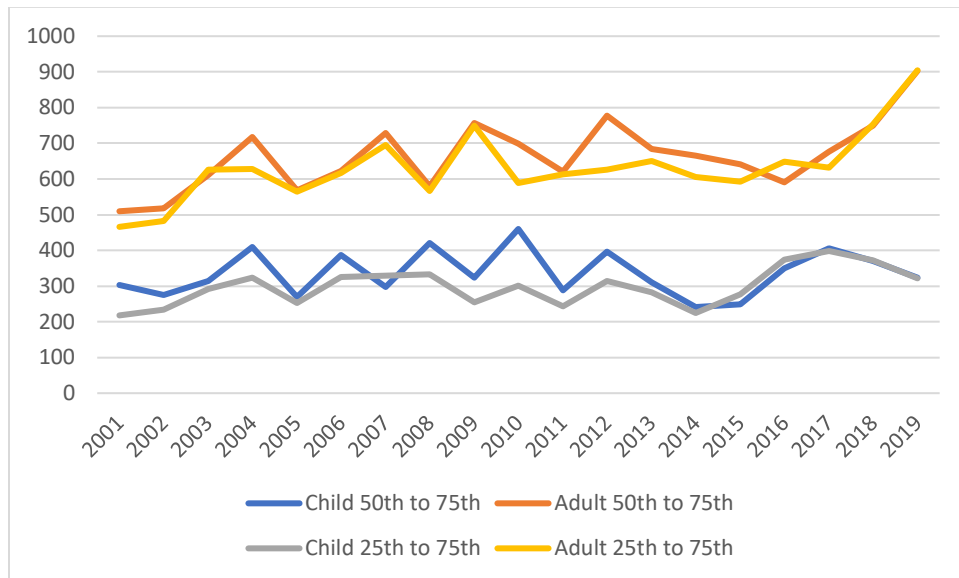
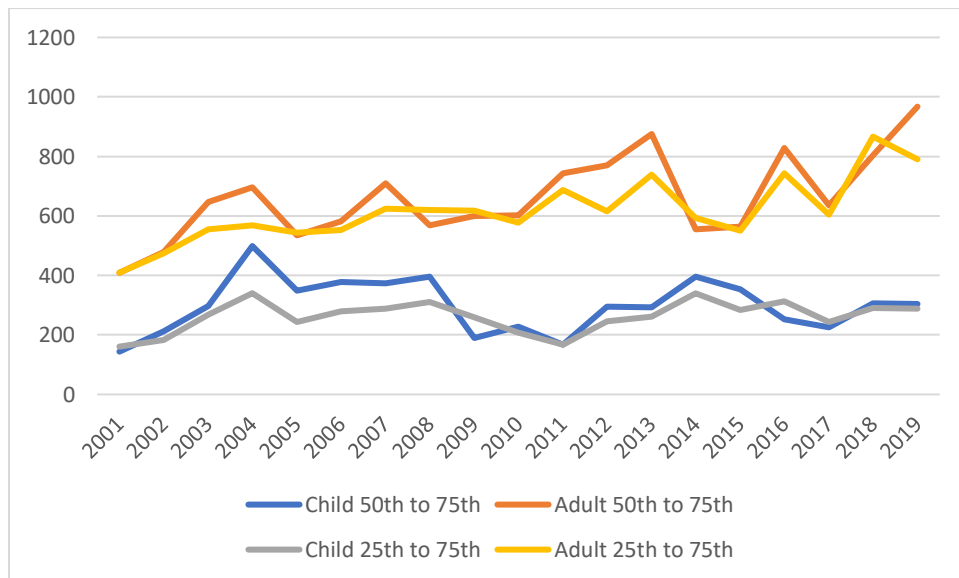


Figure 7D: West Out-of-Pocket Spending Comparison





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## D. Childcare

### i. Aim

The aim of this section is to present the minimal cost for adequate childcare for each type of family. We assume that starting at the age of 6, when the child can attend kindergarten, the child no longer needs daycare. But before- and after-school care are needed, as well as summer programming. At age 12, no childcare is needed. Thus, childcare costs only apply to families with children aged 11 or younger.

The standard for minimal adequate needs that LISEP uses is defined by Childcare.gov, which sets and reports standards for childcare centers based on group sizes, safety, and development.<sup>80</sup> Childcare.gov states: “Children need care that keeps them safe, healthy, and learning. And you need a childcare provider that supports you as your child’s most important teacher and works with you to ensure your child’s healthy development and learning.” Thus, a minimally adequate childcare arrangement should aim to support these goals.

Certain groups are excluded. First are children who are not in licensed childcare centers. Because we assume that both parents are working, children in non-licensed centers would be either under no adult supervision or under supervision of another adult or family member. But this arrangement is not an option for many families, and if it is, it may not be adequate given the Childcare.gov definition above. Second, those who exceed the *minimal* adequate need are

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<sup>80</sup> (Childcare.gov)

excluded. Some highly advanced childcare facilities are extremely expensive and thus don't fit the aim of this project.

## ii. High-Level Methodology

LISEP uses a similar approach to the Economic Policy Institute Family Budget Calculator to estimate the childcare needs of a 4-year-old. The data from Child Care Aware of America (CCoA), an organization focused on access to quality, affordable childcare, is used. This data gives accurate cost measurements by state from 2010 onward. The CPI price trend specific to childcare is then used to adjust the cost closest to the start of the sample for each year in which we did not have relevant data.

This approach would meet the qualifications set forth by Childcare.gov. Because LISEP is only using costs for licensed facilities, some type of oversight is assured. Each state has different childcare licensing requirements, but in general “Licensing agencies set basic rules that must be followed to legally run a childcare program.”<sup>81</sup> These set regulations pertain to:

- *Safety in the building and physical environment*
- *The number of children and childcare providers on site*
- *Preventing the spread of infectious diseases*
- *Staff qualifications and training*<sup>82</sup>

Furthermore, Ceglowski (2004) suggests that all the stakeholders of childcare—from children, staff of facilities, parents, and officials that make and enforce the requirements—have similar preferences and consideration.<sup>83</sup> Because of this, using licensed childcare facilities

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<sup>81</sup> (Childcare.gov)

<sup>82</sup> (Childcare.gov)

<sup>83</sup> (Ceglowski, D., 2004)

<sup>84</sup> These include Professionalism and Training, Caring and Stable providers, communication with families, and enjoyment of children.

meets the adequate need set forth above. The best available source (Childcare of America, discussed in detail later in this section) for this data only provides the average cost of childcare, though, not the median. Thus, LISEP does accept that there could be some upward biasing with the inclusion of very expensive facilities, but the data is collected at the state-level, which means that the high number of centers will mitigate the effect of the outliers.

For before and after school costs, LISEP used licensed center price data at the 75<sup>th</sup> percentile from various sources to get the most reliable estimates by state. From 2008 to 2018, LISEP aggregates the state-level price rates from the county-level rates at the National Database of Childcare Prices (NDCP) published by the Women’s Bureau at the Department of Labor.<sup>85</sup> From 2019 onwards, LISEP uses state-level estimates for the cost at licensed centers of school-aged childcare at the 75th percentile from either market rate survey (MRS) reports from states or Childcare Aware of America. Both the NDCP and CCoA estimates are derived from market rate survey reports. Finally, LISEP imputes data for missing years through a mix of linear interpolation and tracking costs with the CPI for childcare. If there are two end years for costs from the market rate survey or the CCoA data, then we use linear interpolation. If we are extrapolating, we use the CPI.

For the summer costs, Afterschool Alliance research data is used. Surveys by after school alliance are not conducted every year, so there is state-by-state data covering two specific years for summer programming costs (2013, 2019). Using this data also meets the minimal needs aim. Parents are 94% satisfied with their afterschool program, contingent on the fact that their child is in an afterschool program.<sup>86</sup> Parents are 95% satisfied with the summer program that their child

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<sup>85</sup> <https://www.dol.gov/agencies/wb/topics/childcare/price-by-age-care-setting>

<sup>86</sup> (Afterschool Alliance, 2020)

is in, given that their child is in a summer program.<sup>87</sup> Because of the alignment of the parent, licenser, child, and facility operator mentioned above in Ceglowski (2004),<sup>88</sup> LISEP surmises that this approval rating is a good approximation that parents are getting the minimal adequate need for afterschool care at the centers covered by this data. LISEP estimates costs in the missing years with a mix of linear interpolation and tracking the costs using the CPI for childcare and applies these costs to the relevant families.

One avenue that LISEP chose not to take was to allocate some portion of the population lower childcare costs because they had family members who could assist with care. This is because LISEP viewed it unreasonable to assume that family members have the means (both timewise and financially) to be able to take care of the children of a separate family member without payment, or that it would be offered even if time or finances weren't at issue. Further, the data from the Census Survey of Income and Program Participation (SIPP) shows that the share of children in organized facilities increases with household income. In contrast, the share of children being taken care of by relatives decreases as household income increases.<sup>89</sup> These findings suggest that relatives taking care of children is an only option for low-income households rather than a choice. This compliments research showing that organized childcare is beneficial for the growth and development of children.<sup>90</sup>

### iii. Data

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<sup>87</sup> (Afterschool Alliance, 2020)

<sup>88</sup> (Ceglowski, D., 2004)

<sup>89</sup> (Census.gov)

<sup>90</sup> (Afterschool Alliance, 2020)

CCoA's database titled "The US and the High Price of Childcare" is used to estimate the cost of childcare by state for daycare centers and before and after school care.<sup>91</sup> This data is available starting from 2010 onward. Unfortunately, prior to 2010, there is no available data. So, using the data from 2010, LISEP adjusted the cost data using the CPI for childcare back to 2001. This Elementary Level Index (ELI) was EB03 and can be found on the Consumer Price Index database on the BLS website<sup>92</sup>.

LISEP uses the National Database of Childcare Prices published by the Department of Labor to estimate the cost of care for school-aged children at licensed centers by state. The NDCP data is derived from each state's childcare MRS report and is available at the county-level from 2008 to 2018.<sup>93</sup> It provides weekly rates for care at different categories of facilities at the mean and at multiple percentile levels. LISEP also uses state specific MRS reports to fill gaps in the data for some years.<sup>94</sup>

LISEP uses the Afterschool Alliance data for the costs for summer programs. It provides average costs by state for families who participated in any of these programs.<sup>95</sup>

#### iv. Specific Methodology

##### 1. Childcare Costs for the 4-year-old

To calculate the cost of childcare for the 4-year-old, the cost given by the CCoA is taken and applied to families with a child. Each family type that has at least one child has, by definition, exactly one child in 4-year-old childcare. To obtain the cost of daycare for each year

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<sup>91</sup> The Child Care Aware of America organization publishes the cost data for the current year. We were able to contact them, and they graciously gave us the data from 2010 onward: (Child Care Aware of American, 2021)

<sup>92</sup> (Bureau of Labor Statistics)

<sup>93</sup> <https://www.dol.gov/sites/dolgov/files/WB/media/NationalDatabaseofChildcarePricesTechnicalGuideFinal.pdf>

<sup>94</sup> See table on sub-section 2. *Childcare Costs for 8-year old* under iv. *Specific Methodology*

<sup>95</sup> Afterschool Alliance generously provided their data on afterschool care costs for 2009, 2014 and 2020 and on summer programming costs for 2013 and 2019: (Afterschool Alliance, 2021)

in the period of interest, LISEP took the state breakdown of data provided by the CCoA and adjusted each of these costs by the national ELI for childcare for each year prior to 2010. The ELI nationally is also used to extend the Montana values for 2017-2019 because no Market Rate Survey for childcare costs was conducted by the Montana legislature in any of these years. For Arkansas, their first year recorded by the CCoA was 2013, so the value from 2014 had to be used to estimate costs from 2001 to 2013. The CCoA annualized costs for 4-year-old care assume 52 weeks of care in a year. These costs were then aggregated to the regional level using the state populations in the respective regions.

## 2. Childcare Costs for the 8-year-old

The Afterschool Alliance provides snapshots for the summer care costs for 2013 and 2019. For 2019, state-by-state costs for both “voluntary summer programs” and “non-STEM specialty camps or programs” were available. LISEP used the cheaper of these two options on a state-by-state basis and then linearly interpolated the costs from 2013 to 2019 to fill in the missing years. For the years prior to 2013, the summer costs were adjusted using the CPI index for childcare.

For the before and after school care costs, LISEP tracks the 75<sup>th</sup> percentile of licensed centers at the state level using data from the NDCP, from CCoA, and directly from states’ market rate survey reports. In general, LISEP prioritizes using data directly from the MRS reports and the NDCP since it is most reliable. LISEP uses the CCoA estimates to fill in gaps in recent years when it is certain that CCoA is tracking the 75<sup>th</sup> percentile for school-aged children at licensed centers for the year. Finally, LISEP completes estimates for missing years using linear interpolation if possible, and if not using the CPI index for childcare. For specific notes on the methodology for each state, please reference the table below.

These costs are then applied to all families with an 8-year-old assuming that they spend 39 weeks in school-age care and 13 weeks in summer care.

Notes for imputing 75<sup>th</sup> percentile school-age center-based care for selected states:

State	Notes	MRS Link
Arizona	The 75th percentile from the most recent market rate survey was not close to the CCoA estimate for Arizona for 2022, so imputing through CPI for 2021 and 2022.	<a href="#">Link</a>
California	The CCoA estimate does not match with the 2021 MRS report estimate for the 85th percentile (or the NDCP estimate for 2018), so adjusting with CPI from 2018.	<a href="#">Link</a>
Colorado	The CCoA estimate for 2022 correctly tracks the 75 <sup>th</sup> percentile for school age centers. Using the year 2015 from the NDCP, the only year with available data to anchor the prices.	<a href="#">Link</a>
Connecticut	Using the MRS report, LISEP got the 75th percentile for 2022. The MRS reports data at the 60 <sup>th</sup> percentile until 2001. If deflating with CPI from 2008 to 2001, then the 60th percentile would be larger than the 75th, so imputing the 75th percentile with the 60th percentile inflation from 2000 to 2022 (43%) instead	<a href="#">Link</a>
District of Columbia	The specific data MRS for 2012 and 2021 where the 2 important estimates are from, show that costs did actually fall from 2012 to 2021. Using 2012 estimate from NDCP and 2019-2021 from CCoA.	<a href="#">Link</a>
Delaware	Imputing 2019 by linear interpolation because there's a jump in CCoA data from 2019 to 2020, and the CCoA data up to 2019 trends similarly to the national database data, but is lower. Using CCoA data from 2020 onward.	
Florida	Has county-level rates available for 2020-2021 to calculate 2021 cost.	<a href="#">Link</a>
Georgia	2021 MRS report has data for the 75th percentile dating back to 2001 every few years. Replaced the National Database estimate since it was way off the mark in 2016 (the only year it reported it for GA)	<a href="#">Link</a>
Hawaii	Used latest available MRS report for 2022 and computed 2019-2021 with linear interpolation thanks to NDCP data.	<a href="#">Link</a>
Iowa	Used latest available MRS data because it didn't match with CCoA, so that's year 2020, reported in half-day rates.	<a href="#">Link</a>



Idaho	Using CCOA data only in 2019, and inflating with CPI later. Idaho MRS for 2021 did not provide weights for their reported geographical clusters.	<a href="#">Link</a>
Illinois	Using MRS data for 2021 since available, and 2022 estimate from CCOA.	<a href="#">Link</a>
Indiana	Only CCOA data from 2019-2022, and no NDCP data available is available.	
Kansas	Used hourly rate for 75th percentile from 2020 MRS.	<a href="#">Link</a>
Kentucky	Used CCOA for latest years, imputed 2020 and 2022 where it repeated 2 years in a row.	
Massachusetts	The CCOA estimates are too low, so checked the latest MA MRS, but the 2022 data was only at a regional level. Even the lowest 75th percentile was much higher than the CCOA estimate, so using inflation instead to adjust (cannot assume that they all have the same amount of available spots).	<a href="#">Link</a>
Maryland	Used Market Rate Survey from 2021, they have data by jurisdiction.	<a href="#">Link</a>
Maine	CCOA took the median (\$140 for school age centers) rather than 75th percentile (\$165) for weekly rate in 2021, so calculated the annualized cost based on the 2021 MRS report.	<a href="#">Link</a>
Minnesota	There's no CCOA data, so using the NDCP and adjust with CPI. Given the latest MRS, this adjustment might be too low, but since the data is only by regional clusters.	<a href="#">Link</a>
Missouri	Using inflation to adjust from 2018 since CCOA data for Missouri does not track the 75 <sup>th</sup> percentile when comparing to latest MRS for 2022 (reported by MSA area clusters)	<a href="#">Link</a>
Mississippi	The CCOA data matches perfectly with the 2022 MRS report	<a href="#">Link</a>
North Dakota	Estimating the 2021 cost from the MRS report.	<a href="#">Link</a>
North Carolina	Imputing with inflation because the MRS reports the data by subsidy types.	
Nebraska	Could not find a reliable estimate for 2021-2022 with the MRS because it's clustered by urban/rural area, so adjusting by CPI for childcare.	<a href="#">Link</a>
New Hampshire	Market rate survey for 2021 has 2 types of school-age programs for some reason, so adjusting by the childcare CPI from the CCOA 2020 estimate.	<a href="#">Link</a>
New Jersey	Took the 2021 MRS weekly 75th percentile estimate.	<a href="#">Link</a>

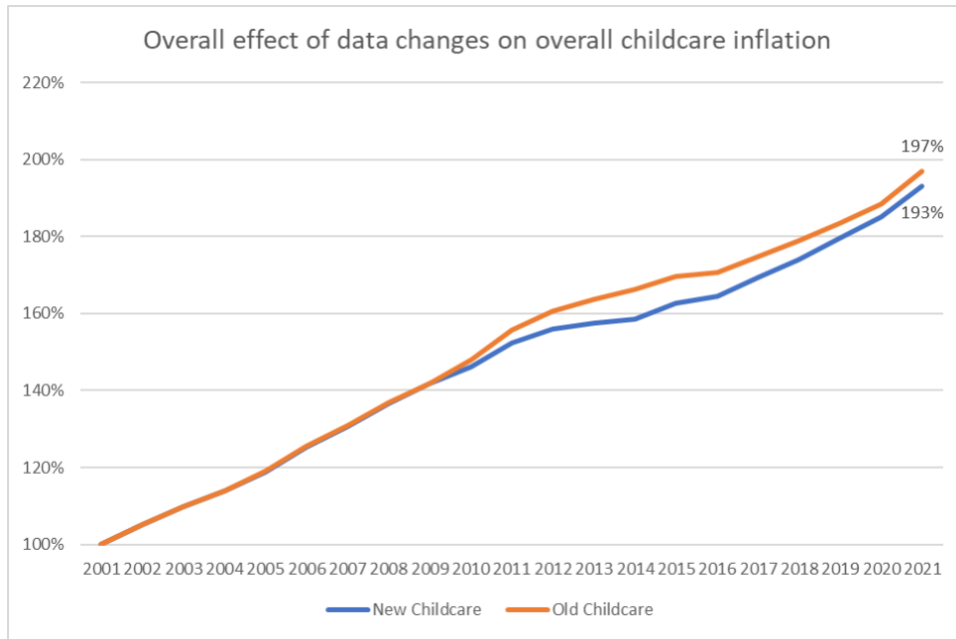
New York	Using the CCOA 2021 estimate. The 2018 estimate from the NDCP is based on 2019 data since all the previous market rate survey reports provided data on reimbursements only (from the NDCP technical document)	
Ohio	Taking their MRS reports for 2020 and 2022 for most recent estimates	<a href="#">Link</a>
Oklahoma	Imputed the 2021 number for the 75th percentile from the Oklahoma MRS. Because it trends similarly, and is pretty close to what CCOA reported for 2021 and 2022, using the 2022 CCOA estimate.	<a href="#">Link</a>
Oregon	Adjusting by CPI from 2018 rather than imputing. The NDCP used monthly prices for all its Oregon estimates, which the 2022 report said were not robust. Imputed a 2020 value with hourly, daily and weekly rates as a sample-weighted average, which was close to the CPI adjustment as a check.	<a href="#">Link</a>
Pennsylvania	Using CPI to adjust forward since unable to find a good way to estimate the 75 <sup>th</sup> with the MRS. The CCOA estimates the cost in PA using family care centers rather than licensed centers which is what we're tracking.	
Rhode Island	Imputed the 2021 estimate from MRS source data, (same as CCOA 2022 estimate). Also using CCOA data for 2020	<a href="#">Link</a>
South Carolina	CCOA Data matches very well for 2019, but not for the years after. So, inflating with CPI from 2020 onwards given data problems with market rate survey.	
Tennessee	The NDCP computes the weighted average by county of the school-age "in" prices (school year). The 2020 and 2022 MRS reports have the weekly price "in" estimate for all counties at the 75th percentile.	<a href="#">Link</a>
Texas	Took the 2019-2022 from each year's MRS.	<a href="#">Link</a>
Utah	imputed the 2021 data from the MRS report. The CCOA 2022 estimate might be correct, but because the CCOA Utah data is very inconsistent, erring on the side of caution and adjusting by CPI for 2022.	<a href="#">Link</a>
Virginia	Using inflation because the 2021 report does not provide data by percentiles	<a href="#">Link</a>
Vermont	Took the 2019 MRS data point for 2019 because the CCOA data does not take the 75 <sup>th</sup> percentile that year.	<a href="#">Link</a>
Washington	Imputed the weighted average data for 2021 from the market rate survey. CCOA only tracks the 75th percentile for Spokane region.	<a href="#">Link</a>

Wisconsin	Only has data by “urbanicity” zones (so 4 zones from most rural to most urban), and CCOA decided for 2022 to take the 75th percentile for Zone C (50%-75% “urbanicity”). There’s not much data on the market rate survey report to use that for a statewide estimate, so it’s better to adjust with CPI.	<a href="#">Link</a>
West Virginia	Used the 2020 market rate survey data to imputed that year. The CCOA 2021 data matches well.	<a href="#">Link</a>
Wyoming	Used the Wyoming MRS report for 2022. The Wyoming estimates from CCOA vary a lot, so LISEP decided to conduct a linear interpolation between 2018 and 2022 rather than take the CCOA data.	<a href="#">WY MRS, p. 10 (Statewide Full Day Rates)</a>

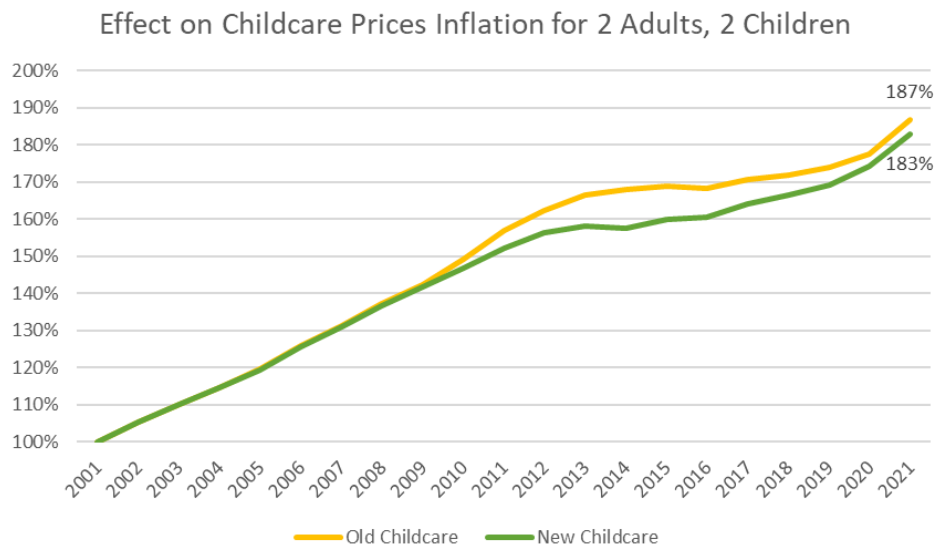
### **Addendum 2023 Edition:**

Below, we show the effect of the change in data sources, annualizing of costs and of taking the 75<sup>th</sup> percentile for afterschool costs. Most notably, the impact on overall inflation since 2001 is negligible with a 4 percentage point difference in 2021 (Figure 1). In particular, the change is smaller since the new cost of childcare, especially afterschool costs, is higher as a result of the changes, ranging from \$2.3k more expensive in 2001 to \$3.7k-\$3.8k more expensive in 2021 for each family type with a school-aged child (Figure 4).

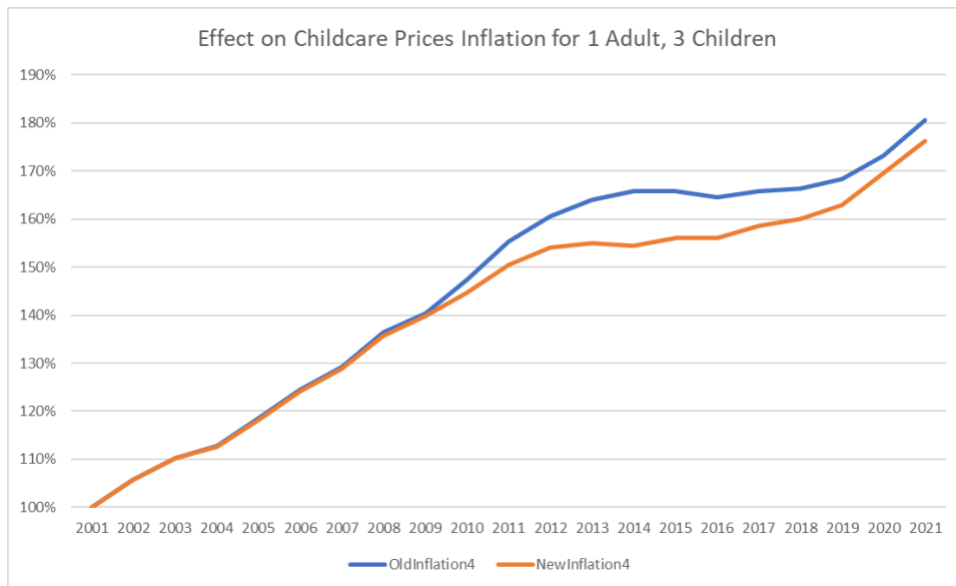
### **Figure 1: Effect of methodological changes on overall childcare prices since 2001**



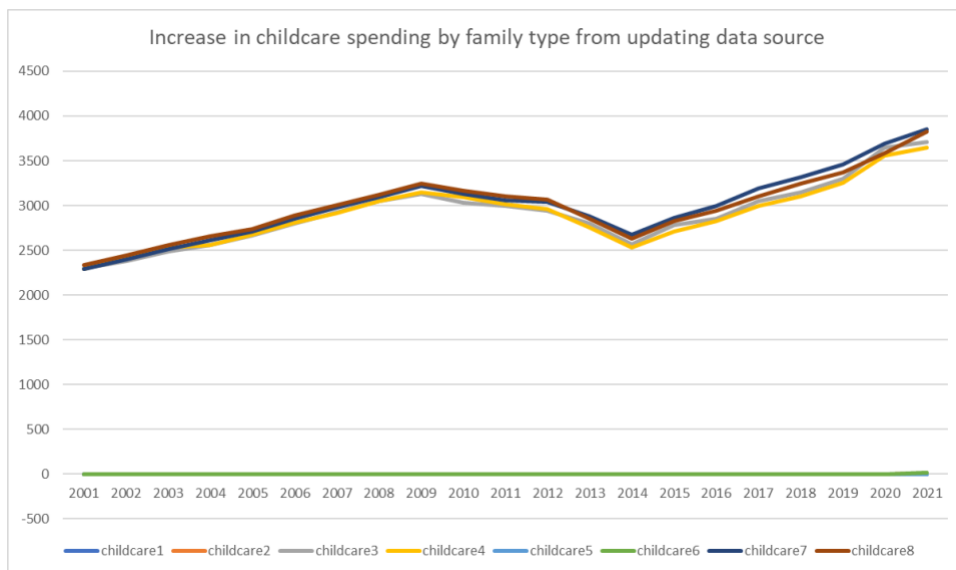
**Figure 2: Effect of methodological changes on overall childcare prices for family type 4**



**Figure 3: Effect of methodological changes on overall childcare prices for family type 4**



**Figure 4: Increase in costs for necessary childcare by family type because of methodological changes**



## Citations:

*Ensuring Safe & Healthy Child Care* | *Childcare.gov*. (n.d.). Childcare.Gov.  
<https://childcare.gov/index.php/consumer-education/ensuring-safe-and-healthy-childcare>

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## E. Technology

### i. Background

Decades of research make clear that unequal access to new and emerging technologies often serves to exacerbate inequality in society. Our entrance into the 21<sup>st</sup> century coincides with a period of rising digital connectivity in the United States that remade how Americans access and

interact with key social institutions and spaces. “Digital connectivity” refers to the ability to use computers, laptops, tablets, smartphones, or other “connected” devices to access the Internet.<sup>96</sup> Thus, digital connectivity is a function of both device ownership and the ongoing ability to reliably connect that device to the Internet.<sup>97</sup> Much previous research documents that by the early 2000s, access to digital connectivity was a critical factor shaping social inclusion in the United States.<sup>98</sup> This work shows that digital connectivity was necessary to access activities that are considered basic to social life, such as education, employment, and access to government.<sup>99</sup> Indeed, research has uncovered a clear “divide” in which those with access to reliable digital connectivity had--and continue to have--better access to these fundamental social goods than those without it.<sup>100</sup> For this reason, a central assumption that underlies this index is that access to reliable digital connectivity was--and is--essential in 21<sup>st</sup> century life for all Americans.

## ii. Key Assumptions that Underlie Our Methodology

Given the definition of “digital connectivity,” above, LISEP carefully considered the minimum basket of devices (computers, mobile phones, tablets, etc.) and access points (dial-up or broadband Internet access) that could produce a level of digital connectivity that would have provided essential digital access for most Americans during the period 2001-2020; digital infrastructure, and the tools used to access it, evolved rapidly during this period.

***1. Defining an Innovation as Mainstream.*** Research on emerging innovations often differentiates between a period of “early” adoption, when the innovation is purchased or used by

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<sup>96</sup> (DiMaggio et al. 2001)

<sup>97</sup> (Powell, Bryne and Daily 2010)

<sup>98</sup> (DiMaggio et al. 2004; DiMaggio et al. 2001; Powell, Bryne and Daily 2010)

<sup>99</sup> (Powell, Bryne and Daily 2010)

<sup>100</sup> (DiMaggio and Bonikowski 2008; Hargittai 2008; Powell, Bryne and Daily 2010; Rice and Katz 2002)

an elite few in a society, to a “mainstream” period, when most people in a society have adopted an innovation.<sup>101</sup> LISEP defines “mainstream adoption” as the point when more than 50% of the American population adopted the innovations that underlie digital connectivity. Figure 1 summarizes the devices and access points required for essential digital connectivity, as well as the timing of their entrance into mainstream American life:

**Figure 1: Diffusion of Innovations Necessary for “Mainstream Connectivity” Among Households in the United States, 2001-present**

Households Access Internet via Dial Up <sup>5</sup>											Households Access Internet via Broadband/High Speed Connections <sup>6</sup>										
Majority of Americans Own Mobile Phone <sup>3</sup>											Majority of Americans Own a Smartphone <sup>4</sup>										
Home Desktop computers are mainstream <sup>1</sup>											Personal Laptop computers are mainstream <sup>2</sup>										
2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	

<sup>1</sup> Martin, Michael. 2021. Computer and Internet Use in the United States: 2018. *American Community Survey Reports*. U.S. Census Bureau, Washington DC.

<sup>2</sup> Zickhur and Smith, 2012.

<sup>3</sup> Tuckel, Peter and Harry O'Neill. 2005. Ownership and usage patterns of cell phones: 2000-2005. Paper presented at the Annual Conference of the American Association for Public Opinion Research, Miami Beach, FL.

<sup>4</sup> Pew Research Center. 2021. Mobile Fact Sheet. <https://www.pewresearch.org/internet/fact-sheet/mobile/>

<sup>5</sup> NTIA. 2002. A Nation Online. U.S. Department of Commerce; By September 2001, a majority of American households had dial-up Internet access.

<sup>6</sup> NTIA. 2007. Networked Nation. U.S. Department of Commerce; By October 2007, a majority of American households had broadband Internet access.

## ***2. Dominant Internet-Based Devices: The Personal Computer and Mobile Phone***

A solid evidence base supports the claim that “mainstream” digital connectivity requires access to both a personal computer (desktop or laptop) and mobile phone during this period.<sup>102</sup> Figure 1 illustrates that home computers (desktops or laptops) had reached a “mainstream” level of adoption by 2001, while the mobile phone was a mainstream device by 2001, with Smartphones as the dominant telephone device by 2012. For this reason, both personal computers and mobile phones are included in our calculations.

## ***3. Accessing the Internet: From Dial Up to Broadband.***

Dial-up, home internet connections were a majority access point for Americans from September 2001 through September 2007. By October 2007, the majority of U.S. households had

<sup>101</sup> (Rogers 1995)

<sup>102</sup> (Hauge, Chiang and Jamison 2009; Martin 2021; Napoli and Obar 2014; Rainie and Wellman 2012; Rennhoff and Routon 2016; Tsetsi and Rains 2017).



a home broadband connection (See Figure 1). Home internet penetration moved above 50 percent (to 54 percent) of households in September, 2001<sup>103</sup> and broadband penetration in households reached majority penetration (50.8 percent) in October of 2007.<sup>104</sup> Maintaining landlines was critical as a source of dial-up connections, particularly prior to 2008, even among users of mobile phones. LISEP incorporates the costs associated with maintaining a reliable internet connection, drawing on the appropriate “mainstream” access point, dial-up versus broadband, in the index. For the period 2001 – 2007, LISEP assumes that a mainstream internet connection required a landline and dial-up subscription. After 2007, it is assumed that a mainstream internet connection required a broadband subscription.

## ii. Methodology

### I. Data Sources

LISEP draws on three publicly available data sources to generate device and internet prices used to estimate the annual costs of digital connectivity from 2001 to 2020.

#### *A. The Consumer Expenditure Survey Public Use Microdata (CE PUMD)*<sup>105</sup>

The central data source is historical consumer spending data drawn from the Consumer Expenditure (CE) Surveys. The CE PUMD is an ideal data source for this purpose because CE data are collected from a representative U.S. sample using two separate surveys, the Interview Survey and the Diary Survey. Data are available quarterly and integrated data from the Diary and Interview surveys provide a complete accounting of consumer expenditures over time, including expenditures related to technology and internet purchases. In general CE PUMD data are

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<sup>103</sup> (National Telecommunications and Information Administration 2002)

<sup>104</sup> (National Telecommunications and Information Administration 2007).

<sup>105</sup> (Bureau of Labor Statistics)

considered the “gold standard” dataset for estimating U.S. consumer spending on a variety of goods and services. The two surveys that comprise the CE PUMD contain a level of granularity in expenses that is unparalleled in any other publicly available dataset. Moreover, the Bureau of Labor Statistics (BLS) uses this dataset to calculate the Consumer Price Index (CPI).<sup>106</sup> Thus, we rely on the CE PUMD for being the most granular and comprehensive dataset on expenditure in the U.S. that is nationally representative.

***Income Groups.*** In LISEP’s analysis, the respondents of the survey are sorted into six different income groups, using the *fincbtxm* variable, which records the “total amount of family income before taxes” to develop six different income groups: 1) 0-10<sup>th</sup> percentile, 2) 10<sup>th</sup> to 25<sup>th</sup>, 3) 25<sup>th</sup> to 50<sup>th</sup>, 4) 50<sup>th</sup> to 75<sup>th</sup>, 5) 75<sup>th</sup> to 90<sup>th</sup>, and 6) 90<sup>th</sup> to 100<sup>th</sup>. These different groups are used because they provide a better view of the distribution without sacrificing the large sample size that helps to make a robust estimate. These bounds are the “quartiles and selected deciles” used in the Usual Weekly Earnings release by the BLS.<sup>107</sup>

***Household Types.*** In our analyses using the CE PUMD data in this section, consumption patterns across consumer units are examined<sup>108</sup> using the *fam\_type* variable: households<sup>109</sup> with a single adult and households with couples. This is to simplify assumptions about device

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<sup>106</sup> (Consumer Expenditure Survey)

<sup>107</sup> (Bureau of Labor Statistics: Current Population Survey)

<sup>108</sup> A consumer unit comprises either: (1) all members of a particular household who are related by blood, marriage, adoption, or other legal arrangements; (2) a person living alone or sharing a household with others or living as a roomer in a private home or lodging house or in permanent living quarters in a hotel or motel, but who is financially independent; or (3) two or more persons living together who use their income to make joint expenditure decisions. Financial independence is determined by the three major expense categories: Housing, food, and other living expenses. To be considered financially independent, at least two of the three major expense categories must be provided entirely, or in part, by the respondent. (<https://www.bls.gov/cex/csxgloss.htm>)

<sup>109</sup> The CE uses the words consumer unit throughout their documentation. We will use “households” to refer to consumer units to maintain consistent with the rest of this methodology.

ownership and access in families, conservatively assuming, for example, that only adults in a household require cell phones. In addition, only households that have less than six people are included in the analysis because all the family types in LISEP's measurement have less than six people (see previous section on family types for justification).

To calculate cell phone prices, only households that are single persons or couples are used. We allocate the single person's cost to that of the family that has a single adult, and the couple's cost to two-parent families. LISEP does not include any families with children in this analysis because cell phones for children aren't considered to be a minimal adequate need. There is no way to distinguish spending within the reporting household, and so just the households that don't have children are evaluated to be completely confident that the cell phone spending was not allocated to the children.

### ***B. Archived Sources of Historic Technology Prices***

The CE PUMD data and analyses are supplemented with historic archival sources that document pricing related to digital connectivity. Two archived sources of technology prices are used: 1) the monthly issues of *PC Magazine*<sup>110</sup> and 2) the *Wayback Machine*, an online Internet archive, to access historical pricing information from websites such as Walmart, BestBuy, and Nokia.<sup>111</sup> *PC Magazine* is a rich source of desktop prices for the period 2001-2005. LISEP found this to be the best, publicly available documentation of desktop prices for the aforementioned period before online shopping became mainstream. The *Wayback Machine* archive provided access to historic webpages of low-cost retailers and technology manufacturers for the period when online shopping became common practice (2006-2020).

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<sup>110</sup> (PC Magazine)

<sup>111</sup> <https://web.archive.org/>

### ***C. Archived Reports from the Federal Communications Commission***

LISEP uses the *Reference Book of Rates, Price Indices, and Household Expenditures for Telephone Service*<sup>112</sup> published by the Industry Analysis & Technology Division of the Wireline Competition Bureau, which is under the Federal communications Commission (FCC). This annual report is used to establish historic landline phone rates for households from 2001-2007. The reports document annual rates for a range of expenses relating to telephone services, such as the cost of the line, or the price of long-distance calls, throughout the United States. It also provides a comprehensive analysis of the different types of charges that telephone service entails. LISEP uses the monthly recurring charge for residential phones, excluding any connection charges for first-time connections that are a one-time charge because such charges likely took place before the first year of our analysis period (2001). Landlines are not being newly adopted during the period 2001-2020 but are on the decline.

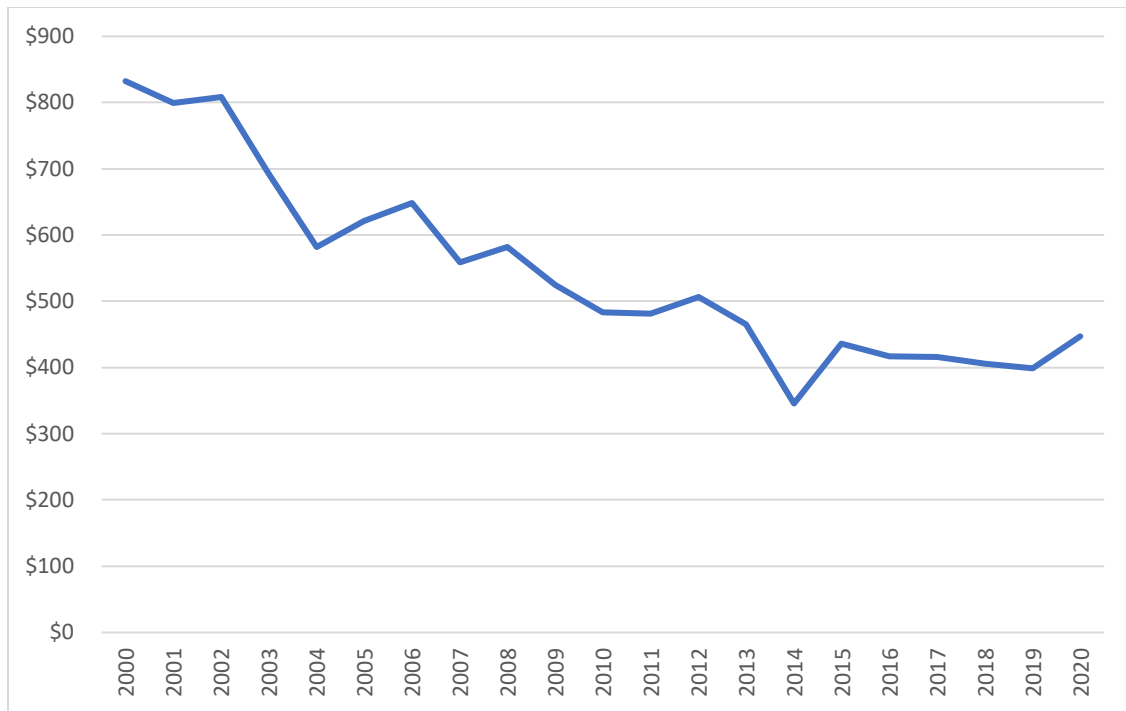
## **2. Procedures for Generating Annual Price Estimates**

### ***a. Personal Computer Prices***

**Figure 2: Time Series of the Average Prices of Three Essential Desktops 2000-2020**

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**112**  
(Reference Book of Rates, Price Indices, and Expenditures for Telephone Service)



Source: *Best Selling Computer Brands- 1999/2020*. (n.d.). Statistics & Data. Retrieved October 29, 2021, from <https://statisticsanddata.org/best-selling-computer-brands-1996-2020/>

For the period 2001-2005, LISEP draws on analysis by Statistics & Data, which identifies the five best-selling computer manufacturers by year. This allowed for a focus on key manufacturers combined with our archival sources of computer prices. Next LISEP reviewed the monthly issues of *PC Magazine* from 2001-2005, where desktop computer prices were identified by manufacturer (e.g., Compaq, Gateway) for desktops marketed as suitable for web surfing or otherwise identified as essential, such as when an advertisement by the manufacturer clearly labeled the desktop for essential home use. LISEP documented the prices of three desktops offered by manufacturers among the most popular five and calculated an average “essential desktop” price for each year.<sup>113</sup>

For the period 2006-2020, LISEP consulted archived websites of manufacturers or large stores that served home technology consumers (e.g., BestBuy, WalMart) to price essential

<sup>113</sup> A list of the desktops’ features (processor speed, monitor size and SDRAM) are available in Appendix 1.

desktops following a two-step process. Again, drawing on the list of the five top manufacturers in a given year (described above), three manufacturers were chosen, and their archived websites were reviewed for the year in question. The archived websites were visited in June of a given year, but if the June page was not archived, we selected a close date in July or August. The choice of three manufacturers depends on the availability of archived pages in a given year. If LISEP was unable to access at least three manufacturers' websites, pricing information was reviewed on the websites of large consumer goods suppliers, such as Wal-Mart or BestBuy. Just as in the earlier period, LISEP uses prices associated with desktop computers that are marketed by the manufacturer as essential web-surfing devices that do not have any luxurious features such as a touchscreen and are generally the cheapest choice the manufacturer offered in that year.

For example, in 2014 the top desktop manufacturers were Lenovo, HP, Dell, Acer and Asus, in this order. Of all five websites, only the Dell and HP websites were archived for 2014. On BestBuy's website, LISEP was able to find a Lenovo desktop with analogous "essential" features given the sparse archiving of Lenovo's website for that year. LISEP was not able to find archived pages advertising Acer or Asus desktops on Walmart or BestBuy. Further, the Acer and Asus websites weren't archived, so LISEP did not select them. In sum, ability to document prices for the top five manufacturers in any given year was subject to available historic information.

It is worth noting that starting 2010, LISEP chose to include price estimates for all-in-one computers because in this year, they become widely available at prices comparable to desktops. The all-in-one computer ensures accounting for the cost of a mouse, a keyboard, and adequate speakers.

In all years, the desktop price is recorded before any discount or deal because LISEP does not assume that a median-wage worker has any specific subscriptions or otherwise

privileged access to discounted prices. A desktop lifespan of five years is assumed. Research shows that typically 10% or less of users own a desktop that is more than five years old.<sup>114</sup> LISEP thus assumes that the user will need to purchase a new desktop every five years as an essential adequate need. Hence, the cost of a desktop is divided over five years to simulate a replacement rate and smooth the expenditure.

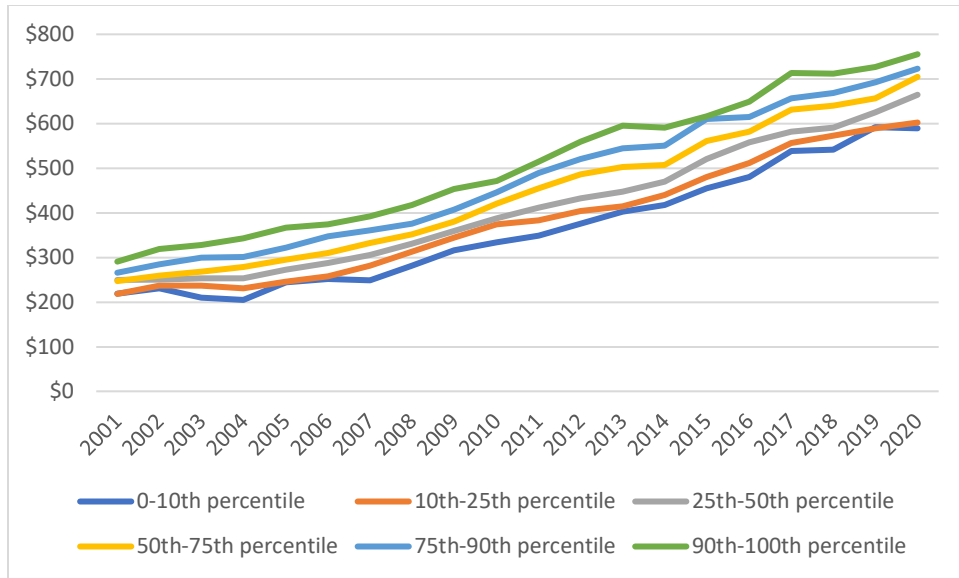
***b. Ancillary Computer Costs***

Personal desktop computer users also encounter maintenance costs to keep these devices functional over time, such as the costs of repairs or costs associated with consulting experts to troubleshoot common problems, such as a downloaded virus. Estimates based on real spending in this area are used, drawn from the CE PUMD data, specifically the MTBI survey file. In this file, LISEP uses the UCC code 690114 for computer information services, distinguishing average spending per year across our six income groups for households of five or less. Figure 3 documents average spending on computer information services by income group from 2001-2020:

**Figure 3: Computer Information Services Spending by Income Group**

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<sup>114</sup> (Gordon B. R. 2009)



Source: Consumer Expenditure Survey. (2021, September). *Consumer Expenditure Surveys Public Use Microdata*

The graph depicts a very tight grouping of spending changes by income group. In fact, the six income groups show average annual spending increases of 5.5%, 5.5%, 5.4%, 5.7%, 5.5%, and 5.2% in order of lowest income group to highest income group. By this change in spending, LISEP can assume that computer repair costs increase at roughly the same pace per year for each income group and takes a conservative 10<sup>th</sup> to 25<sup>th</sup> income range spending for the cost in the index (taking the 0-10<sup>th</sup> and 50<sup>th</sup>-75<sup>th</sup> would have the same effect).

### ***c. Internet Prices***

#### ***c1. Internet***

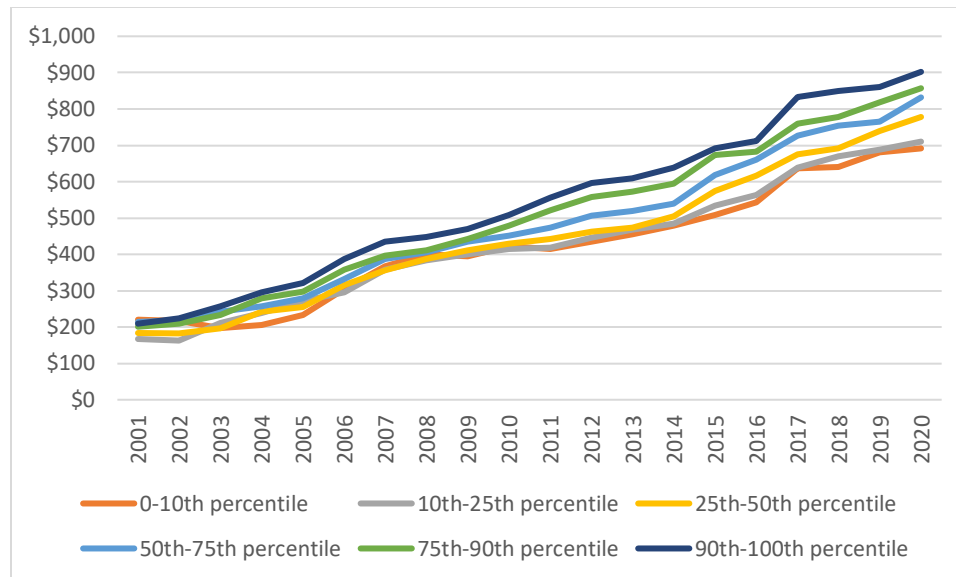
To estimate household internet expenses, the CE PUMD data is used, specifically the UTA detailed data file from the interview survey and the *qadinetx* variable which records the “total expense for internet access or data services”<sup>115</sup> for the consumer unit. LISEP uses the *finlwt21* variable to generate an annualized weighted spending according to the procedures

<sup>115</sup> (Consumer Expenditure Survey)



specified on the CE PUMD site. Finally, only households with five members or less (using the fam\_size variable) are analyzed. Figure 4 shows the average spending by income group, contingent on internet spending.

**Figure 4: Internet spending by income level**



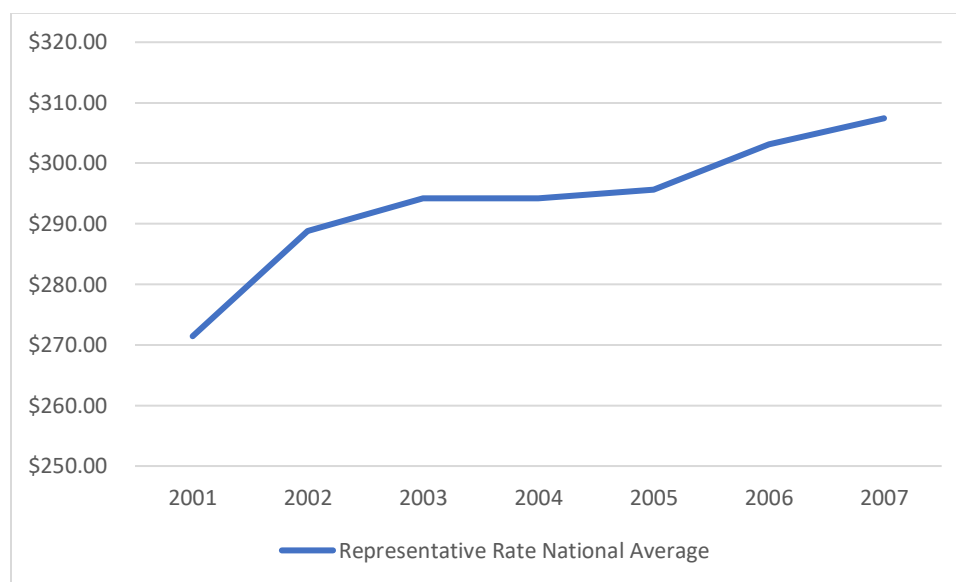
Source: Consumer Expenditure Survey. (2021, September). *Consumer Expenditure Surveys Public Use Microdata*

Figure 4 documents that households at all income levels consumed internet services over the study period, consistent with the idea that internet access is essential. While variability in spending is higher across income groups later in the period, particularly important is the very similar spending changes from the 10<sup>th</sup> to 100<sup>th</sup> percentile (income groups 2-6). By group, the average spending annual increase was 8.1%, 8.1%, 7.5%, 8.1% and 8.1% respectively. Not following this trend was the lowest decile, at a 6.5% annual increase. These similarities suggest that the vast majority of Americans increased their expenditures on internet technology, on average, 8.1% each year (the median rate of increase).

## c2. Additional Internet Related expenses- Landline

Estimates of internet costs, described above, omit one important expense earlier in the period—the cost of maintaining a landline. Research shows that the majority of Americans accessed the internet using a dial-up connection from 2001-2007 (see Figure 1). This means that the cost of essential digital connectivity incorporated the price of a landline during that part of the period. There are two types of phone line rates: 1) flat-rate and 2) measured/message rates. The “representative rate” is defined by the FCC as being the flat rate if that type of charge is available for a given area, but otherwise the average charge for the measured/message rate. To establish the price of landline connection, LISEP uses the average national “representative rate.” LISEP also does not vary this cost by region because of evidence from Table 2.1 in the FCC release. This table shows that, over time, the expenditures by households for telephone services by region are very similar (with less than 10% gap between the lowest and highest expenditures). Figure 5 documents the average monthly representative rate for landline prices as documented by the FCC:

**Figure 5: Annualized Recurring Charges for Telephone Services**



Source: *Reference Book of Rates, Price Indices, and Expenditures for Telephone Service* (Federal Communications Commission, Comp.; (Reference Book of Rates, Price Indices, and Expenditures for Telephone Service). (2008).

The costs indicated by these reports are applied to the household budget for landlines from 2001 to 2007.

#### **d. Mobile Phone Prices.**

To generate precise mobile phone pricing estimates, the 2001-2020 period of interest is divided into two distinct time periods that require different pricing approaches: 1) 2001-2012, a period where cell phones were bundled with a plan (typically a two-year contract), making it difficult to isolate device versus connection costs, and 2) 2013-2020 where users were required to purchase a cellphone and a cellular plan separately. These two periods were determined by analyzing historic product and pricing data on the websites of cellular service providers (e.g., AT&T, Horizon, T-Mobile) and mass market suppliers like Wal-Mart and BestBuy.

For the period 2001-2007, an annual price is estimated that bundles the device cost into the overall cellular plan for a given year. Proof is provided from Nokia's archived website pages, indicating one could purchase a free phone with a cellular plan in that year. Nokia was chosen because it was the only important mobile phone manufacturer with a website that was archived in the early 2000's and because Nokia phones consistently ranked among the best-selling phones in the U.S. for this period.<sup>116</sup> For the period 2008-2012, LISEP provides proof that one could purchase a free phone with a cellular plan, but our estimates include price information on at least two different plans to suggest that at least two carriers offered a phone for "free" when purchasing a carrier's plan (see Appendix 1). This is because cell phone carriers only started advertising their plans with free phones on their websites in 2008. LISEP reasons that it is

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<sup>116</sup> (List of best-selling mobile phones)

possible to purchase a free phone with a plan if at least two websites advertise such a bundle. In addition, LISEP pays attention to the availability of choice or carrier to ensure that a hypothetical user can purchase a plan that can operate in their area of residence.

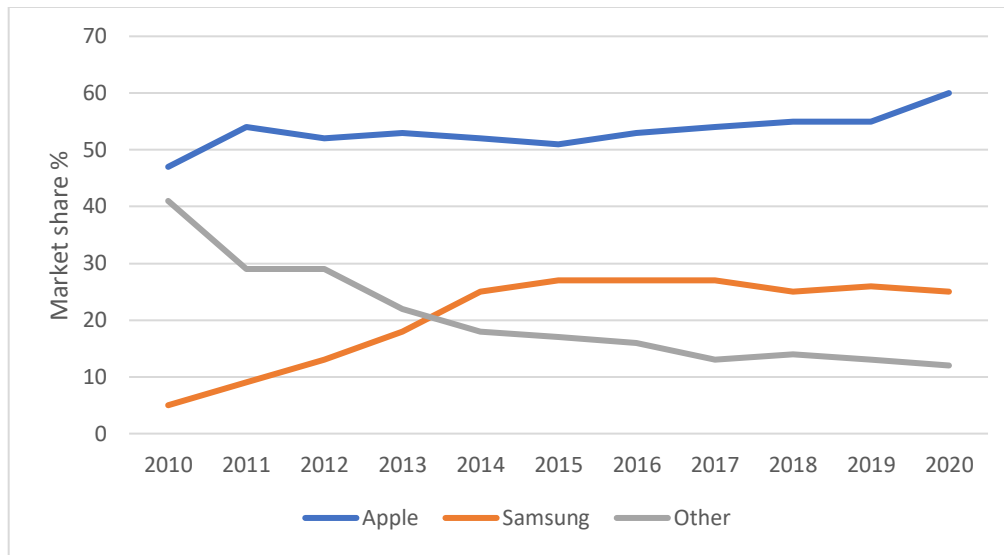
For the period 2013-2020, the cost of a mobile phone is estimated separately from the cost of a mobile phone plan. Evidence suggests that Apple and Samsung captured a clear majority of the cellphone market ranging from about 71% of U.S. sales in 2013 to 85% of sales in 2020 (See Figure 6). Given the dominance of these two manufacturers in the LISEP period of interest, annual prices for Apple and Samsung Galaxy S phones are averaged across these two prices to generate a single annual estimate. The Galaxy S Series of Samsung phones was chosen because it was ranked among the top-selling Samsung smartphones for each year in the period 2013-2020.<sup>117</sup> In each year, a price is estimated as follows: 1) take the phone's market price upon release, 2) depreciate the price by a two-year model-specific depreciation rate recorded by Decluttr, a tech buyback site and refurbished phone seller,<sup>118</sup> and 3) average the iPhone and Samsung depreciated prices to create a single annual estimated cell phone cost (see figure 7 for how the Samsung and iPhone depreciated prices compare to the composite average annually).

**Figure 6: U.S. Mobile Phone Market Share for Apple, Samsung, and Others, 2010 – 2020)**

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<sup>117</sup> List of best-selling mobile phones)

<sup>118</sup> (Smith C. 2017)



Source: *Mobile Vendor Market Share United States Of America Mar 2010 - Sept 2021*. (2021). Statcounter Global Stats. Retrieved October 29, 2021, from <https://gs.statcounter.com/vendor-market-share/mobile/united-states-of-america/#monthly-201003-20219>

A two-year depreciation rate was chosen because waiting two years to purchase a phone significantly reduces its price, usability notwithstanding. However, available software updates become increasingly rare. A 2018 report from the Federal Trade Commission showed that software updates after five years are rare.<sup>119</sup> In addition, there is some evidence from consumer guides recommending replacement of phones when software updates are no longer available.<sup>120</sup> Since LISEP assumes the median-wage worker purchases a mobile phone two years after its release, this results in three years of essential use.

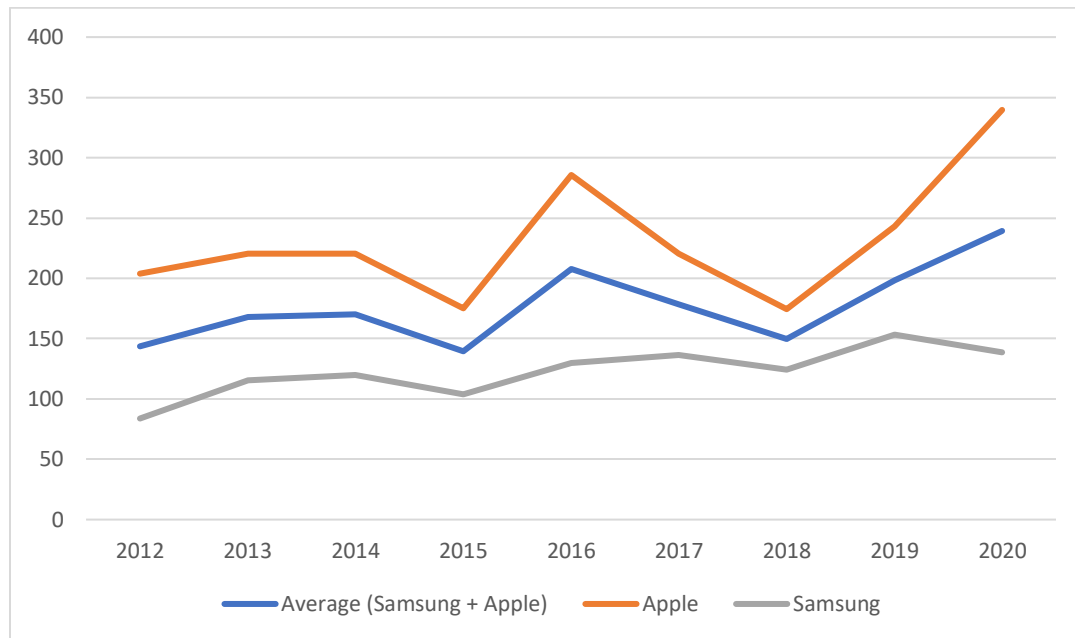
In some cases, a two-year depreciation rate for a specific phone of interest cannot be specified each year because this information is not available. In those cases, the average iPhone or Samsung two-year depreciation rate is used. For example, LISEP could not find the two-year depreciation rate for iPhone 4 (available in 2010), so this phone was depreciated by a rate of 66%, which is the average two-year depreciation of all iPhones released until 2021. Similarly, a

<sup>119</sup> (Mobile Security Updates: Understanding the Issues)

<sup>120</sup> (Chen B.X. 2021)

two-year depreciation rate for the Samsung Galaxy S2 (available in 2011) wasn't available, so the average Samsung Galaxy S Series two-year depreciation rate of 79% was used.

**Figure 7: U.S. Mobile Phone 2-Year Depreciated Prices (Apple, Samsung, & Average)**



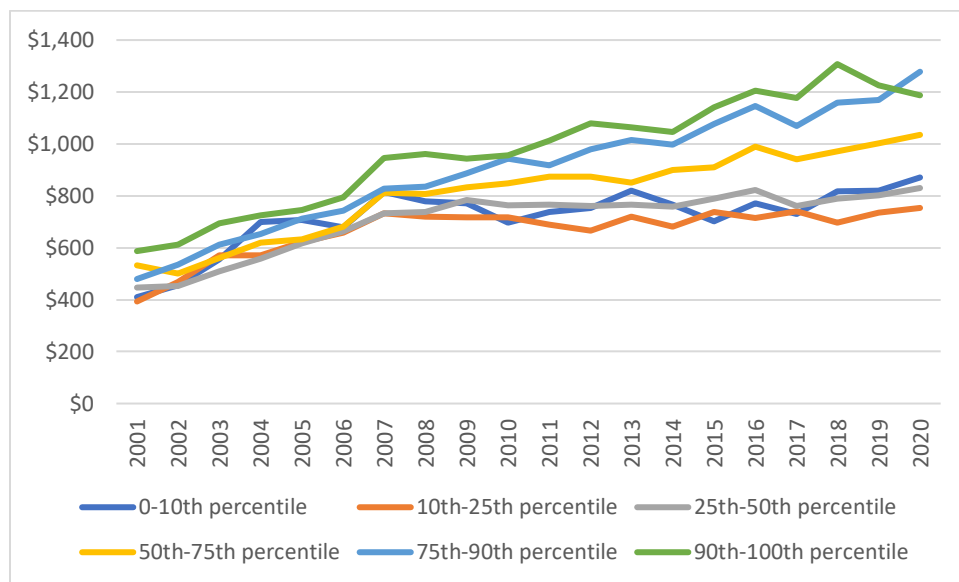
Sources: *iPhone prices from the original to iPhone X*. (2017, September 12). Venture Beat. Retrieved October 29, 2021, from <https://venturebeat.com/2017/09/12/iphone-prices-from-the-to-iphone-x/>  
 Brown, C. S. (2021, April 10). *How the price of Samsung Galaxy S phones changed over the years*. Android Authority. Retrieved October 29, 2021, from <https://www.androidauthority.com/samsung-galaxy-s-price-s-1192063/>

### e. Cellular Service

LISEP used CE PUMD data, specifically the UTA detailed data file from the interview survey, to estimate the cost of cellular service from 2001-2020. Note that cellular service is the cost of the service, not of the hardware, making this a necessary accompaniment to the previous section. In this file, LISEP uses the *telcellx* variable that records the “total expense for

mobile/cellular”<sup>121</sup> for the consumer unit. The *finlwt21* variable is used to generate an annualized weighted spending according to the procedures specified on the PUMD site. In the years prior to 2013, the cost of the cellular device was bundled with the cell phone service. LISEP generated the average spending within income groups by year among those that purchased cellular service (see Figure 8). Lastly, because it is assumed that just household adults use cell phones, different estimates are created for households with one versus two adults, with reasoning justified in the data section.

**Figure 8: Cellular service spending by income group for single households**



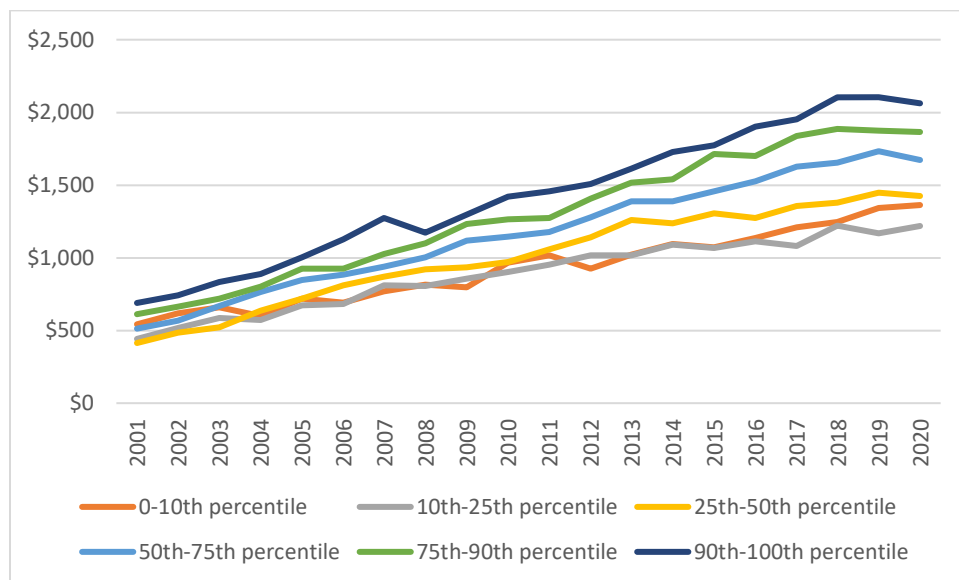
Source: Consumer Expenditure Survey. (2021, September). *Consumer Expenditure Surveys Public Use Microdata*

The percentage growth from 2001 to 2020 for households headed by a single adult in the 10<sup>th</sup>-75<sup>th</sup> percentile income groups for cell phone service is similar (see Figure 8). The average yearly increase in spending for the 10<sup>th</sup> to 25<sup>th</sup>, 25<sup>th</sup> to 50<sup>th</sup>, and 50<sup>th</sup> to 75<sup>th</sup> percentiles is 3.7% 3.4% and 3.7% respectively. These consistent spending patterns suggest that these income groups are facing very similar cost increases. We take the spending increases for the 10<sup>th</sup> to 25<sup>th</sup>

<sup>121</sup> (Consumer Expenditure Survey)

percentiles to take a “minimal” approach to conservatively allocate costs to the relevant household budgets (single adult families).

**Figure 9: Cellular service spending by income group for couple households**



Source: Consumer Expenditure Survey. (2021, September). *Consumer Expenditure Surveys Public Use Microdata*

Figure 9 documents spending trends on cellular service for households with two adults. Again, spending increases are very similar, especially in the middle of the distribution. The 10<sup>th</sup> to 25<sup>th</sup>, 25<sup>th</sup> to 50<sup>th</sup>, 50<sup>th</sup> to 75<sup>th</sup>, and 75<sup>th</sup> to 90<sup>th</sup> have increases of 5.7%, 6.8%, 6.5% and 6.2% respectively. All of these are very close to 6%, which suggests that the middle of the distribution is experiencing similar cost changes. To remain consistent within cell phones, and to take a “minimal” approach, LISEP again takes the spending of the 10<sup>th</sup> to 25<sup>th</sup> income percentiles and allocates these costs to the relevant household budgets (families with two parents).



## Appendix 1

**Table 1: Desktop features and composite prices**

<b>Y E A R</b>	<b>FIRST DESKTOP PRICE</b>	<b>FEATURES</b>	<b>SECOND DESKTOP PRICE</b>	<b>FEATURES</b>	<b>THIRD DESKTOP PRICE</b>	<b>FEATURES</b>	<b>COMPOSITE PRICE</b>
2000	\$699	Processor 500MHz + 15" monitor + 32 SDRAM	\$899	Processor 500MHz + 15" monitor	\$899	Processor 667MHz + 15" monitor + 32 SDRAM	<b>\$832</b>
2001	\$699	Processor 933 MHz + 15" monitor + 64 SDRAM	\$899	Processor 766MHz + 15" monitor + 64 SDRAM	\$799	Gateway essential PC	<b>\$799</b>
2002	\$678	Processor 733 MHz + 15" monitor + 64 SDRAM	\$899	Processor 1.7 GHz + 17" monitor + 128 SDRAM	\$849	Processor 1.8 GHz + Samsung monitor	<b>\$809</b>
2003	\$759	Processor 2GHZ + 17" monitor + 256 SDRAM	\$599	Processor 2.4 GHz + Samsung monitor + 256 SDRAM	\$719	Processor 2.4 GHz + Samsung monitor + 128 SDRAM	<b>\$692</b>
2004	\$599	Processor 2.66GHz + 17" monitor + 128 SDRAM	\$529	Processor 2.8 GHz + Samsung monitor + 128 SDRAM	\$618	Processor 2.6 GHz + 17" monitor + 128MGB SDRAM	<b>\$582</b>
2005	\$400	Processor 2.4GHz + Samsung monitor + 256 SDRAM	\$696	Processor 2 GHz, 15" monitor + 256 SDRAM	\$768	Processor 2.8 GHz + 15" monitor + 256 SDRAM	<b>\$621</b>
2006	\$684	Processor 2.2GHz + 17" LCD monitor + 512 SDRAM	\$729	Processor 2.53 GHz + 17" LCD monitor + 512 SDRAM	\$533	Processor 2.8 GHz + 17" LCD monitor from Walmart + 256 SDRAM	<b>\$649</b>
2007	\$510	Processor 3.46GHz + 17" LCD monitor	\$528	Processor AMD Sempron 3400+ + 17"LCD Dell monitor + 512 SDRAM	\$638	Processor Pentium D + 19" LCD MONITOR + 1024 SDRAM	<b>\$559</b>
2008	\$598	Processor 2.2 GHz + monitor 19" LCD + 2 GB SDRAM	\$548	Processor 2 GHz + 19" LCD monito + 1 GB SDRAM	\$599	Intel dual core processor 1.8 GHz + 19" LCD monitor + 1 GB SDRAM	<b>\$582</b>
2009	\$598	X2 4850e+ Dual-Core Processor + 20" LCD monitor + 3 GB of SDRAM	\$479	Processor dual core E1400 + 20" LCD monitor	\$498	Processor 2.2 GHz + 19" LCD monitor + 2GB SDRAM	<b>\$525</b>
2010	\$498	Processor 2.2 GHz + 18.5" LCD monitor + 3GB of SDRAM	\$448	Processor 1.6 GHz + 19" LCD monitor + 3GB SDRAM	\$503	Processor 1.6GHz + 15.6" LCD monitor + 2GB of SDRAM	<b>\$483</b>

2011	\$498	Processor 3.5GHz + 20" LCD monitor + 4GB SDRAM	\$498	Processor 2.2 GHz + 21.5" LCD monitor + 3GB of SDRAM	\$448	Processor 2.2 GHz + 18.8" LCD monitor + 3GB SDRAM	<b>\$481</b>
2012	\$479	Processor 1.7 GHz + 20" monitor + 2GB SDRAM	\$529	Processor 2.2 GHz + 20" monitor + 4GB SDRAM	\$510	Processor 1.8 GHz + 18.5" LCD monitor + 2GB SDRAM	<b>\$506</b>
2013	\$499	Processor 2.5GHz + 20" monitor + 4GB SDRAM	\$449	Processor 1.4GHz + 20" monitor + 2GB SDRAM	\$449	Processor 2.2ghZ + 20" monitor + 2GB of SDRAM	<b>\$466</b>
2014	\$349	Processor intel Celeron + 19.5" monitor + 4GB of SDRAM	\$339	Processor 1.4GHz + 18.5" monitor + 4GB SDRAM	\$349	Processor quad core + 20" monitor + 4GB SDRAM	<b>\$346</b>
2015	\$399	Processor 2.41GHz + 19.45" monitor + 4GB SDRAM	\$479	Processor 2.58GGHz + 19.5" monitor + 2GB of SDRAM	\$429	Processor 2.9GHz + 23" monitor + 8GB SDRAM	<b>\$436</b>
2016	\$449	Processor 2.9GHz + 20" monitor + 4GB SDRAM	\$452	Processor 1.4GHz + 21.5" monitor + 4GB SDRAM	\$349	Processor 2.8GHz + 19.5" monitor + 4GB of SDRAM	<b>\$417</b>
2017	\$499	Processor 2.4GHz + 21.5" monitor + 4GB SDRAM	\$349	Processor 1.6GHz + 19.5" monitor + 8 GB SDRAM	\$399	Processor 2.64GHz + 19.5" monitor + 4GB SDRAM	<b>\$416</b>
2018	\$379	Processor 1.8 GHz + 19.5" monitor + 4GB SDRAM	\$439	Processor 1.4GHz + 21.5" monitor + 4GB SDRAM	\$399	Processor 2GHz + 21.5" monitor + 4GB SDRAM	<b>\$406</b>
2019	\$379	Processor 2.7GHz + 19.5" monitor + 4GB SDRAM	\$379	Processor 2.3 GHz + 19.5" monitor + 4GB SDRAM	\$438	Processor 2GHz + 22" monitor + 4GB SDRAM	<b>\$399</b>
2020	\$541	Processor 3.7GHz + 21.5" monitor + 4GB SDRAM	\$399	Processor 2.3 GHz + 19.5" monitor + 4GB SDRAM	\$400	Processor 3GHz + 19.5" monitor + 4GB SDRAM	<b>\$447</b>

## Appendix 2

**Table 2: Evidence for availability of free cellphones with a plan**

YEAR	WEBSITE VISITED	URL
2001	Nokia	<a href="https://web.archive.org/web/20010615132849/http://www.nokiausa.com/firsttimebuyers/1,2506,;;index,FF.html#howmuch">https://web.archive.org/web/20010615132849/http://www.nokiausa.com/firsttimebuyers/1,2506,;;index,FF.html#howmuch</a>
2002		
2003	All business	<a href="https://www.allbusiness.com/cell-phone-basics-1124-1.html">https://www.allbusiness.com/cell-phone-basics-1124-1.html</a>
2004	Nokia	<a href="https://web.archive.org/web/20040614184050/http://www.nokiausa.com/phones/">https://web.archive.org/web/20040614184050/http://www.nokiausa.com/phones/</a>
2005	Nokia	<a href="https://web.archive.org/web/20050624013656/http://www.nokiausa.com/phones/compareandbuy/1,1816,hm:link,00.html">https://web.archive.org/web/20050624013656/http://www.nokiausa.com/phones/compareandbuy/1,1816,hm:link,00.html</a>
2006	Nokia	<a href="https://web.archive.org/web/20060703040716/http://www.nokiausa.com/phones/comparephones">https://web.archive.org/web/20060703040716/http://www.nokiausa.com/phones/comparephones</a>
2007	Nokia	<a href="https://web.archive.org/web/20070202130024/http://www.nokiausa.com/phones/comparephones">https://web.archive.org/web/20070202130024/http://www.nokiausa.com/phones/comparephones</a>
2008	AT&T and T-Mobile	<ul style="list-style-type: none"> <li>• <a href="https://web.archive.org/web/20080615011510/http://www.wireless.att.com/cell-phone-service/cell-phone-sales/promotion/free-phones.jsp?source=IC4425L3100u9000">https://web.archive.org/web/20080615011510/http://www.wireless.att.com/cell-phone-service/cell-phone-sales/promotion/free-phones.jsp?source=IC4425L3100u9000</a></li> <li>• <a href="https://web.archive.org/web/20081012072217mp_/http://www.t-mobile.com/shop/phones/default.aspx?all=true">https://web.archive.org/web/20081012072217mp_/http://www.t-mobile.com/shop/phones/default.aspx?all=true</a></li> </ul>
2009	AT&T and T-Mobile	<ul style="list-style-type: none"> <li>• <a href="https://web.archive.org/web/20090706234012/http://www.wireless.att.com/cell-phone-service/cell-phones/free-phones.jsp">https://web.archive.org/web/20090706234012/http://www.wireless.att.com/cell-phone-service/cell-phones/free-phones.jsp</a></li> <li>• <a href="https://web.archive.org/web/20090228121303mp_/http://www.t-mobile.com/shop/phones/default.aspx?all=true">https://web.archive.org/web/20090228121303mp_/http://www.t-mobile.com/shop/phones/default.aspx?all=true</a></li> </ul>
2010	AT&T and T-Mobile	<ul style="list-style-type: none"> <li>• <a href="https://web.archive.org/web/20100519230557/http://www.wireless.att.com/cell-phone-service/cell-phone-sales/promotion/free-phones.jsp">https://web.archive.org/web/20100519230557/http://www.wireless.att.com/cell-phone-service/cell-phone-sales/promotion/free-phones.jsp</a></li> <li>• <a href="https://web.archive.org/web/20100722094207/http://www.t-mobile.com/shop/phones/?priceRange=0-0&amp;WT.z_unav=mst_shop_phones_free">https://web.archive.org/web/20100722094207/http://www.t-mobile.com/shop/phones/?priceRange=0-0&amp;WT.z_unav=mst_shop_phones_free</a></li> </ul>

<b>2011</b>	AT&T, T-Mobile, and Verizon	<ul style="list-style-type: none"> <li>• <a href="https://web.archive.org/web/20110620074417/http://www.wireless.att.com/cell-phone-service/cell-phones/free-phones.jsp?wtSlotClick=1-0060AM-0-2">https://web.archive.org/web/20110620074417/http://www.wireless.att.com/cell-phone-service/cell-phones/free-phones.jsp?wtSlotClick=1-0060AM-0-2</a></li> <li>• <a href="https://web.archive.org/web/20110626005501/http://www.t-mobile.com/shop/phones/?pricerange=0-0">https://web.archive.org/web/20110626005501/http://www.t-mobile.com/shop/phones/?pricerange=0-0</a></li> <li>• <a href="https://web.archive.org/web/20110603223730/http://www.verizonwireless.com/b2c/promo/splash/ewp?v=16">https://web.archive.org/web/20110603223730/http://www.verizonwireless.com/b2c/promo/splash/ewp?v=16</a></li> </ul>
<b>2012</b>	T-Mobile, AT&T, and Verizon	<ul style="list-style-type: none"> <li>• <a href="https://web.archive.org/web/20120613231729/http://www.t-mobile.com/shop/phones/?pricerange=0-0">https://web.archive.org/web/20120613231729/http://www.t-mobile.com/shop/phones/?pricerange=0-0</a></li> <li>• <a href="https://web.archive.org/web/20120601172548/http://www.wireless.att.com/cell-phone-service/cell-phones/free-phones.jsp?wtSlotClick=1-006PV2-0-2">https://web.archive.org/web/20120601172548/http://www.wireless.att.com/cell-phone-service/cell-phones/free-phones.jsp?wtSlotClick=1-006PV2-0-2</a></li> <li>• <a href="https://web.archive.org/web/20121018010506/http://www.verizonwireless.com/b2c/store/controller?&amp;item=phoneFirst&amp;action=viewPhoneOverviewByDevice&amp;linkId=15">https://web.archive.org/web/20121018010506/http://www.verizonwireless.com/b2c/store/controller?&amp;item=phoneFirst&amp;action=viewPhoneOverviewByDevice&amp;linkId=15</a></li> </ul>

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## F. Miscellaneous Items

### i. Aim

The aim for the miscellaneous items section is to fill in the gaps of necessities that are not covered by the other categories. These include apparel, personal care, necessary services, and household items not included in rent. The minimal adequate need of personal care and apparel items is defined to be such that they do not impede the ability for people to interact in society and live a healthy life.

Two groups are thus excluded from consideration. One group is characterized by the inability to meet this standard for any reason. This group may not have access to the necessary apparel, personal care, or household cleaning products because of monetary restrictions, or individuals may not maintain social standards because of personal preferences. Second, we exclude those who spend superfluously on these miscellaneous items. This might include spending on expensive brands, purchasing too many items too frequently, or frivolous use of goods.

## ii. High-Level Methodology

There is an important distinction that LISEP makes in this section. Instead of using the family types to sort the households, the number of people in the household is relied upon. We reason that the expenditures in personal care, apparel, and housekeeping supplies are largely similar for both children and adults. Further, the sample size of the CE PUMD data used does not allow for precise estimates for less common family types such as single parents with three children. For example, the same shampoo that can be used for a 4-year-old in a single parent household can also be used by an adult in a married couple household. Although children's clothes are generally cheaper, this is potentially evened out by the fact that children's clothes may be bought more often. LISEP takes the general lower and middle class of each household



size (defined by household income between the 10<sup>th</sup> and the 75<sup>th</sup> percentile) and measures their actual expenditures on these goods throughout time, adjusting for regional differences.

To justify the inclusion of these goods into the budgetary needs of the household, personal care and apparel are addressed together, and necessary household items separately. For hygiene and apparel, studies show that there is a strong correlation between personal hygiene and social impediments. [OBJ] These can be in day-to-day social interactions, but also in the labor force and in hiring. Mack and Rainey (1990) show that it is practically impossible for employers to ignore deficient grooming in candidates seeking employment. [OBJ] Thus, expenditures on personal care and apparel are a necessity.

The other large group of miscellaneous items are those spent on household items. For health reasons, it is imperative to buy cleaning supplies and other household items that help to maintain the living space clean.<sup>122</sup> Further, the UN defines that adequate housing must provide habitability, stating that “housing is not adequate if it does not guarantee physical safety or provide adequate space, as well as protection against the cold, damp, heat, rain, wind, other threats to health and structural hazards.”<sup>123</sup> Because of this, furniture, window and floor coverings, and other household items are a necessity for habitability in order to meet the need of minimal adequate housing established in section A.

Use of the PUMD data from the CE survey then satisfies the minimal adequate need requirement of not impeding a person’s ability to interact and be hygienic in society. This is because LISEP is taking the actual spending of respondents from the middle half of the income distribution on goods that are deemed necessary. Susserman and Alter (2012) argue that

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<sup>122</sup> (University of Michigan Health, 2020)

<sup>123</sup> (Office of the United Nations High Commissioner for Human Rights & UN Habitat, 2009)

consumers fail to accurately predict the cost of these non-recurring expenses (overestimating the cost of some and underestimating the cost of others). <sup>[OBJ]</sup> This suggests that it is more accurate to consider actual spending habits of individuals rather than hypothesizing about potential costs and replacement rates. Thus, LISEP's best metric of what is minimally adequate is most likely the actual spending habits of the middle part of the income distribution. Including only the middle part of the distribution is LISEP's best attempt at excluding those who do not have access to the necessary miscellaneous goods and those who superfluously spend on these goods.

### iii. Data

LISEP uses data from the Public Use Microdata on the Consumer Expenditure surveys portion of the Bureau of Labor Statistics site<sup>124</sup> (the BLS uses this data to construct overall consumer expenditures and the CPI bundle). LISEP uses the microdata from both the diary and the interview surveys, specifically, the elementary level indexes (ELIs) sorted by general category in the table below.

**Table 1: Elementary Level Indexes (ELI) included in Miscellaneous Budget**

Overall Category	ELI	ELI Description
Apparel	AA01	Men's suits, sport coats, and outerwear
Apparel	AA02	Men's furnishing
Apparel	AA03	Men's shirts and sweaters
Apparel	AA09	Men's uniforms
Apparel	AB01	Boys' apparel
Apparel	AC01	Women's outerwear
Apparel	AC02	Women's dresses
Apparel	AC03	Women's suits and separates

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<sup>124</sup> (Bureau of Labor Statistics)

Apparel	AC04	Women's underwear, nightwear, sportswear, and accessories
Apparel	AC09	Women's Uniforms
Apparel	AD01	Girls' apparel
Apparel	AE01	Men's footwear
Apparel	AE02	Boys' and girls' footwear
Apparel	AE03	Women's footwear
Apparel	AF01	Infants' and toddlers' apparel
Apparel	AG01	Watches
Apparel	AG02	Jewelry
Apparel	AB09	Boy's Uniforms
Apparel	AD09	Girl's uniforms
Apparel	AA04	Men's pants and shorts
Personal Care	GC01	Personal Care Services
Personal Care	GB01	Hair Care Products
Personal Care	GB02	Cosmetics, Perfume, Bath Prep
Personal Care	GD03	Clothing Storage and Laundry
Personal Care	GD09	Misc. Personal Services
Personal Care	GE01	Infant equipment/Luggage
Personal Care	GB09	Wigs and Hairpieces
Services	GD01	Legal Fees
Services	GD02	Cemetery Lots
Services	GD04	Alterations of Apparel
Services	GD05	Checking Account and Banking services
Household	HL03	Dishes and flatware
Household	HL04	Nonelectric cookware and tableware
Household	HM01	Tools, hardware, and supplies
Household	HM02	Outdoor equipment and supplies
Household	HM09	Office Furniture/Roofing/Landscaping supplies
Household	HN01	Household cleaning products
Household	HN02	Household paper products
Household	HN03	Miscellaneous household products
Household	HH01	Floor coverings
Household	HH02	Window coverings

Household	HH03	Other linens
Household	HJ01	Bedroom furniture
Household	HJ02	Living room, kitchen, and dining room furniture
Household	HJ03	Other furniture
Household	HJ09	Furniture rental
Household	HK01	Major appliances
Household	HK02	Other appliances
Household	HK09	Dishwasher
Household	HL01	Clocks, lamps, and decorator items
Household	HP04	Repair of household items
Household	HP09	Septic

#### iv. Specific Methodology

LISEP uses both the interview datafiles and the diary datafiles. They had to be dealt with separately at first because the sample was different for each survey, which means that matching the two surveys by the consumer unit is impossible. The entries to the public use microdata are recorded by universal classification codes (UCCs). For the purposes of the CPI, the CPI program at the BLS then combines specific UCCs into groups of ELIs that are similar and have similar price fluctuation. Because UCCs are very detailed (e.g., white bread, wheat bread), sorting these into slightly larger categories of ELI (bread) is useful.

For the interview, we used the FMLI and the MTBI files. Taking each quarterly file and appending it to create the entire year file, the *finlwt21* variable is used to accurately weight the different consumer units for the year. The UCCs that are recorded in both the interview and the diary are dropped so that these expenditures aren't double counted. The UCCs are then sorted into their respective ELI categories.<sup>125</sup> At this point then, for each year, LISEP created a file that

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<sup>125</sup> (Bureau of Labor Statistics)

contained the total ELI expenditure by consumer unit and the household income of that specific consumer unit (matched using the *newid* variable).

For the diary survey, LISEP used the EXPD and the FMLD data files. Each quarterly file was taken and appended to create an annual file. Then the *finlwt21* variable was used to weight the CU impact on the overall numbers. UCCs associated with the diary file were kept so as to not double count the variables, and like in the interview dataset, combined them to create ELI expenditures. At this point, for each year, LISEP had a file that listed the total amount spent by ELI for each consumer unit, the number of household members in that unit, and the household income of the consumer unit, matched using the *newid* variable. Note these are all different consumer units than those in the interview survey, but both samples are nationally representative.

LISEP then took each yearly file from the interview survey and sorted them by household size. For each separate household size (from one to five members), households in the 10<sup>th</sup> to 75<sup>th</sup> percentile range of household income were kept. This was to get an accurate representation of minimal adequate needs. If a family has too low of an income, they most likely do not meet minimal adequate needs, whereas if their income is too high, they may splurge on luxuries. For each family type, the average expenditure on each ELI that is recorded in the interview is calculated. LISEP does the same steps to reduce the sample for the diary survey and then appends these ELIs to the interview survey to get the full range of ELIs as measured by the Consumer Expenditure Survey. This is done for each family size and for the total of all family sizes from the 10<sup>th</sup> to the 75<sup>th</sup> percentile.

LISEP then sorted the expenditures into three categories: personal care/general, apparel, and housing. The final spending is calculated for each category separately. For ease of understanding, LISEP will illustrate the process with apparel as the example.

Apparel expenditures for each household size are calculated for the total population.<sup>126</sup> LISEP does this for each year and then takes the regional average of spending on apparel, not sorting by household size. LISEP then takes the ratio of the regional average to the national average and adjusts the household sizes by their respective regional-to-national ratio.

For example, assume the average spending on apparel is \$100 a year in 2001 for a one-person household nationally. Also assume that the average total apparel spending for all household sizes nationally is \$500. In the South, the average total apparel spending for all households in 2001 is \$400. LISEP then adjusted the one-person household's expenditure by 0.8 (400/500) to get that a one-person household in the South in 2001 would spend an average of \$80. LISEP then completes this process for each region, year, and household size. Although the above example is for apparel, the same process is used for personal care /general items and household miscellaneous items.

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<sup>126</sup> 10<sup>th</sup> to 75<sup>th</sup> percentile but including all regions.

Sussman, A. B., & Alter, A. L. (2012). The Exception Is the Rule: Underestimating and Overspending on Exceptional Expenses. *Journal of Consumer Research*, 39(4), 800–814. <https://doi.org/10.1086/665833>

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*CPI Handbook of Methods Appendix 5: CE UCC to CPI ELI Concordance: U.S. Bureau of Labor Statistics*. (2020, September 23). Bureau of Labor Statistics. <https://www.bls.gov/cpi/additional-resources/ce-cpi-concordance.htm>

### III. Robustness Checks

#### A. MIT Living Wage Calculator Comparison

##### i. Overview of Robustness Check

A robustness check is conducted for overall trends of cost of living using different definitions for each one of the expenditures. The Living Wage Calculator, developed by Dr. Amy K. Glasmeier and Tracey Farrigan, has been published since 2004. We wanted to affirm that our findings on the change in the cost of living were aligned well with other cost of living estimates. Although the Living Wage Calculator is published every year for each county throughout the United States, it is not published as a time series to track the cost of living on average throughout time. Thus, we used the definitions for each different type of expenditure in the methodology from 2019-2020. Given the resources made publicly available, LISEP

reconstructed a cost-of-living index using these definitions for each type of good. This was done to show robustness in LISEP findings by using different definitions of what is necessary to meet basic needs. The “living wage model is an alternative measure of basic needs”<sup>127</sup> to the federal poverty metric, which moves in line with CPI.<sup>128</sup> Thus, any attempt to measure the change of cost of living for those near the poverty level is futile and will just yield the CPI-U, which is the cost-of-living metric LISEP is trying to improve. First LISEP shows the differences between MIT cost-of-living budget allocations and the LISEP TLC budget allocations. The method of calculating the cost-of-living changes using the MIT allocations.

## ii. Differences in Budget Allocations

### 1. Family Types

MIT Living Wage calculator uses 12 different family types whereas LISEP TLC uses only 8. The first 8 family types are identical: working single parent with zero, one, two, and three children; two working parents with zero, one, two, and three children. MIT then adds four more family types of “two adult families where one adult is not in the labor force with 0, 1, 2, or 3 dependent children.”<sup>129</sup> The percentage of family types averaged throughout the 20-year sample are shown in table 1.

**Table 1: Family Type Proportions from 2001-2020 MIT vs LISEP**

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<sup>127</sup> (Massachusetts Institute of Technology, 2021)

<sup>128</sup> “The January 2021 poverty guidelines are calculated by taking the 2019 Census Bureau’s poverty thresholds and adjusting them for price changes between 2019 and 2020 using the Consumer Price Index (CPI-U)”: (Office of the Assistant Secretary for Planning and Evaluation, 2021)

<sup>129</sup> (Massachusetts Institute of Technology, 2021)



<b>MIT Description</b>	<b>MIT Proportion of total population</b>	<b>LISEP description</b>	<b>LISEP proportion of total population</b>
Single person	20.4%	Single person	20.4%
Single parent one child	3.7%	Single parent one child	3.7%
Single parent two children	3.0%	Single parent two children	3.0%
Single parent three children	2.3%	Single parent three children	2.3%
Dual income couple	12.4%	Couple	28.3%
Dual income couple one child	9.3%	Couple one child	12.5%
Dual income couple two children	12.4%	Couple two children	17.1%
Dual income couple three children	8.2%	Couple three children	12.7%
Single earner couple	15.8%		
Single earner couple one child	3.2%		
Single earner couple two children	4.7%		
Single earner couple three children	4.5%		

## 2. Housing

MIT and LISEP used the same method for allocating housing to each family. For county population estimates, the MIT uses the American Community Survey population data whereas LISEP uses the Intercensal county population estimates from the Census Bureau. This does not make a meaningful difference, though. The Census Bureau's Population Estimation Program (PEP) publishes a methodology where it explains its estimates. The PEP explains that it bases its initial estimate from the decennial census, and then adjusts the county flows using predominantly ACS data sources.<sup>130</sup> Thus, the population estimates align.

## 3. Food

MIT and LISEP both use the low-cost food plan from the United States Department of Agriculture. MIT adjusts their data regionally using a regional food price proportion developed by the USDA in 2007.<sup>131</sup> "The regional adjustment factors by region are as follows: East (1.08), Midwest (0.95), South (0.93), and West (1.11)."<sup>132</sup> LISEP instead uses the Map the Meal Gap database to adjust food costs by state. Figure 1 shows the food costs using these different regional adjustments. They are extremely similar until 2020. This is because MIT did not recalculate their numbers for 2020 year, instead just used the average CPI to inflate the 2019 numbers to 2020.

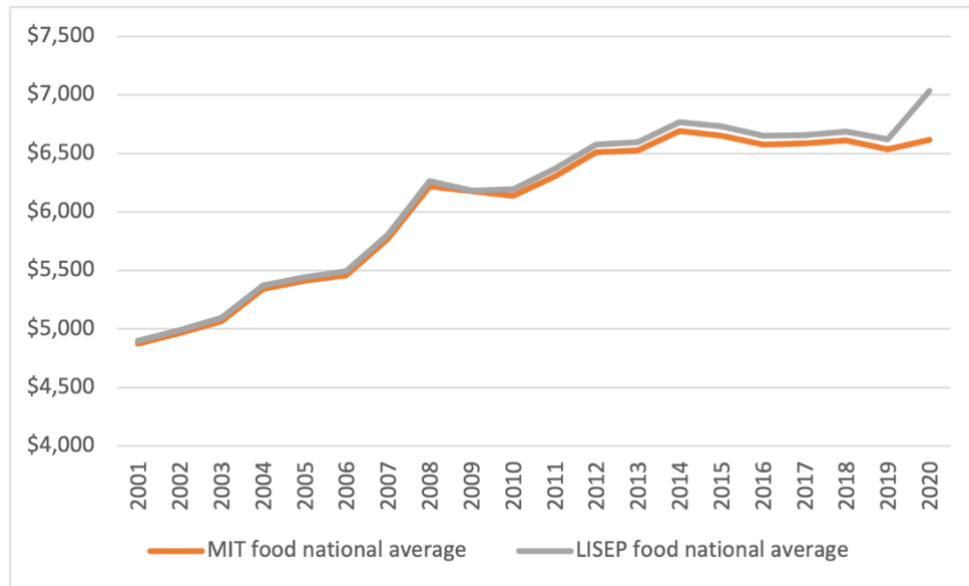
Figure 1: MIT versus LISEP Food Costs

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<sup>130</sup> (U.S. Census Bureau, 2021)

<sup>131</sup> (Liebtag, E. S., 2007)

<sup>132</sup> (Massachusetts Institute of Technology, 2021)



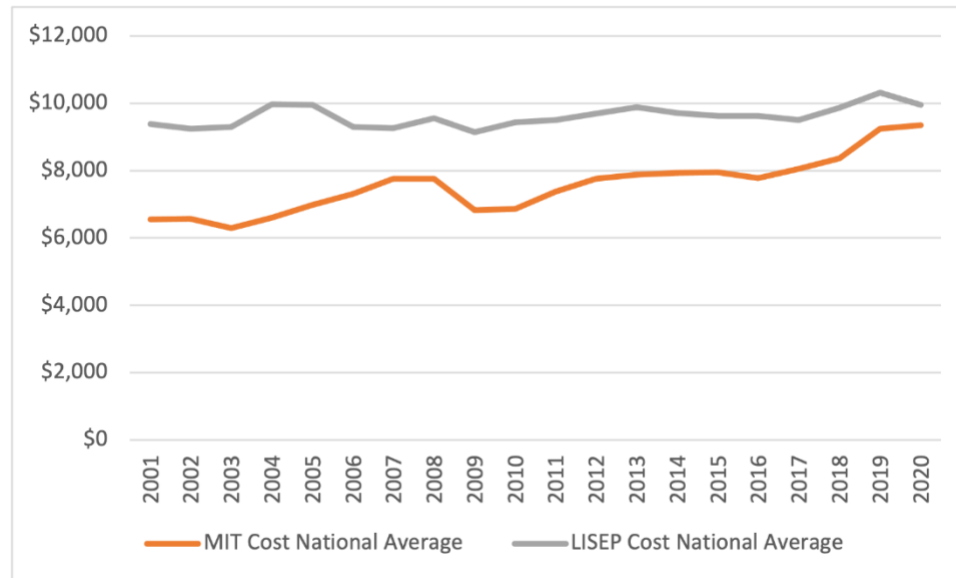
Source: Author's calculations based on MIT assumptions and LISEP data

#### 4. Transportation

MIT uses the average spending on “(1) Cars and trucks (used), (2) gasoline and motor oil, (3) other vehicle expenses, and (4) public transportation”<sup>133</sup> by household size. They use the data from table 1400 from the Consumer Expenditure Survey. LISEP’s transportation cost calculation is vastly different and is detailed earlier in the methodology.

Figure 2: MIT versus LISEP Transportation Costs

<sup>133</sup> (Massachusetts Institute of Technology, 2021)



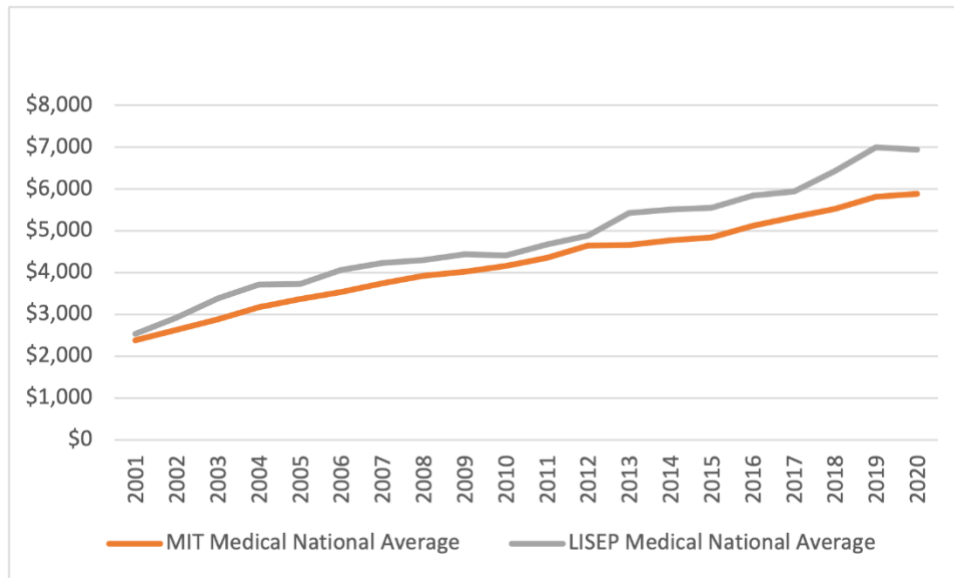
Source: Author's calculations based on MIT assumptions, CE table 1400, and LISEP data

## 5. Health

For health insurance, MIT uses the MEPS data for Private Sector Establishments: State Specific Data for Private-Sector Establishments. This is the same data source that LISEP uses, and both assume that the household is privy to employer provided insurance. In contrast to LISEP using the median spending, MIT uses the average spending.

For health expenditures, MIT uses the Consumer Expenditure Survey, table 1400 to allocate average costs for medical services, drugs, and medical supplies by household size. LISEP uses the MEPS data tool to allocate out of pocket costs as detailed in the methodology.

Figure 3: MIT versus LISEP Medical Costs



Source: Author's calculations based on MIT assumptions, CE table 1400, and LISEP data

The reason that LISEP's medical cost allotment is higher than MIT's even though the average of the middle 50% of OOP costs is lower than the average of the entire distribution, is because of dental costs. LISEP determines dental care to be a minimal adequate need, thus these dental costs drive it slightly higher than MIT's although the change throughout time is similar.

## 6. Technology

For the first time in 2019, MIT allocated broadband and cellular phone costs to each household's budget. Prior to this it allocated technological expenses from the CE survey. Unfortunately, past versions of the methodology are no longer available, and so tracking these trends throughout the period is not possible. But in 2020, after extensive research using many different data sources, it was concluded that \$60 was the average cost of broadband, and that this cost was not regionally idiosyncratic.

They also allocated the cost of cellular service to the living wage calculator. They allocated \$42.96 a month for cell phone service (\$40 plan with 7.39% U.S. average sales tax). Further, they allocated \$204.50 for a low-cost smart phone, assuming a new phone would be purchased every three years.

In contrast to this particular year, LISEP allocates a single person about \$61.23 for a cell phone service if he or she is single, whereas if they are on a couple's plan, they allocated them \$50.77. Internet of \$198 is a little less than MIT, with also the assumption of the replacement rate every three years. The reason LISEP has a more expensive cell phone plan here is because we use the actual spending of lower-income households. These spending costs may be skewed upwards by people in rural regions that have to pay more for connection and Wi-Fi. It also could be skewed upwards by the real-life, steep data overages costs.

## 7. Miscellaneous and Civic

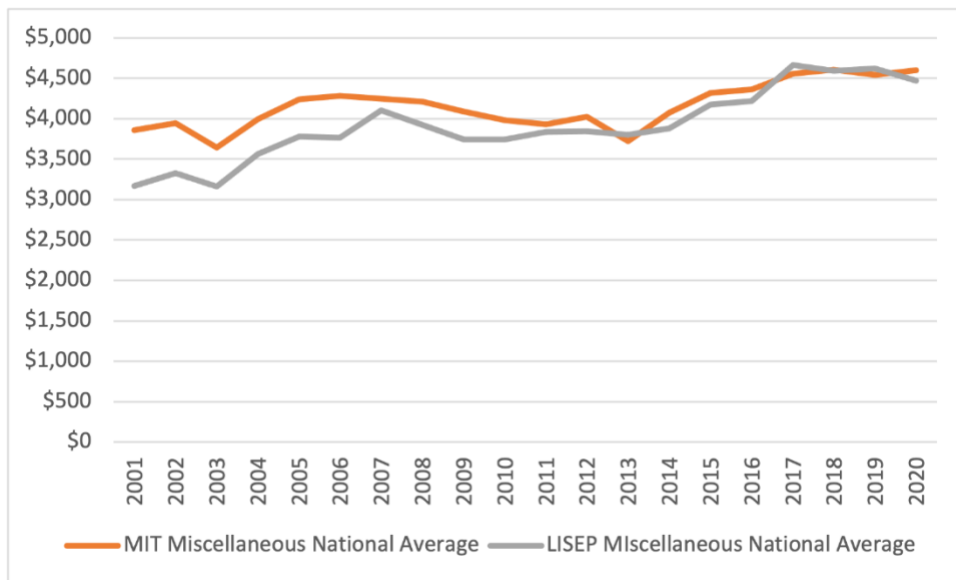
The MIT Living Wage Calculator uses the average cost by household size for “(1) Apparel and services, (2) Housekeeping supplies, (3) Personal care products and services, (4) Miscellaneous” from the CE survey. LISEP uses the CE microdata to find the costs of similar items in the spending of the 25<sup>th</sup> to 75<sup>th</sup> percentile households.

But MIT includes a civic engagement budget in their family costs. “The civic engagement component is constructed using 2019 national expenditure data by household size from the 2019 Bureau of Labor Statistics Consumer Expenditure Survey including: (1) Fees and admissions, (2) audio and visual equipment and services, (3) pets, and (4) toys, (5) hobbies, and playground equipment, (6) other entertainment supplies, (7) equipment, and services, (8) reading, and (9) education.”<sup>134</sup> MIT uses the same table 1400 from the Consumer Expenditure Survey that gives the average expenditures by family size. The LISEP TLC takes a more conservative approach and does not budget for any of these items. Figure 5 shows the comparison of miscellaneous costs without the MIT civic costs.

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<sup>134</sup> (Massachusetts Institute of Technology, 2021)

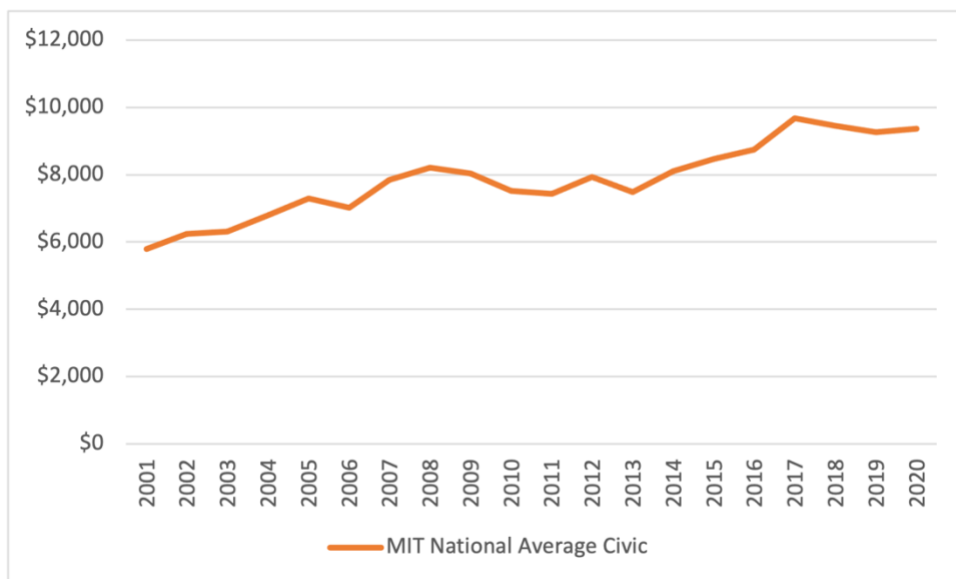
Figure 5: MIT versus LISEP Miscellaneous Costs



Source: Author's calculations based on MIT assumptions, CE table 1400, and LISEP data

MIT civic costs are also graphed. LISEP does not have these costs in its budget.

Figure 6: MIT National Average Civic Spending



Source: Author's calculations based on MIT assumptions, CE table 1400

## 8. Tax

The MIT living wage calculator incorporates taxes into the family budget. This aligns with the aim of the living wage calculator- to establish a monetary income level which families need to attain to survive. In LISEP's main number, taxes are left out. But in LISEP's analysis to investigate the change in available spending on recreation/savings for real world families, the TAXSIM32 model detailed in Appendix B is used. MIT on the other hand uses the Urban-Brookings Tax Policy Center Microsimulation Model (version 0217-1). This model outputs distribution samples for average tax rates faced by families in each quintile of income.<sup>135</sup> This is less precise than the model that LISEP uses, but yields an averaged result similar to the TAXSIM32, which reports each individual's tax burden rather than the average for the quantile.

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<sup>135</sup> (Urban Institute)



## B. Consumer Expenditure Survey Data

The second large robustness check LISEP conducted was to compare the results of the Consumer Expenditure Survey with the allocated costs for our index. We compared these for housing, transportation, food, and healthcare. The costs of childcare were not investigated because there is not a CE question specifically for childcare. The consumer expenditure survey is largely used to estimate technology costs and miscellaneous costs, so LISEP also doesn't use this same source to check these costs.

The FMLI files from the interview survey were used. The files are accessed via the Public Use Microdata (PUMD) from the Consumer Expenditure Survey portion of the Bureau of

Labor Statistics site.<sup>136</sup> The survey respondents are sorted into the six different income groups used in the technology section using the household income variable. The income groups are: 1) 0-10<sup>th</sup> percentile, 2) 10<sup>th</sup> to 25<sup>th</sup>, 3) 25<sup>th</sup> to 50<sup>th</sup>, 4) 50<sup>th</sup> to 75<sup>th</sup>, 5) 75<sup>th</sup> to 90<sup>th</sup>, and 6) 90<sup>th</sup> to 100<sup>th</sup>. These different income groups are sorted based on the family size, so a 90<sup>th</sup> percentile single person family is not in the same group as a 90<sup>th</sup> percentile five-person family. LISEP compares its costs to the spending habits of the lower- and middle-income class, arguing why they are similar or different. In the conclusion, LISEP explains what this comparison tells us about the validity of the data we use.

### i. Housing Comparison

LISEP uses the PUMD interview survey file variables *houspq* and *housecq*, which give the total expenditure for housing in the previous quarter and the current quarter respectively. LISEP calculates the average spending for housing for the year for households in each income range. Below, the graph show the spending of households in the 25<sup>th</sup> to 50<sup>th</sup> percentile against the allocated costs from the TLC index. In figure 1A, the spending for single person households in the 25<sup>th</sup> to 50<sup>th</sup> percentile household income range (among single person households) is shown compared to our allocated costs for single people. Figure 1B shows the comparison of spending for five-person households compared to our costs for five-person households (family type of 2 adults and 3 children).

Figure 1A: Housing Expenditures compared to Housing Cost Index for Single person households

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<sup>136</sup> (Consumer Expenditure Survey 2021)

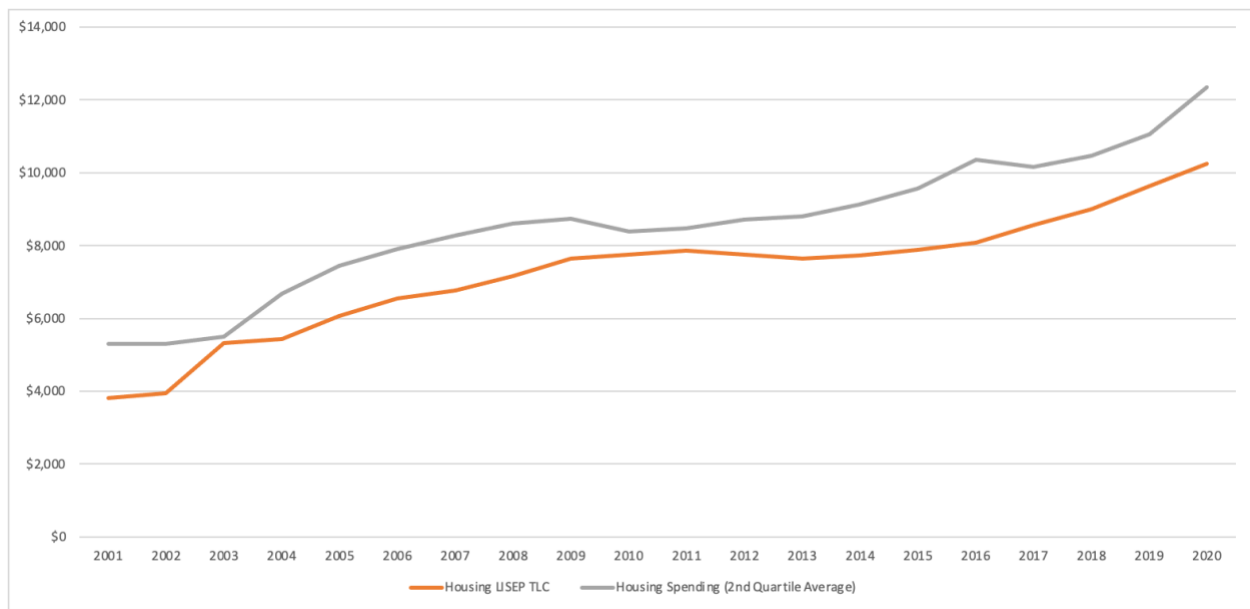
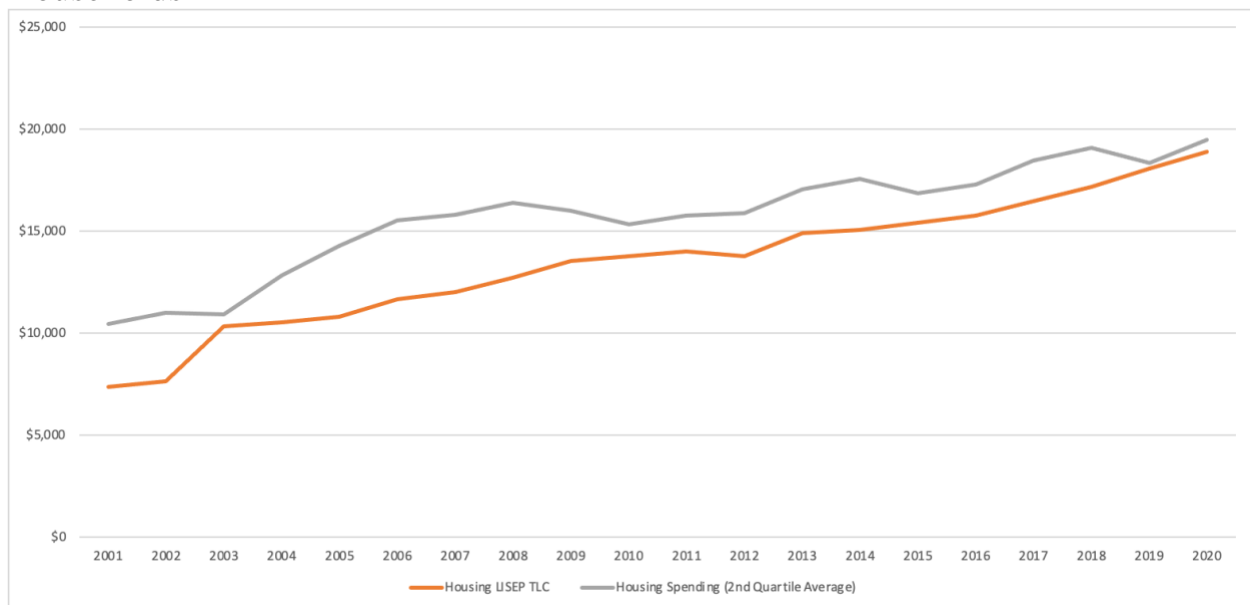


Figure 1B: Housing Expenditures compared to Housing Cost Index for five person Households



The above graphs show that LISEP's estimates of the costs of one person households align almost perfectly with actual spending. They differ slightly for five-person households but show a very similar trend. This is validating to LISEP's cost estimates because housing is an expense

that is usually high up on a family's spending hierarchy. Thus, it is unsurprising that even those who are not well-off purchase housing. But because we match the second-quartile average, these costs are not overestimated.

Figure 1C and 1D show the costs of LISEP versus the spending of the 75<sup>th</sup> to 90<sup>th</sup> percentile. These graphs show that the LISEP estimates are consistently below the actual spending for upper middle-class households, thus proving the conservative nature of our estimates.

Figure 1C: Housing Expenditures (75<sup>th</sup> to 90<sup>th</sup> percentile) compared to Housing Cost Index for single person Households

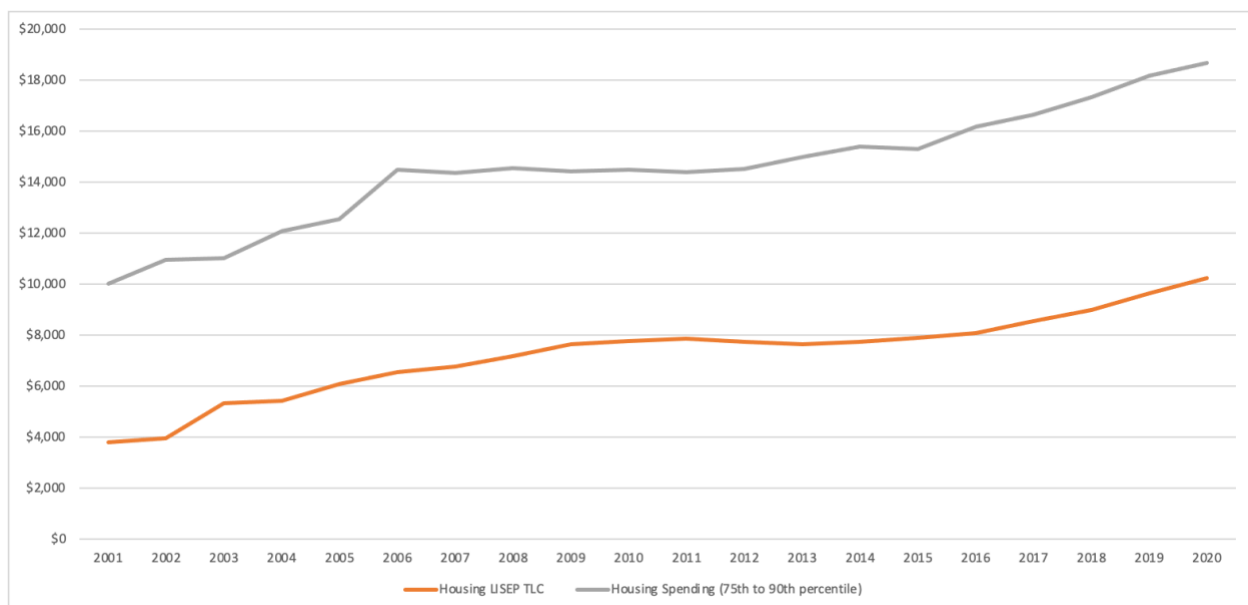
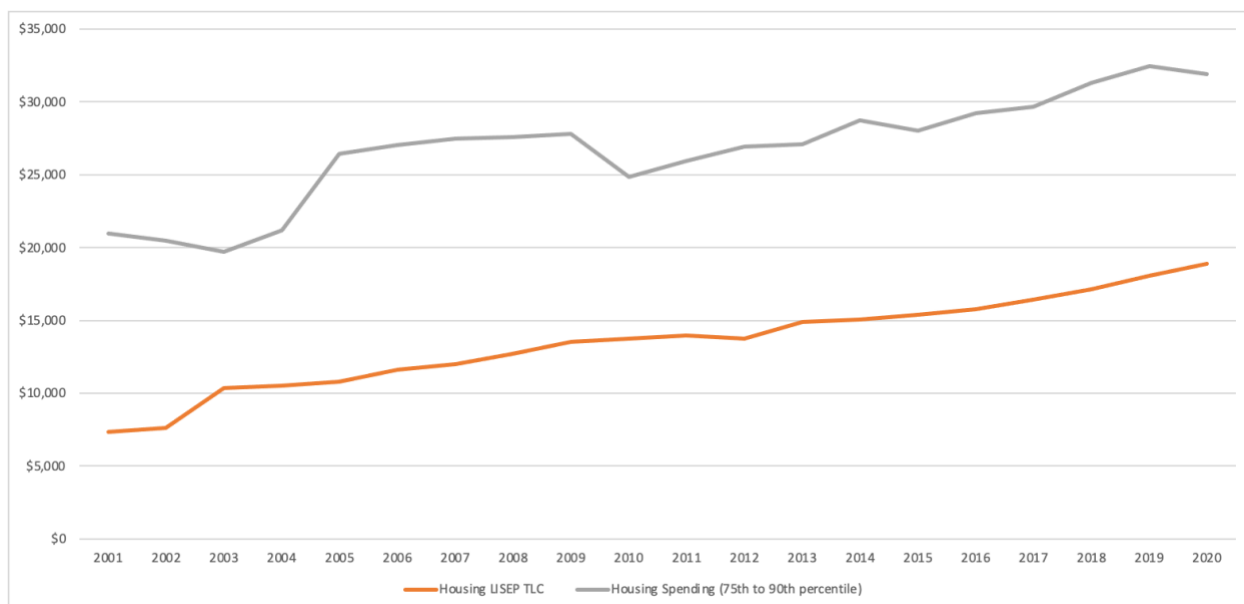


Figure 1D: Housing Expenditures (75<sup>th</sup> to 90<sup>th</sup> percentile) compared to Housing Cost Index for five person Households



Source for 1A-1D: Consumer Expenditure Survey. (2021, September). *Consumer Expenditure Surveys Public Use Microdata*

## ii. Food Comparison

LISEP uses the PUMD interview survey file variables *fdhomepq* and *fdhomecq*, which give the total expenditure for food purchased for in-home use in the previous and current quarters. LISEP calculates the average spending for food at home for the year for households in each income range. Below the graph shows the spending of households in the 25<sup>th</sup> to 50<sup>th</sup> percentile against the allocated costs from the TLC index. In figure 2A, the food spending for single person households in the 25<sup>th</sup> to 50<sup>th</sup> percentile household income range (among single person households) is shown compared to allocated costs for single people. Figure 2B shows the comparison of spending for two-person households compared to our costs for households with an adult couple. Figure 2C shows spending for five-person households compared to our allocated costs for the five-person household family (family type of 2 adults and 3 children).

Figure 2A: Food Expenditures compared to Food Cost Index for Single Person Households

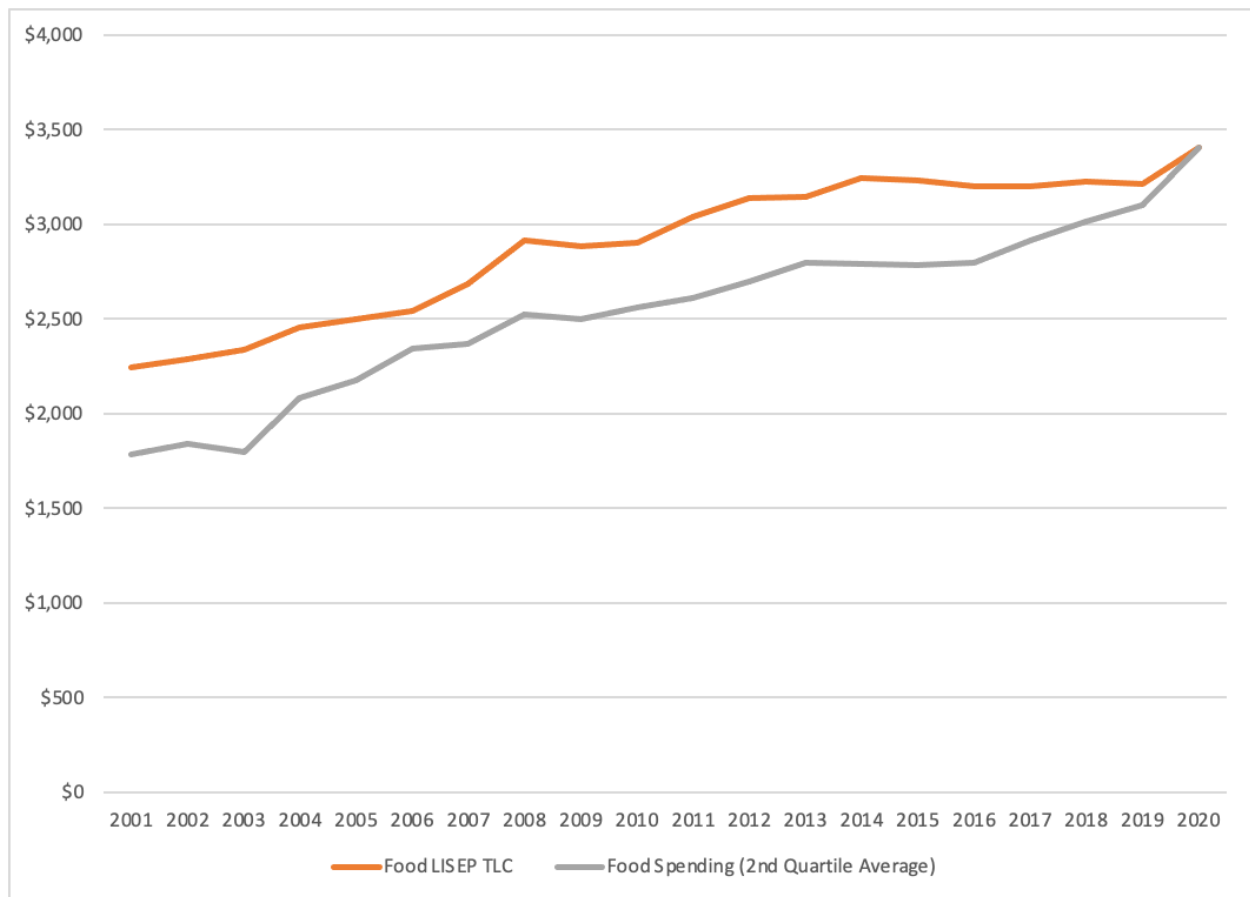
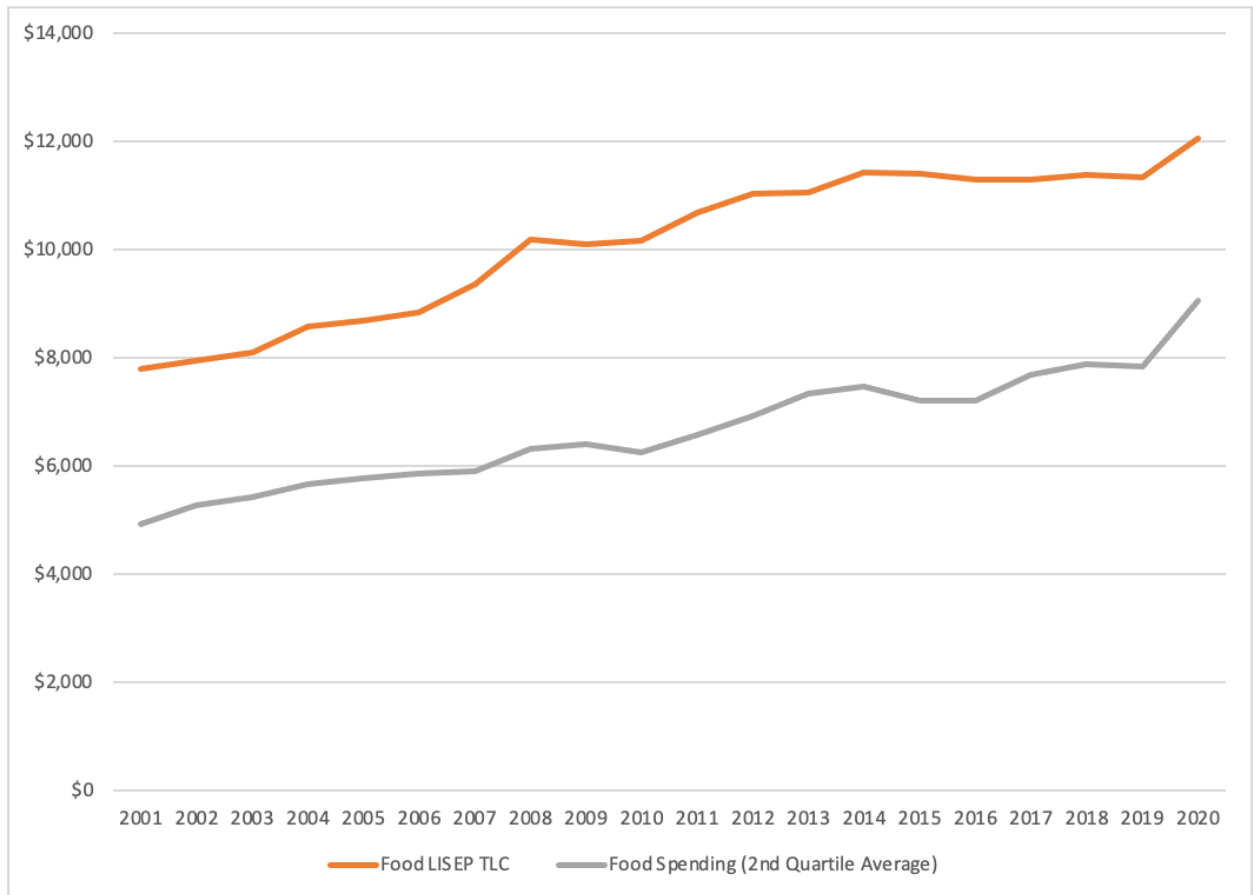


Figure 2B: Food Expenditures compared to Food Cost Index for five person households



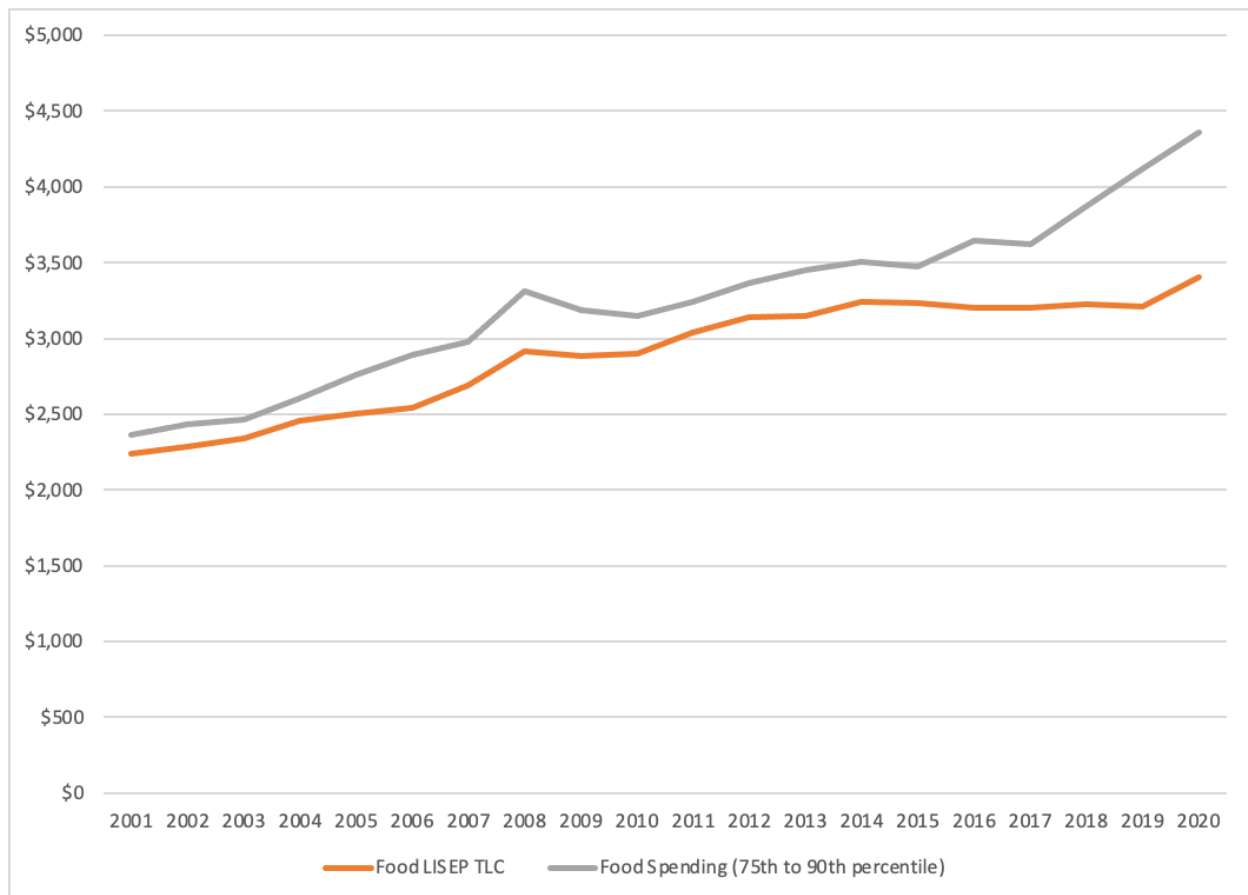
This suggests that the food spending in total is relatively similar for those in households with fewer people than those of households with more people. Further, in almost all the households, our cost allocation is higher than the spending of households in the second quartile. French et. al. finds that in their study, “overall nutritional quality of foods and beverages purchased was significantly lower among lower income households compared with higher income households.”<sup>137</sup> Thus, it makes sense that lower income households have lower food budgets than the nutritious budget that is estimated by the USDA.

Figure 2C shows the food at home spending for the upper middle class (75<sup>th</sup> to 90<sup>th</sup> percentile) compared to the food cost allocated in the TLC. This level of spending matches almost perfectly,

<sup>137</sup> (French, S.A., Tangney, C.C., Crane, M.M. *et al.* 2019)

thus showing that higher incomes allow households to purchase the nutritional quality suggested by the USDA. LISEP deems that nutritional food is a minimal adequate need, even though spending data suggests that the lower middle class is not meeting this standard.

Figure 2C: Food Expenditures compared to Food Cost Index for single person households in the 75<sup>th</sup> to 90<sup>th</sup> percentile



Source for 2A-2D: Consumer Expenditure Survey. (2021, September). *Consumer Expenditure Surveys Public Use Microdata*

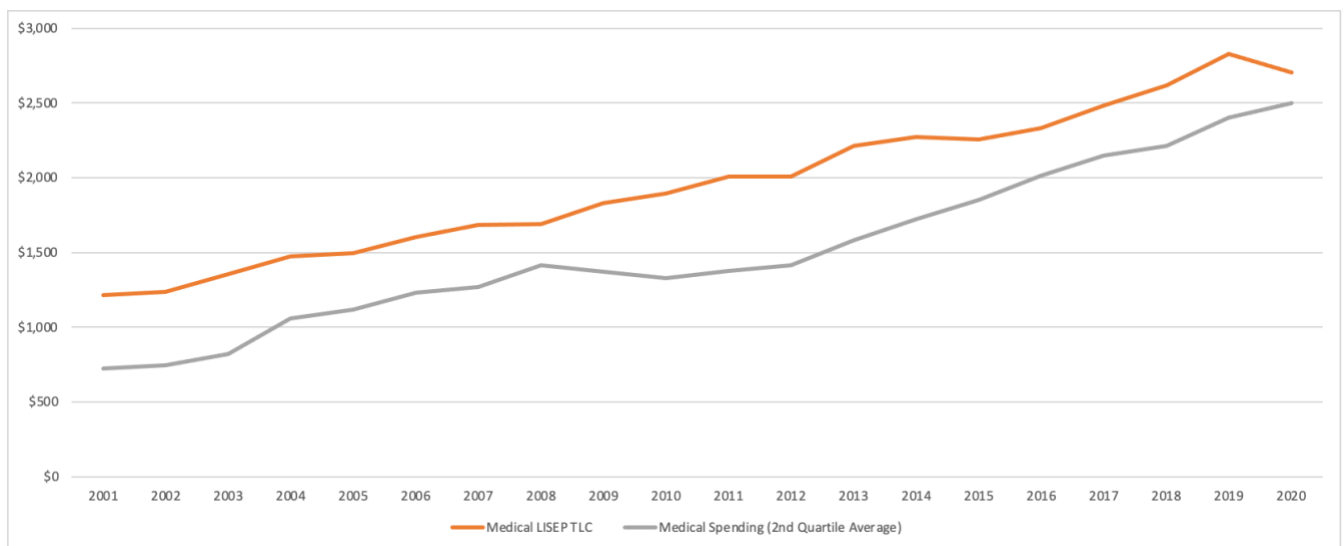
### iii. Medical Care Comparison

The PUMD interview survey file variables *healthcq* and *healthpq*, which give the total expenditure for healthcare in the previous and current quarters, are used to calculate the average spending for medical care for the year for households in each income range. Below we graph the



spending of households in the 25<sup>th</sup> to 50<sup>th</sup> percentile against the allocated costs from the TLC index. In figure 3A, medical care spending for single-person households in the 25<sup>th</sup> to 50<sup>th</sup> percentile household income range (among single person households) are compared to LISEP's allocated costs for single people.

Figure 3A: Total Medical Expenditures compared to Medical Cost Index for Single Person Households

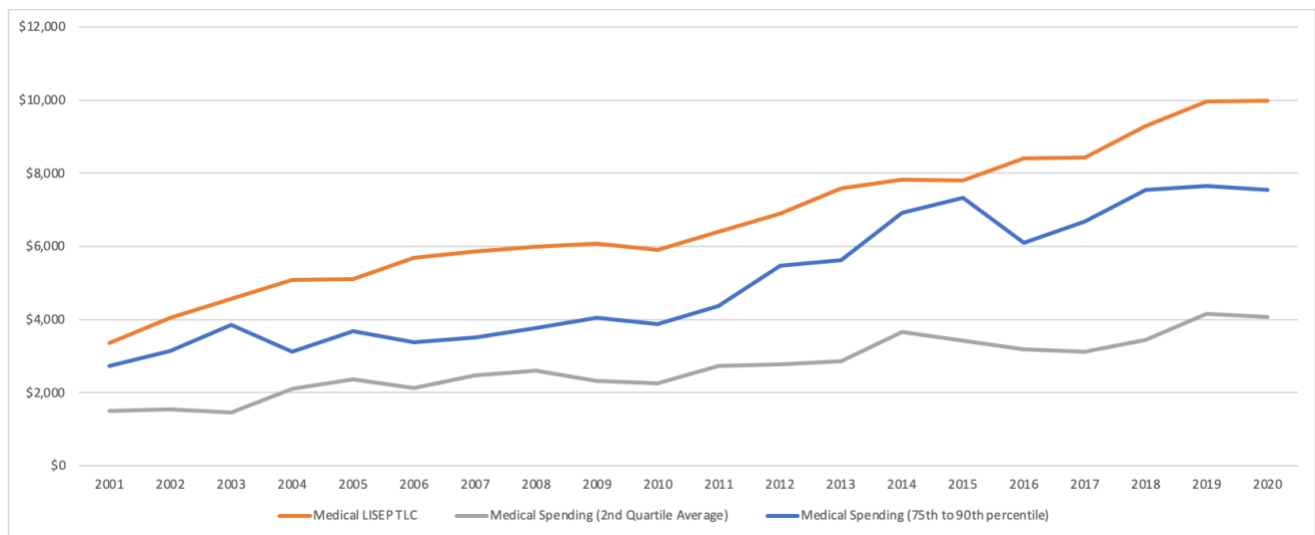


This above figure is unsurprising as a large part of the population is uninsured.<sup>138</sup> This would then lead to less spending on healthcare through healthcare avoidance, or larger out of pocket expenses. Similar trends emerge when household size is expanded. Figure 3B shows the comparison of spending for five-person households compared to our costs for five person households (family type of two adults and three children). It also includes the spending for the upper-middle-class on healthcare. This again is below the cost LISEP has allocated in the budget

<sup>138</sup> (Sommers et al 2021)

but is much closer than the lower-middle class. Again, we argue that the difference in cost versus real life spending does not suggest that we have overestimated the cost of adequate healthcare. Rather it indicates that a large portion of the American population is underinsured or inadequately covered.

Figure 3B: Total Medical Expenditures compared to Medical Cost Index for five person households



#### iv. Transportation

LISEP uses the PUMD interview survey file variables *transcq* and *transpq*, which give the total expenditure for transportation costs in the previous and current quarters. LISEP calculates the average spending for transportation for the year for households in each income range. Below LISEP graphs the spending of households in the 25<sup>th</sup> to 50<sup>th</sup> percentile against the allocated costs from the TLC index. In figure 4A, LISEP shows the medical care spending for single-person households in the 25<sup>th</sup> to 50<sup>th</sup> percentile household income range (among single-person households) compared to the costs that we allocate for single people.

Figure 4A: Total Transportation Expenditures compared to Transportation Cost Index for Single Person Households

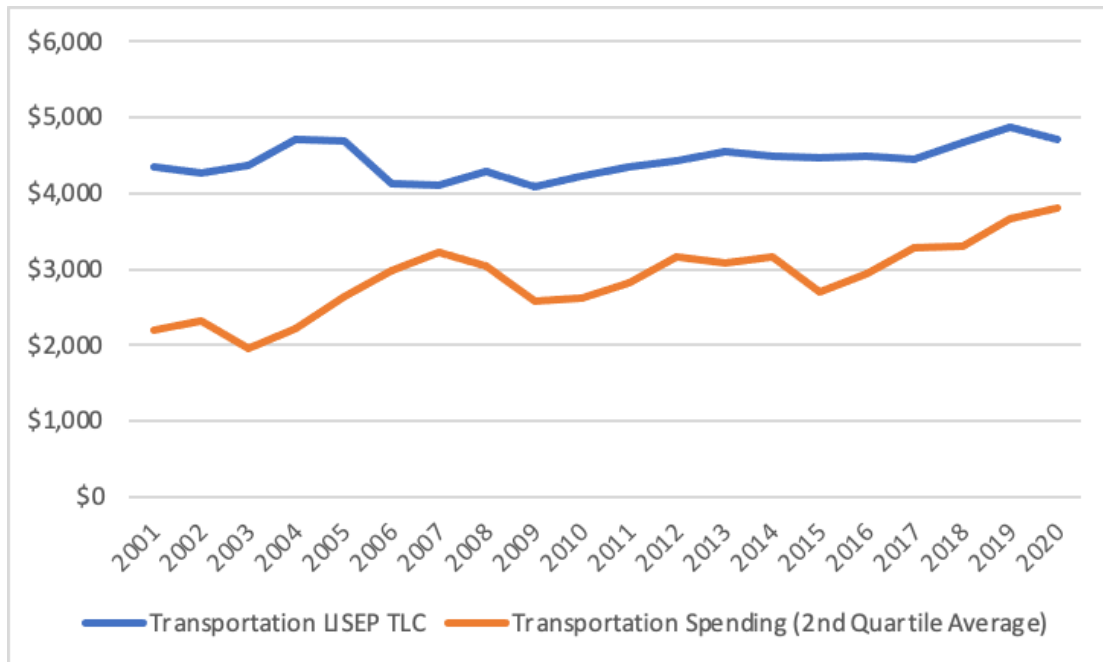
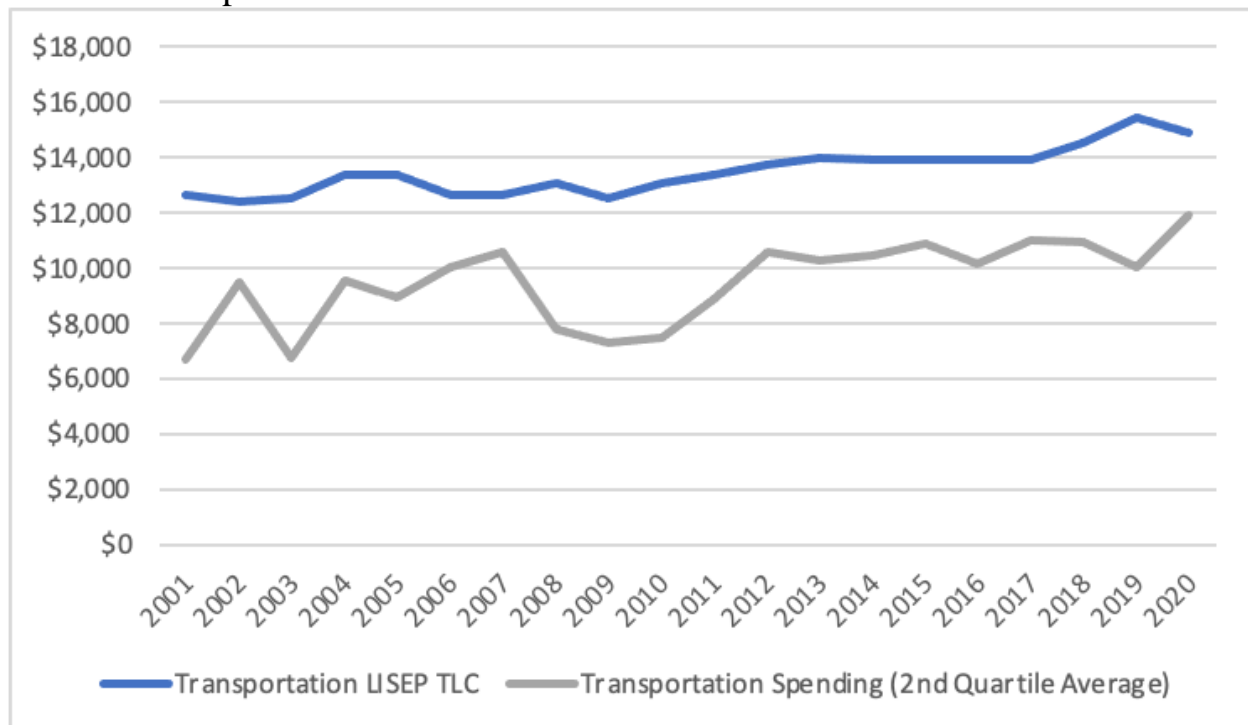


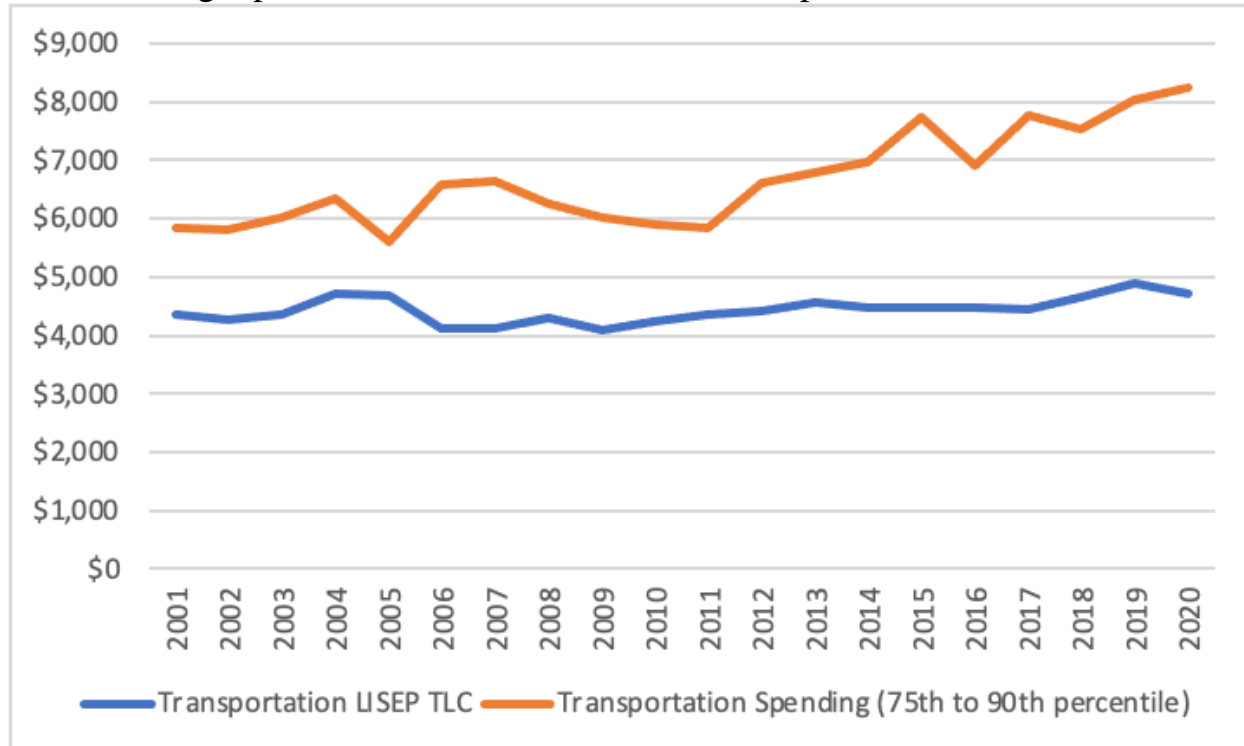
Figure 4B: Total Transportation Expenditures compared to Transportation Cost Index for five person households



These two figures suggest that the cost of transportation allocated in the LISEP TLC index for transportation was more than the 2<sup>nd</sup> quartile spent in both five-person families and single-person families. But the change in transportation spending was actually less than the change in the budget for transportation LISEP allocated.

In figure 4C, the upper middle-class average spending on transportation is shown throughout the period revealing that by the time that the household income moves into this level, it can spend more on transportation, and exceeds the transportation budget allocated by TLC.

Figure 4C: Total Transportation Expenditures compared to Transportation Cost Index for single person households at the 75<sup>th</sup> to 90<sup>th</sup> percentile



## v. Conclusion

LISEP's estimates of what families should buy are largely consistent with the second quartile's average spending on housing. In food costs, the second quartile spends slightly less on food at home. This makes sense because LISEP allocates a conservative food allotment of only eating

meals cooked at home. Even in the lower middle-class, people in real life eat sometimes at restaurants, and so some of their spending is allocated to this. Further LISEP suspects that, to meet the nutritional needs ascribed by the USDA, one must eat a more diverse diet of fresh food than lower middle-income families consume. Looking at the upper middle-class, though, food spending exceeds the allotment of the TLC index. Thus, we are assured that this is a minimal, and not extravagant, allotment.

Regarding medical care, the fact that the 2<sup>nd</sup> quartile spends less than allotted is unfortunately of no surprise. With higher income, the spending approaches LISEP's adequate allotment. In 2018, national polls found that over 40% of Americans skip medical treatment due to costs.<sup>139</sup> Thus, it is of no surprise that Americans actually are spending less than what LISEP determined to be an "adequate" need.

Finally, the same trend observed for food persists in transportation. The second quartile spends less than we allot (although their spending increases faster than our budget), but the upper middle-class spending exceeds our budget.

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<sup>139</sup> (NORC at the University of Chicago 2018)

## D. Healthcare Affordable Care Act Premiums Comparison

This robustness check reverses the assumption that each family is covered by employer provided healthcare. Instead, the employer does not provide healthcare. Above details the reasons LISEP assumes that employer-provided healthcare is a given, but we take the opposite assumption to measure the impact of this on a family's health spending. One of the major problems with assuming that the families are not provided with employer healthcare is that it is impossible to track the "silver level" coverage (used in the ACA benchmark) before 2014 because this benchmark did not exist prior to the law. Instead, LISEP uses a level of healthcare (defined by actuarial value) that is provided to the lowest-wage workers. The actuarial value of a healthcare policy is the percentage of total medical costs that the healthcare company expects to cover. For example, for an 80% actuarial value, the healthcare company would expect to pay for 80% of the costs and the policyholder would then pay for the other 20% of the costs out of pocket. To attempt to hold this constant throughout the sample, the total premium cost of the lowest 25% of workers offered healthcare is used, assuming that the family is paying for that level of coverage but in the private marketplace. This is done for two reasons. First, this level of insurance can be tracked throughout the whole sample, so there is available and accurate data. Second, this provides a good proxy for an adequate level of insurance to meet minimal needs. Because LISEP is using the average premium cost for the lowest quartile, an exorbitantly high

premium cost isn't being used. Furthermore, we also are assured that it is adequate coverage because the MEPS data shows that the actuarial percentage for the average plan for the lowest-quartile wage worker on employer health insurance is about 80%.<sup>140</sup>

## i. Data

Kaiser Foundation Health Insurance Marketplace Calculator<sup>141</sup> is used for the years 2014 through 2019. Because the rules and poverty limits of the ACA changed each year, a different calculator was necessary, but all were from the Kaiser Family Foundation. A second data source is also from the Kaiser family foundation<sup>142</sup> to establish the benchmarks. Data from the BLS's earner study,<sup>143</sup> which reports the median earnings for full-time workers by quarter, is also used. This was necessary to obtain the subsidy level provided to each family (each subsidy is dependent on annual household income).

To determine the maximum premium amount that could be paid by that family, IRS data for the premium caps was used. These were all based on the original ACA law and then updated each year with different percentages based on the family's relationship to the poverty level.<sup>144145</sup>

The next source of data was from the Medical Expenditure Panel Survey (MEPS), which is published under the Agency for Healthcare Research and Quality, which is a part of the Department of Health and Human Services.<sup>146</sup> The data used to get the premium calculation is taken from the Insurance/Employer Component of the survey, which asks establishments and

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<sup>140</sup> This is similar to the "gold level" tier of insurance offered by the ACA.

<sup>141</sup> (Kaiser Family Foundation, 2018)

<sup>142</sup> (Kaiser Family Foundation, 2021)

<sup>143</sup> (Bureau of Labor Statistics)

<sup>144</sup> (Legal Information Institute)

<sup>145</sup> (Internal Revenue Service)

<sup>146</sup> (Agency for Healthcare Research and Quality)

governments the amount that they pay for their employees’<sup>147</sup> insurance. LISEP used the summary level tables by state and quartile of earners (the microdata was not available) found in tables VIII.A.1, VIII.D.1, and VIII.E.1 which are the total premium for single coverage, family coverage, and employee plus one coverage respectively.

## ii. Specific Methodology

The ACA establishes the maximum amount that each family type is legally allowed to pay depending on that family’s relationship to the poverty level. The tax credit assistance given by the ACA is determined by the “benchmark” plan, which is a plan with an actuarial value of 70%. With this benchmark then, the calculation of the subsidy is the benchmark minus the maximum that you can pay by law. Note that this does not actually mean that this silver plan must be purchased, and one can use this tax credit to purchase a higher or lower-level metal (Bronze, Silver, Gold, Platinum) plan<sup>148</sup>.

Each year though, the cost of the benchmark plan changes. The benchmark plan is determined by the private marketplace’s cost of a 70% actuarial value plan and is thus set by health insurance companies. For example, the cost of a silver plan (the benchmark) for a single payer from 2014 to 2019 moved from \$3,276 to \$5,736 on average. Furthermore, each year the premium cap (the maximum amount that you can pay) changes. In 2014, the maximum amount that someone who lives in a household that is 300% of the poverty limit can spend on their healthcare is 9.50%, whereas by 2019 this was 9.86%. To further complicate things, each state was encouraged by the ACA to set up their own healthcare marketplace. For example, the cost of

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<sup>147</sup> (Agency for Healthcare Research and Quality)

<sup>148</sup> (Legal Information Institute)



a premium in Vermont in 2014 was 188% higher of the average plan in the United States, but in 2018 the average silver plan in Vermont was only 88% of the average plan in the entire U.S.

Thus, the specific calculation for each year and plan depends on the state in which the family resides, the premium cap (maximum premium), the poverty status of the family, and the cost of the benchmark plan for that year. To generate the specific subsidy that each family type would get, LISEP continued the assumption that each adult in the family worked at the median wage level for that year as a full-time employee. To determine the maximum premium amount that could be paid by that family, LISEP used the household income and multiplied it by the maximum amount of the premium that could be paid that year. This number then is the maximum amount that the family could pay for a benchmark plan.

The subsidy was calculated by taking the benchmark plan and subtracting it by the maximum amount that each family type was allowed to pay for their health insurance under the ACA given their relationship to the poverty line. If the maximum amount that they were allowed to pay was greater than the benchmark plan, they received no subsidy. LISEP then applied this subsidy to a different level of healthcare rather than the silver plan: the plan provided by employees of the lowest 25% of wage earners that were on their employer's healthcare.

The benchmark plan was not used. As mentioned above, the ACA did not come into practice until 2014, and so the ranking of tiered plans also did not exist until then, so "silver plans" couldn't be tracked throughout time because this title was invented with the ACA.

To address this problem, LISEP used employer-based health insurance for the lowest 25% of wage earners as the minimal adequate health insurance. Luckily this data is quite robust, and costs of premiums could be tracked by state, which is important when states have their own respective health insurance marketplaces. Also, because of the granularity of the microdata for

the MEPS, LISEP was able to calculate the actuarial value for the employer-based health insurance by region and year. ]<sup>149</sup> During the sample it ranges from 80 to 90% which further lends credence to the decision not to accept the 70% actuarial value of the silver plan; even the lowest-paid workers on employer-provided healthcare had plans with actuarial values significantly higher.

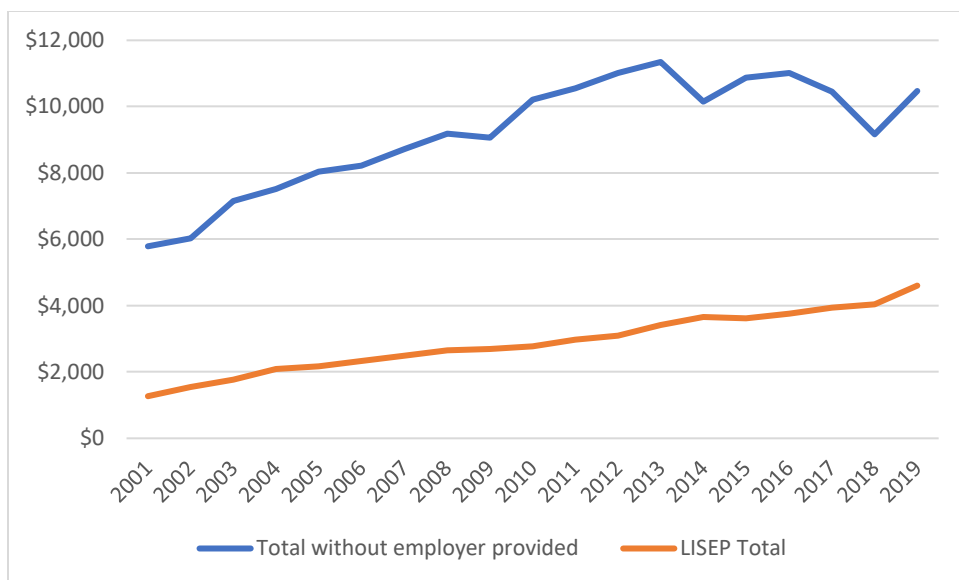
To calculate the total cost of health premiums by family, LISEP took the total amount of a premium paid for each insurance type (single, employee plus one, and family insurance) applied this premium to the representative family within our framework. LISEP then subtracted this premium value by the amount of subsidy that they would receive. Essentially, LISEP is taking the subsidy provided by the ACA and applying it to what the labor market has deemed to be the minimally acceptable level of health insurance.

In figure 1, the comparison for the total costs for the premiums is shown for both assumptions: the original assumption of employer-provided healthcare versus the assumption of no employer-provided healthcare. Without employer subsidies, the cost of healthcare is about four times as much, but there is a leveling out and even a decline in the average with the introduction of the ACA in 2014.

### Figure 1: Total Costs for Health Premiums Comparison

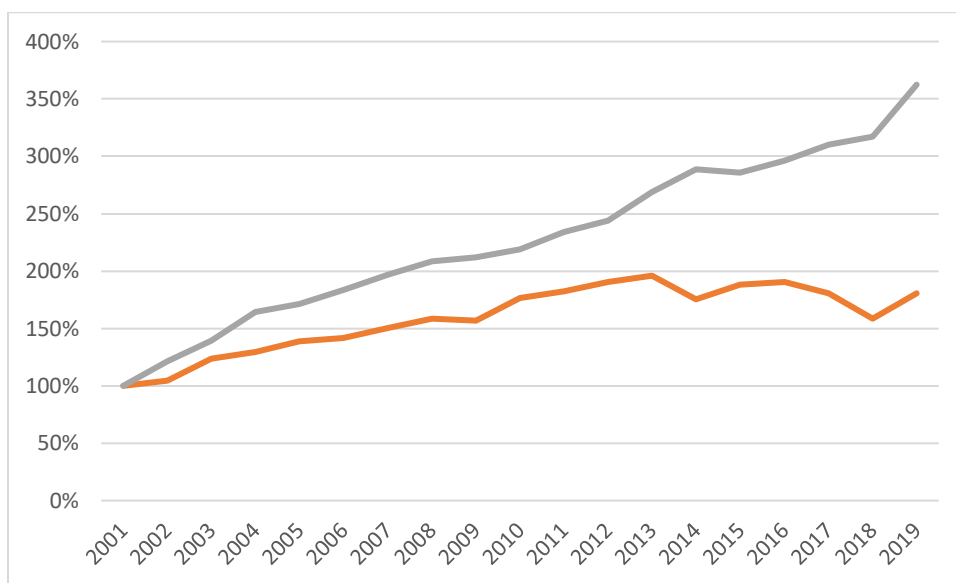
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<sup>149</sup> We report this calculation in the Appendix.



In figure 2, we show the percentage increase for costs with the two different assumptions.

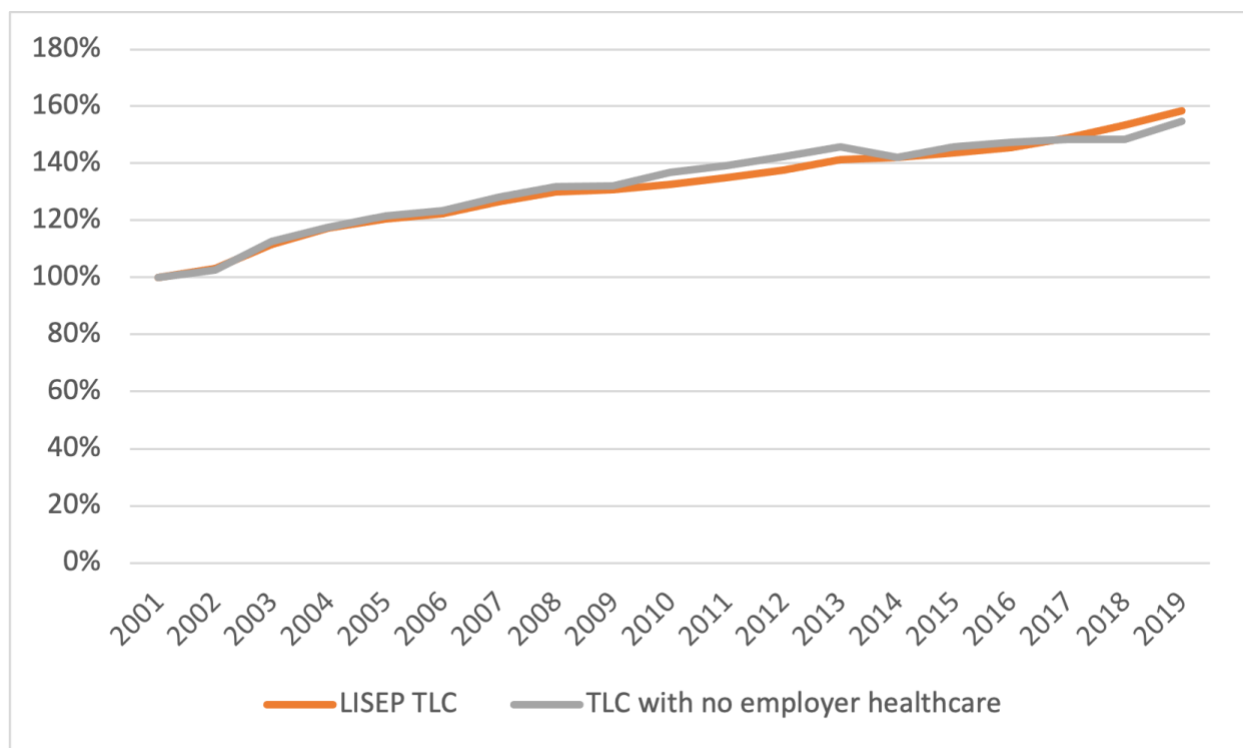
Figure 2: Percentage Change Comparison in Premiums Costs



This suggests that the percentage change in employee contributions to employer-provided premiums is steeper than the percentage change in overall premiums. This is a result of the dual effect of rising premium costs and employers reducing their contributions. Notably, in 2014 the percentage change levels off with the introduction of the ACA. This effect is driven by single parents and couples with at least two children. That is because a dual-earning couple with both

earners earning the median wage exceeds the 400% of poverty threshold needed to qualify for the ACA. In all though, if you compare the LISEP TLC and the TLC without the assumption of employer provided healthcare, this changes the total number only marginally. In figure 3, we graph the entire index with both assumptions to compare. The graph suggests a negligible difference.

Figure 3: TLC versus TLC without employer healthcare percentage change



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# Appendix

## A. Recreation/Social/Civic Goods

In LISEP's budget calculation, no recreation, civic, or any type of extra good is included. This is to better determine the pure minimal needs to maintain community standards and to possess potential for socioeconomic mobility. LISEP understands that excluding these types of expenditures from a family's budget is not realistic. First, it is impossible to remain part of a community and to build connections with fellow Americans without having some sort of leisure or social time. Furthermore, many of these imposed budget constraints demand an unattainable level of prudence, not only for adults but also for their children. For example, the low-cost food plan does not account for the fact that sometimes someone will want a cup of coffee in the morning. A black cup of homemade coffee has 0 calories, however, meaning it does not help to meet the nutritional needs of the family, and thus is not included in the budget estimate. Or what if a 4-year-old wants an ice cream cone or a 12-year-old wants to play on the middle school basketball team, and there is no school-provided transport?

In all, LISEP recognizes that assuming this extremely low level of necessities does not actually meet the human needs of social interaction and enjoyment. Furthermore, the amount of prudence needed would be impossible to maintain. LISEP chose to use this extremely minimal basket in order to separate the cost-of-living increases of an American family's most crucial needs from the CPI.

## B. Taxes

### i. Aim

The aim for the taxes section of the index is to show the budget as faced in real life for median-income earners throughout time. When evaluating the state of the middle- and lower-income Americans throughout time, LISEP judged that it is important to recognize the role that the government might have played through changing tax or transfer rates. Thus, by including specific tax burdens and government benefits into the budget, LISEP accurately estimates the amount of money these households have left (or debt) after paying for their minimal adequate needs. In a sense, because taxes are non-negotiable in a budget and transfers can help to ease the burden of meeting minimal adequate needs, this shows a real picture of middle-class livelihood.

### ii. Data

The input used for the tax calculations is taken largely from the True Living Cost Index. These are the FMRs and the childcare expenses. Our formulations for these are detailed in II.A and II.D, respectively. For the median-income data, LISEP used the series published by the BLS for the Usual Weekly Earnings report.<sup>150</sup> The same data source is for each sub-population's (e.g., high school graduates, women, white) median earnings. These values (which are published as weekly numbers) are annualized by multiplying them by 52. For dual-earning households, this same value is applied to the spousal income.

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<sup>150</sup> Bureau of Labor Statistics- Current Population Survey. (2021, October 19). *Usual weekly earnings of wage and salaried workers – Third Quarter 2021* [Press release]. <https://www.bls.gov/news.release/wkyeng.toc.htm>.

### iii. Methodology

To calculate the tax burden, it is important that we standardize the input variables that determine tax levels. These include income, average amount paid in rent (some states have deductions based on rent payment levels), childcare expenses, and age of the earner. LISEP uses the national median-earner's income for each adult in the household as the income input. The average FMR is used for each state aggregated by county with applicable weights for the county's proportion in the state population. LISEP uses the childcare expenses attributed to the family in the TLC Index by state. LISEP then applies these metrics to their corresponding family types and states and uses the TAXSIM32<sup>151</sup> published by NBER to calculate the income tax burden with all these inputs.

In different iterations (by sub-populations), LISEP keeps constant the values inputted for rent and childcare but changes the income variables. The former two inputs are minimal adequate needs, and thus not subject to income. But the last input might change depending on the population that is considered. For example, if looking at the after-tax discretionary income of high school graduates, the median-income of high school graduates would be used. This would impact the total tax burden because this population's median income is lower, and thus may fall into a different tax bracket. Even if not, this population would have less income subject to tax, still changing the impact of taxes' addition to the minimal adequate needs.

The tax simulator then takes these inputs and gives as the output 1) federal tax liability, 2) FICA tax liability, and 3) state tax liability. These values can be negative if the total amounts

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<sup>151</sup> Initial version of the simulator was published with the paper Feenberg, Daniel Richard, and Elizabeth Coutts, *An Introduction to the TAXSIM Model*, Journal of Policy Analysis and Management vol 12 no 1, Winter 1993, pages 189-194. The current version can be found at <https://taxsim.nber.org/taxsim32/>.



received in tax returns were higher than the liability paid. The FICA tax is divided by two because this tax burden is split between the employer and the employee.