Energy Policy 113 (2018) 420–429

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Counting energy poverty in Spain between 2004 and 2015

Oihana Aristondo[a,*], Eneritz Onaindia[b]

[a] BRIDGE Research Group, Departamento de Matemática Aplicada, Universidad del País Vasco, Avenida de Otaola 29, 20600 Eibar Gipuzkoa, Spain
[b] Departamento de Organización de Empresas, Universidad del País Vasco, Avenida de Otaola 29, 20600 Eibar Gipuzkoa, Spain

ARTICLE INFO

JEL classification:
C02
C44
D63
I32

Keywords:
Counting
Multidimensional poverty
Energy poverty

ABSTRACT

In this paper, energy poverty is measured in Spain between 2004 and 2015. It has been analyzed globally for Spain and we have also decomposed and analyzed energy poverty for two different groups: three different types of areas, depending on their population share, and regions. The variables used to measure energy poverty are the three energy accessibility indicators: *the ability to keep the home adequately warm*, *the arrears on utility bills (electricity, water, gas)* and *the presence of a leaking roof, damp walls or rotten windows*. Energy poverty is measured using Chakravarty and D'Ambrosio *counting poverty* measures. These indices have been chosen since they are able to capture inequality, and in our opinion they are the most appropriate poverty indices when multidimensional poverty needs to be measured for dichotomous variables. In addition, counting dominance curves have been computed in order to give more robustness to the obtained results. Results suggest that energy poverty in Spain worsened between 2004 and 2015. Specifically, rural areas and Southern regions show the highest energy poverty values.

1. Introduction

Since Boardman's seminal work, Boardman (1991), the concepts of energy poverty or fuel poverty[1] have received a great deal of attention in energy literature and public policy, see also (Boardman, 2013) and (Bouzarovski and Petrova, 2015). It is widely accepted that access to modern energy, or cleaner energy, can be considered a welfare indicator of society. Hence, we can conclude that the welfare of society is closely linked with the use of or the access to energy services and modern energy technologies.

In the literature there is not a universally accepted definition of energy poverty or fuel poverty (see Pachauri et al., 2004; Pachauri and Spreng, 2011; Li et al., 2015; Day et al., 2016). In fact, the concept of energy poverty can be divided into availability and affordability of energy sources. The availability of basic energy resources such as electricity is usually the central issue in developing countries, see González-Eguino (2015), while in developed countries socially and materially affordable domestic energy services are the principal issues.

In this paper, we are going to analyze energy poverty in Spain. For this purpose, we will define energy poverty as the lack of essential, affordable, reliable and safe energy services. The variable we will use to capture energy poverty will be: *the ability to keep the home adequately warm*, *the arrears on utility bills (electricity, water, gas)* and *the presence of a leaking roof, damp walls or rotten windows*. We have decided to use these energy accessibility indicators following a *consensual methodology* denominated by Healy (2004) and Healy and Clinch (2004) in reference to the consensus existing in European societies around a few minimum living conditions that a household is expected to have.

We have mentioned that energy poverty is going to be measured in terms of three energy indicators. Therefore, we are considering that energy poverty is a multidimensional concept. In fact, Pereira et al. (2011) argue that energy poverty extends beyond a unique variable and could be measured with a greater degree of accuracy using a multidimensional framework. In the literature we can find many works that measure energy poverty following a multidimensional framework, see Nussbaumer et al. (2012), Sadath and Acharya (2017), Bouzarovski and Tirado (2015) and Okushima (2017). Most of these works measure energy poverty following the counting poverty approach proposed by Alkire and Foster (2011).

In a counting poverty procedure, the first thing we must do is identify the poor individual. Firstly, we determine if the individuals are deprived or not in each variable and then if they are poor or non-poor depending on the number of dimensions in which they are deprived. In fact, we can identify as poor the individual who is poor in at least one dimension, at least two dimensions, at least in one specific dimension, in all the dimensions and so on. This procedure is called the *dual cutoff identification* in Alkire and Foster (2011). Secondly, a deprivation value is assigned to each individual, which depends on the individual

* Corresponding author.
E-mail addresses: oihana.aristondo@ehu.es (O. Aristondo), eneritz.onaindia@ehu.eus (E. Onaindia).
[1] In what follows, the concept of energy poverty and fuel poverty will be equivalent in this paper.

https://doi.org/10.1016/j.enpol.2017.11.027
Received 11 May 2017; Received in revised form 28 September 2017; Accepted 14 November 2017
Available online 23 November 2017

deprivation values in all the dimensions, and a unidimensional poverty index is applied to these deprivation levels.

In this paper we follow the counting poverty measures proposed by Alkire and Foster (2011) and Chakravarty and D'Ambrosio (2006) in order to measure energy poverty in Spain between 2004 and 2015. We have obtained energy poverty results for different poverty measures and different identification cutoffs. However, the problem of choosing different measures or different cutoffs could lead to contradictory or opposite results. Therefore, with the intention of adding more robustness to the obtained results, we have also followed the procedure proposed by Lasso de la Vega (2010) that provides a dominance criterion that establishes unanimous poverty ordering for counting poverty measures.

Summarizing, we have done a global energy poverty analysis for Spain and we have also decomposed and analyzed energy poverty for two different groups: for three different types of areas depending on their population share, and for regions.

The remainder of the paper is structured as follows. Section 2 introduces the concept of multidimensional energy poverty. Section 3 presents the data we are going to use in order to compute energy poverty in Spain. Sections 4 and 5 are devoted to the methodology and the empirical findings, respectively.

2. Measuring multidimensional energy poverty

There is an agreement that poverty is a multidimensional phenomenon where several findings have been made in theoretical and empirical aspects. A similar situation is concerned when measuring energy poverty since it should be considered as a multidimensional concept and measured for more than one variable or dimension related with energy.

As mentioned in the previous section, we are going to measure multidimensional poverty using counting poverty measures.

If we want to apply a counting poverty index, the first thing we must do is to identify the poor individuals. This identification step is usually done using two cutoffs. The first cutoff concerns the identification of the poor within each dimension. The second cutoff establishes the minimum number of deprived dimensions required for an individual to be considered a poor person. Therefore, a person is identified as poor if she or he is deprived in at least a given number of dimensions. This procedure is what (Alkire and Foster, 2011) called the *dual cutoff identification*. The two extreme situations are called the *union* and *intersection* approaches. The *union* procedure determines poor individuals as those who are deprived in at least one dimension. On the other hand, the *intersection* procedure requires an individual to be poor in all dimensions in order to be classified as poor.

Once we have identified the poor individuals, we need to aggregate the individual poverty in a poverty index. There exists an appropriate methodology, which deals with dichotomous, ordinal and categorical variables, called counting approach, that focuses on the number of dimensions in which an individual is deprived, see Atkinson (2003). Among others, Chakravarty and D'Ambrosio (2006), Bossert et al. (2007), Alkire and Foster (2011) and Bossert et al. (2009) propose indices based on a counting approach. Note that some of them offer the possibility to assign different weights to the dimensions.

However, the choice of different cutoffs in the identification of the poor, or the choice of different poverty measures, adds arbitrariness to poverty comparisons, concluding that different choices can lead to different and/or contradictory results. For this reason, we follow the procedure, proposed by Lasso de la Vega (2010), that provides a dominance criteria that establishes unanimous poverty orderings for some counting poverty measures.

In particular, she establishes unanimous poverty orderings, based on some specific curves, for two distributions regardless of the identification cutoff and of the counting poverty measure. She defines the *FD* curves as the multidimensional headcount ratio for all the admissible dimension cutoffs. Then, if the ranking provided by the *FD* curves is unambiguous over all admissible identification cutoffs, the same poverty ranking is assured over a large number of counting poverty measures and every identification cutoff.

Therefore, we think that these curves are a powerful tool for checking unanimous orderings according to a wide class of counting measures and every feasible cutoff.

3. Methodology

3.1. The selection of the energy poverty variables

There exist official definitions of energy poverty for three European countries, see Thomson and Snell (2013). These definitions are based on the relationship between energy efficiency and low income. However, the rest of the 27 EU member states do not have an official definition of energy poverty.

The “inability to afford adequate warmth in a home, or the inability to achieve adequate warmth because of the energy inefficiency of the home”, “difficulties in the accommodation in terms of energy supply related to the satisfaction of elementary needs due to the inadequacy of financial resources or housing conditions” and “the affordability to keep home adequately warm at a reasonable cost” are the official definitions for Ireland, France and the United Kingdom, respectively. However the most widely accepted definition of energy poverty is one in which the household needs to spend more than 10% of its income on fuel use, which can include heating, electricity and hot water. Boardman (1991) gives the first definition of energy poverty as the inability to have adequate energy services for 10% of income. It is known as the 10% *measure* in this research field. Specifically, this measure defines a household in energy poverty as one that needs to spend more than 10% of its income on energy costs. The energy costs include energy expenses for space heating, water heating, lights and appliances, and cooking. The 10% *measure* has been widely used in energy poverty studies such as Boardman (2013), Heindl and Schüssler (2015), Phimister et al. (2015), Okushima (2016) and Pachauri et al. (2004).

However, this methodology has some drawbacks, since with the use of the 10% *measure*, it is possible that rich households that are overconsuming energy are identified as energy poor, see Hills (2011, 2012). These papers emphasize that energy poverty should be measured looking at fuel prices, low incomes, and energy efficiency. In fact, there is much discussion on how to define and identify fuel poverty, and numerous criticisms have been made of the expenditure approach, see Healy and Clinch (2004), Liddell et al. (2011) and Moore (2012). However, all literature on energy poverty measurement concludes that energy poverty is a multidimensional problem, rather than a unidimensional one of energy costs or expenditures.

Considering the limitations of the expenditure approach, some authors, pioneered by Gordon et al. (2000), analyze energy poverty using subjective variables that are based on the *inability to afford the basic necessities of life*. For example, Healy and Clinch (2004) use a *consensual approach* to energy poverty by analyzing it using subjective variables such as the absence of central heating and the ability to keep a household warm. Nevertheless, this approach also has some flaws such as the inclusion of the likelihood of errors of exclusion, since there are households that do not identify themselves as energy poor, see Dubois (2012). However, the use of a *consensual methodology* enables researchers to measure energy poverty for any European country, and more over, to obtain comparative results. Some results based on subjective energy poverty indicators can be found in Healy and Clinch (2004), Tirado Herrero et al. (2016) and Thomson and Snell (2013).

In this work we follow the above papers and we will measure energy poverty in Spain using three commonly used subjective energy poverty indicators. The variables are: *the ability to keep the home adequately warm*, *the arrears on utility bills (electricity, water, gas)* and *the presence of a leaking roof, damp walls or rotten windows*.