

Fuel Poverty Measurements in America. Who are the Most Vulnerable?

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Contents

1. Introduction
2. Fuel Poverty Measurements
3. Data & Descriptive Statistics
4. Multidimensional Measurement
 - a) Energy
 - b) Energy Efficiency of Housing
 - c) Income
5. Model
6. Discussion & Results
7. Summary

Introduction

Fuel Poverty

- was first identified, as a result of energy policies stemming from the OPEC oil crises of the 1970s.
- is perhaps the strongest adverse social impact resulting from the inefficient consumption of energy in the domestic sector.
- There are three different but related perspectives that make fuel poverty a distinct and serious problem: poverty and its reduction; health and well-being; climate change and the reduction of carbon emissions.

Introduction

Fuel Poverty

- in a developed country is a result of a combinations of three factors: low household income, low energy performance of buildings and high energy prices.
- the definition of fuel poverty is important for policy formulation; for determining the scale and nature of the problem, targeting a strategy and monitoring progress.
- However which measurement approach to use is still a debate.

Introduction

My Study's Objectives

- use a multidimensional measurement approach to highlight the extent and composition of fuel poverty in USA.
- to determine the probability of a household being fuel poor we use a logistic model to show what are the major socioeconomic and dwelling characteristics of households that affect the odds of being fuel poor.

Fuel Poverty Measurements - Expenditure

10% ratio indicator

$$\text{Fuel Poverty} = \frac{\text{Required domestic fuel costs}}{\text{Income}} > 0.1$$

Advantages

-straight forwardness, its objectivity and its responsiveness to major drivers of fuel poverty.

Disadvantages

-does not include a cut off for households with high income.

Fuel Poverty Measurements – Expenditure

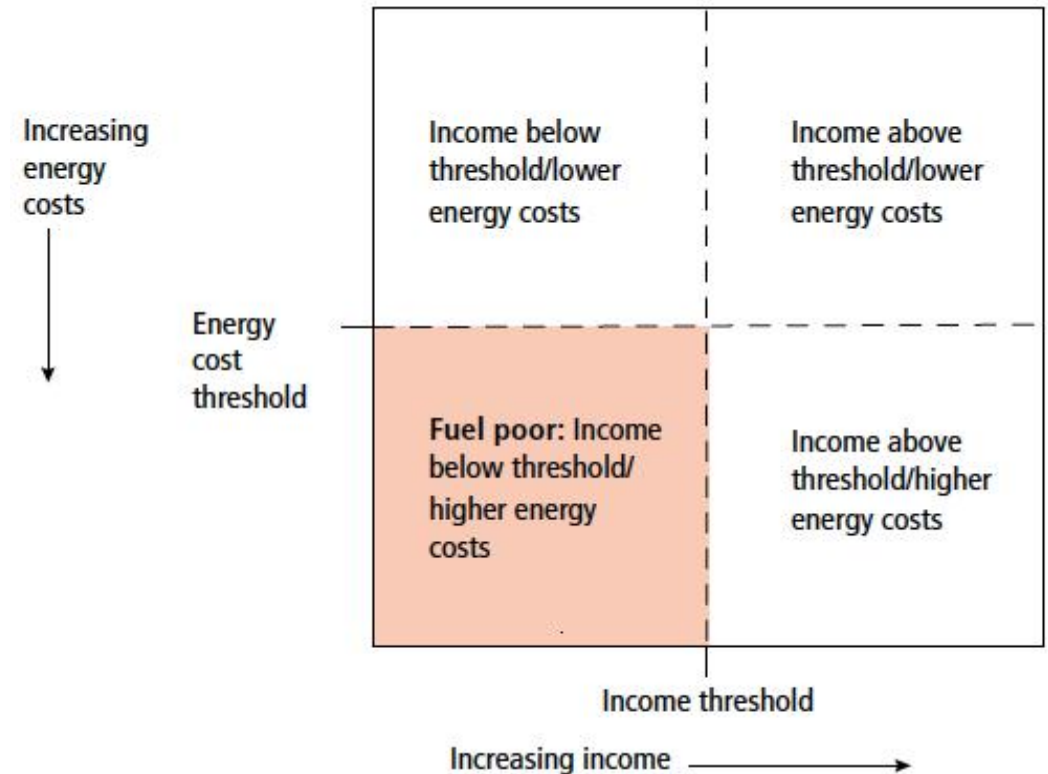
The Hills report (2011), several other options:

- a fuel poverty ratio with income measured after housing costs;
- a fuel poverty ratio with a dynamic threshold based on twice median spending;
- low income and low SAP rating overlap.

The “Low Income-High Costs” indicator

- have high energy costs above the national median, adjusted for household composition,
- low household income, which is defined as income below the 60% median poverty line, adjusted for household size and composition, after energy costs are deducted.

The “Low Income-High Costs” indicator.

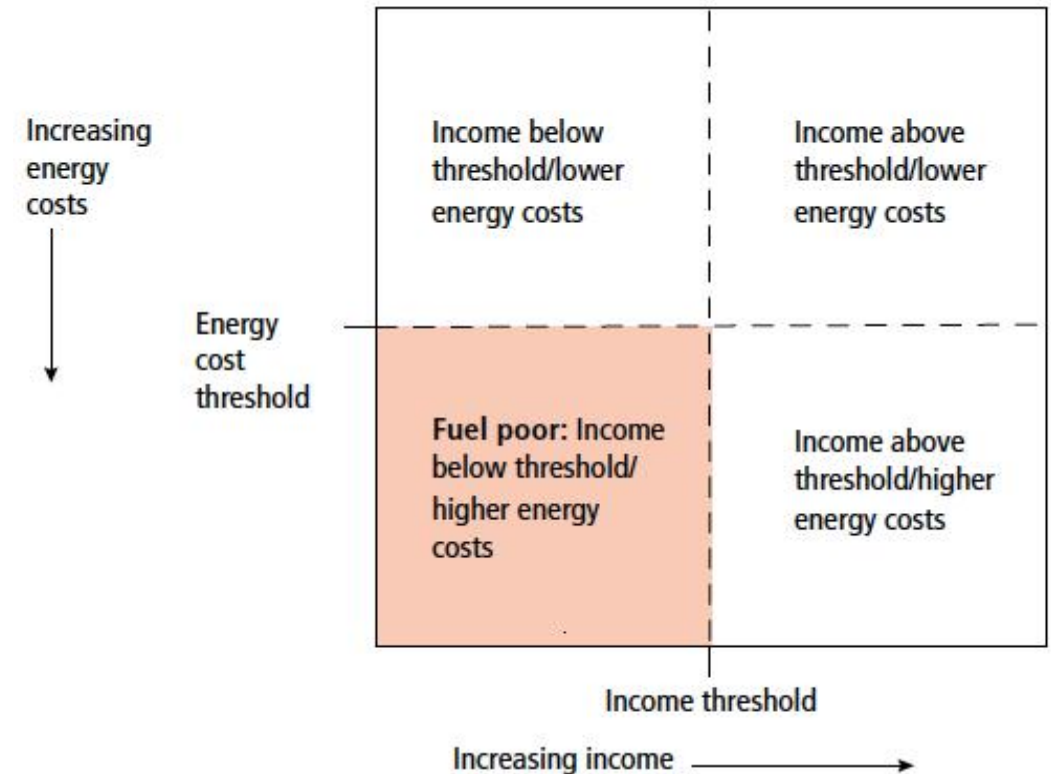


Fuel Poverty Measurements – Expenditure

The “Low Income-High Costs” indicator.

The “Low Income-High Costs” indicator Criticisms

- the design of the relative energy costs component of the LIHC indicator for its failure to provide an accurate picture of the extent to which households can or cannot afford their energy costs.
- the LIHC indicator has counter-intuitive dynamic properties, which may cause false policy implications



Fuel Poverty Measurement - Consensual

Using subjective variables such as the absence of central heating, arrears on utility bills, the ability to keep a household warm and the presence of a leaking roof, damp walls or rotten windows.

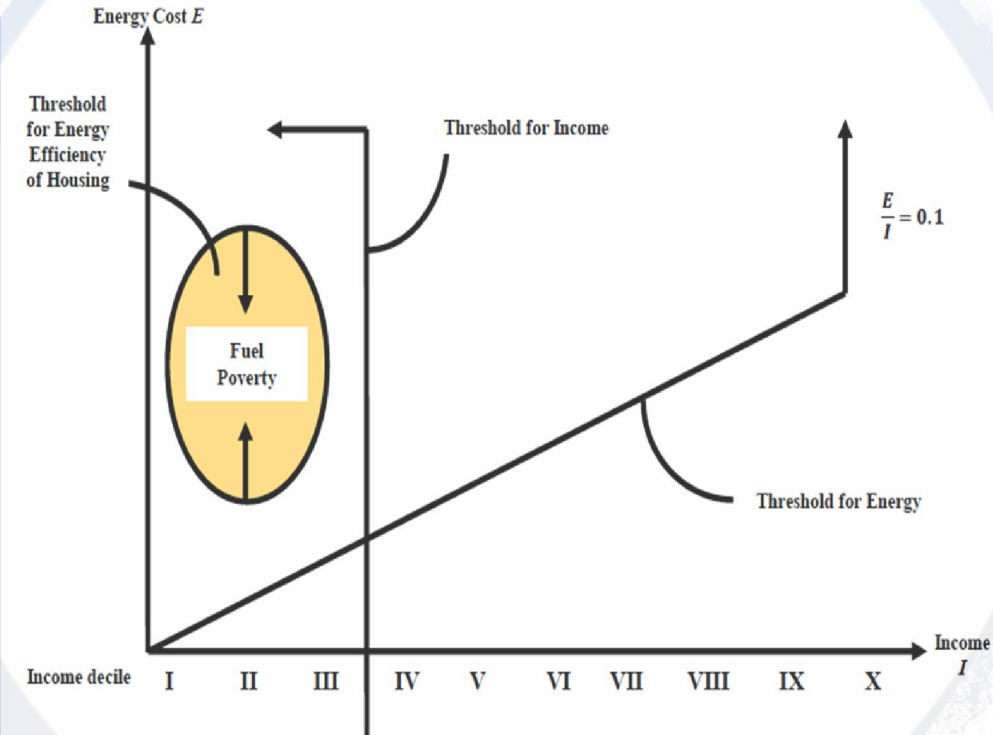
one criticism is on the issue of subjectivity of the indicators due to their error of exclusion. Some households may be fuel poor under other measures but don't report themselves as fuel poor.

Fuel Poverty Measurement - Multidimensional

To overcome the short comings associated with the expenditure and consensual approaches, this paper will employ a multidimensional poverty framework approach as demonstrated by Okushima (2017).

A multidimensional poverty approach considers poverty as a shortfall from a threshold (cut-off) for each attribute.

1. Energy – using the 10% ratio for fuel poverty
2. Energy Efficient of Housing – house unit is built after 1970.
3. Income - the boundary income between the third decile and the fourth decile.



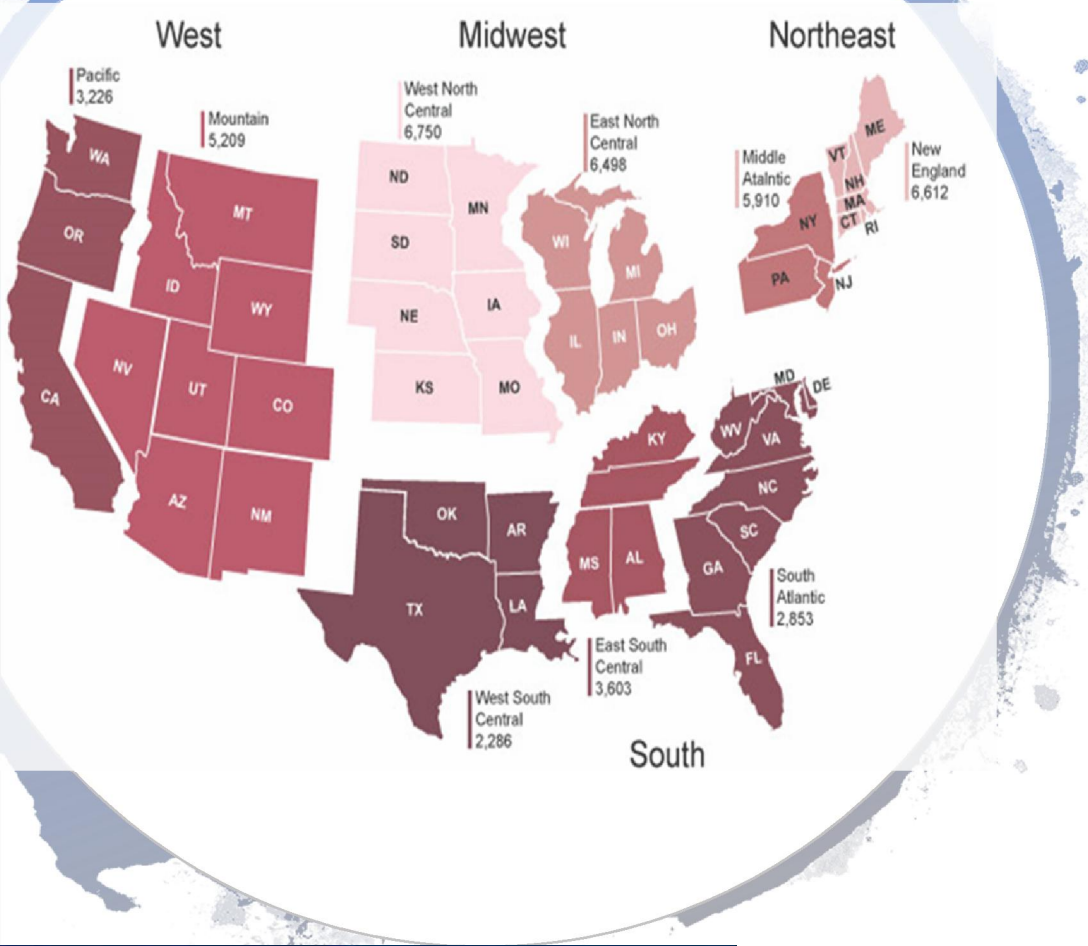
Data and Descriptive Stats

2017 American Household Survey (AHS).

The following regions in America;

- West North Central (WNC),
- East North Central (ENC) and
- New England (NE).

These regions were chosen as they are the three coldest regions in the USA in terms of heating degree days (HDD)



Logistic Model

A logistic model was used to analysis the impact of several socioeconomic factors and dwelling characteristics on the odds of being fuel poor on each region in our study.

$$Y_i = \beta_0 + \sum \beta_i X_i + \varepsilon_i$$

Letting Y_i represent *Multidimensional Fuel Poverty* with a binary response. We define Y_i equal to 1 when a household is deemed fuel poor and 0 when it is not.

where X_i is the vector of covariates and ε_i is the error term. The X_i variables in our model were selected on previous fuel poverty literature and include; Tenure, Education, Heating System, Type of House, Kids, Elderly, Solar, Cooking Fuel, Housing Unit Structure and Race.

Discussion & Results

The first variable is household type which is a categorical variable.

- A separated household across all regions is twice or more likely to be in fuel poverty than a married couple household.
- Similar odds are seen in the category of living alone.
- The only category that differs in odds across the regions is non-family (multiple people) household where in New England they are nearly 40% less likely to be in fuel poverty than the reference category.

The tenure of the household had the same outcome across all regions, with owners just less likely to be in fuel poverty.

The presence of children in a household shows that they are about twice as likely to be in fuel poverty than a household without children.

The presence of elderly people in the household results in a household being more likely in fuel poverty.

This is worrying because fuel poverty, has serious effects on health of the people, especially that of children and the elderly.

| | New England | | East North Central | | West North Central | |
|---------------------------------------|-------------|---------|--------------------|---------|--------------------|---------|
| | No. of Obs | 2,376 | No. of Obs | 6,546 | No. of Obs | 2,055 |
| | Pseudo R2 | 0.1561 | Pseudo R2 | 0.1232 | Pseudo R2 | 0.1211 |
| | Coefficient | P Value | Coefficient | P Value | Coefficient | P Value |
| Type Household | | | | | | |
| Married Couple | Ref Cat | | Ref Cat | | Ref Cat | |
| Separated Household | 2.647 | 0.000 | 3.025 | 0.000 | 2.098 | 0.000 |
| Living Alone | 2.618 | 0.000 | 2.036 | 0.000 | 2.373 | 0.000 |
| Non Family Household, multiple people | 0.607 | 0.000 | 1.210 | 0.000 | 1.137 | 0.000 |
| Tenure | | | | | | |
| Rent | Ref Cat | | Ref Cat | | Ref Cat | |
| Owner | 0.576 | 0.000 | 0.554 | 0.000 | 0.431 | 0.000 |
| Kids | | | | | | |
| No Kids | Ref Cat | | Ref Cat | | Ref Cat | |
| Kids | 2.145 | 0.000 | 1.990 | 0.000 | 2.017 | 0.000 |
| Elderly | | | | | | |
| No elderly | Ref Cat | | Ref Cat | | Ref Cat | |
| Elderly | 2.699 | 0.000 | 1.760 | 0.000 | 2.211 | 0.000 |
| Education | | | | | | |
| No High School Education | Ref Cat | | Ref Cat | | Ref Cat | |
| High School Education | 0.219 | 0.000 | 0.402 | 0.000 | 0.823 | 0.000 |
| College Education | 0.108 | 0.000 | 0.174 | 0.000 | 0.257 | 0.000 |
| Race | | | | | | |
| Non-White | Ref Cat | | Ref Cat | | Ref Cat | |
| White | 0.872 | 0.000 | 0.528 | 0.000 | 0.687 | 0.000 |
| House Unit Structure | | | | | | |
| Detached | Ref Cat | | Ref Cat | | Ref Cat | |
| Attached | 1.077 | 0.000 | 0.394 | 0.000 | 0.468 | 0.000 |
| Small apartment Building | 1.979 | 0.000 | 0.910 | 0.000 | 0.296 | 0.000 |
| Medium apartment Building | 0.822 | 0.000 | 0.307 | 0.000 | 0.305 | 0.000 |
| Large apartment Building | 0.878 | 0.000 | 0.356 | 0.000 | 0.163 | 0.000 |
| Solar | | | | | | |
| No Solar | Ref Cat | | Ref Cat | | Ref Cat | |
| Solar Energy | 0.493 | 0.000 | 0.746 | 0.000 | 0.905 | 0.000 |
| Heating System | | | | | | |
| Furnace | Ref Cat | | Ref Cat | | Ref Cat | |
| Steam or Hot Water System | 0.887 | 0.000 | 1.791 | 0.000 | 1.775 | 0.000 |
| Electric Heat System | 0.821 | 0.000 | 0.799 | 0.000 | 0.622 | 0.000 |
| Others | 1.173 | 0.000 | 0.963 | 0.000 | 1.438 | 0.000 |
| Cooking fuel | | | | | | |
| Electric | Ref Cat | | Ref Cat | | Ref Cat | |
| Gas | 0.824 | 0.000 | 1.011 | 0.000 | 0.772 | 0.000 |
| Constant | 0.535 | 0.000 | 0.563 | 0.000 | 0.255 | 0.000 |

Discussion & Results

Education;

- If the householder has been educated at high school they are 78%, 60% and 18% less likely to be fuel poor than those in the reference category in New England, East North Central and West North Central respectively.
- While a householder with some college experience are less likely to be fuel poor than those in the reference category.

Race;

- In all regions a white household is less likely to be fuel poor than a non-white household.

The structure of the housing unit;

- In New England, Household in detached unit and small apartment buildings are more likely to be in fuel poverty. While households in medium and large apartment buildings are less likely to be fuel poor than those in the reference category.
- Results in the other two regions are that a household in all category are less likely to be fuel poor than that of the reference category.

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Discussion & Results

Solar Energy;

- Households in all regions are less likely to be fuel poor if they have some form of solar energy installed on their unit.

Heating system category variable;

- electric heat system is the only variable that had the same outcome across each of the regions, less likely to be fuel poor.
- A household with a steam or hot water system are less likely to be fuel poor in New England, however in the East and West North Central a household with a steam or hot water system more likely to be fuel poor.
- While for all other forms of heating systems, households in New England and West North Central are more likely to be fuel poor and households in East North Central marginally less likely to be fuel poor.

Cooking Fuel;

- with households in New England and West North Central less likely to be fuel poor if they use gas to cook with instead of cooking with electricity. While cooking with gas in East North Central means a household is more likely to be poor.

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Summary

This paper is noteworthy for two reasons,

- the topic of fuel poverty isn't as deeply researched in the USA as it is in Northern Europe.
- where this study improves on previous USA studies, is in the measurement used to assess the extent of fuel poverty which is argued to be superior to previous measurement approaches.

Summary

The first objective of this paper was to use a multidimensional measurement to assess the extent of fuel poverty in three of the most at risk regions of the United States.

The multidimensional measurement approach overcomes some of the issues surrounding the expenditure and consensual approaches to fuel poverty.

In this study we follow the previous literature on multidimensional measurement approach and use the following three attributes to define fuel poverty; Energy, Income and Energy Efficiency of Housing.

Summary

we presented the statistics for the multidimensional measurement, as well as the statistics for each of the attributes used in it; for each region.

Highlighted was the fact that the 10% ratio approach to fuel poverty, reports households as fuel poor up to the 8th income decile which is one of the drawbacks to this approach.

When using the multidimensional measurement we see a dramatic decrease in those classified as fuel poor, over 10% in some cases.

Summary

A logistic model was used to analysis the impact of several factors on the odds of being fuel poor on each region in our study.

The purpose of this analysis is to inform policy makers as to which types of households to prioritise.

Some of the most common predictors of fuel poverty across all regions are those households the rent, that have children and that have elderly people living in the household.

Those at particular risk of being fuel poor under the variable type of household type are household where the couple has separated.

An interesting finding was that households living medium and large apartment buildings are less likely to be fuel poor across all regions compared to detached houses and could warrant further investigation.

Summary

The findings from our study can be use by policy makers to how best address the issue of fuel poverty.

Future areas of research should examine, selecting different attributes of multidimensional fuel poverty measurement, for example, using a consensual measurement as an attribute.



Thank You For Your
Attention.

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