ESTIMATING THE EXTENT OF DOMESTIC ENERGY DEPRIVATION THROUGH HOUSEHOLD EXPENDITURE SURVEYS[1]

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Abstract

Domestic energy deprivation, or energy poverty, is a growing problem worldwide, affecting millions, if not billions, of families in developing countries. One of the ways of making the issue more visible to policy makers and the wider public is by devising a common measurement framework that could be applied to different countries and contexts. In this paper, I lay out some of the methods and procedures that could be used to devise such a framework, based on data from a widely accessible source-household expenditure surveys. The framework has been tested on two national samples from such sources. The results of the paper emphasise the need for relying on a multi-layered methodological approach for estimating the size and extent of domestic energy deprivation, which is a complex phenomenon that does not conform to standard poverty lines and measurement methods.

Introduction

Domestic energy deprivation—also known as 'energy poverty'—is a condition where households lack the resources for heating their homes to an adequate level. 'Adequate' in this case can mean that either the average daytime indoor temperature of the dwelling is below a biologically-determined limit necessary to maintain comfort and health, or that the amount of warmth in the home is lower than the subjective minimum which allows an individual to perform his/her everyday life. Energy poverty is a growing problem worldwide, affecting millions, if not billions, of families in developing countries. At the G8 summit in St Petersburg in July 2006, developed-world leaders 'noted the importance of fighting against energy poverty', because 'it is impossible to develop the economy, improve health care and develop education without having access to energy resources' (RIA Novosti, 2006).

One of the regions where domestic energy deprivation is particularly pronounced is Eastern and Central Europe (ECE). Various strands of evidence suggest that increasing numbers of households in the former communist states in this region are suffering from energy poverty (for example see Jones and Revenga, 2000). Many ECE countries have implemented significant energy price increases, with the aim of removing

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the old price structure inherited from socialism, where tariffs were set at below-cost-recovery levels, and there were extensive cross-subsidies from industry to the residential sector. The problem that has emerged in the post-socialist transition, however, is that most governments have been unable to develop the necessary social safety net to protect vulnerable households from energy price increases. This leaves many families with no option other than to cut back on their energy purchases. The problem is further aggravated by the cold climates of these countries, and the poor energy efficiency of the building stock.

However, domestic energy deprivation in ECE has remained politically invisible to date, due to the private nature of the problem, and the complex, variable and fragmented character of its temporal and spatial distribution. Also, there has been very little research of energy poverty extending beyond the narrow focus on affordability promoted by international financial institutions. One of the ways of making domestic energy deprivation more visible to policy makers and the wider public is by devising a common measurement framework that could be applied to different countries and contexts. In this paper, I lay out some of the methods and procedures that could be used to devise such a framework, based on data from an universally accessible source—the household expenditure survey. It is hoped that the wider application of this method can lead to a more comprehensive understanding of energy poverty not only in ECE, but also in the developing countries of the global South.

Understandings of poverty

Traditionally, economists have measured welfare using either a commodities- or a utility-based approach. The former originates from the Rawlseian theory of justice, which equates well-being with the possession of commodities and income. The utility approach draws its roots in Jeremy Bentham's 18th century utilitarianism, whereby 'an action is right if it tends to promote happiness, and wrong if it tends to promote the reverse of happiness' (Bentham, 1996). The corresponding poverty- measuring method sees poverty as a function of 'utility', which can be interpreted as the fulfilment of a certain need, desire, happiness, or choice. Both approaches operate with an income-based definition of poverty, in that it is assumed that the loss of either commodities or utility occurs below a certain amount of income, which can be absolute (as in a 'basic needs' subsistence level) or relative (where the most commonly-used principle states that a household is 'poor' if its income does not exceed 2/3 of the median income of the entire population).

The hegemony of these two theories was disrupted by Amartya Sen, who proposed that the space of 'capabilities' is more appropriate for evaluating inequality (Sen, 1980). He argued that the possession of commodity or utility cannot provide proxies for well-being, but rather it is important to concentrate on what the person actually succeeds in doing with the commodity, given its circumstances. As a result, poverty is measured on the basis of variations in the individuals' 'capabilities to function', i.e. 'their ability to have a long and healthy life, to be well-nourished, literate, safe, and so on' (Cornia et al., 1996:161, also see Saith, 2001 for an operalisation of the capabilities approach). Amartya Sen's theory switches the emphasis of poverty analysis away from the 'means' (income, wealth etc.), and onto the 'ends' (quality and quantity of life), allowing for the incorporation of a wider range of factors. The UNDP's 1996 Human Development Report has concluded that 'while 900 million people in developing countries are income poor, 1.6 billion are capability poor' (UNDP, 1996:2)

The measurement of energy poverty requires a combination of all three approaches, because an energy-poor family is by definition deprived of domestic energy (i.e. the household is suffering from a loss of utility), due to falling real income or inadequate housing stocks (lack of commodities), and the individuals' decreased ability to keep warm (loss of capabilities).

Defining and measuring domestic energy deprivation

In order to develop a measurement framework for domestic energy deprivation, it is first necessary to define the meaning of the terms 'poverty' and 'energy poverty'. The most widespread definition of poverty sees it as 'a lack of access to resources and denial of opportunities' which hampers an individual's ability to participate in the 'lifestyles, customs and activities which define membership of society' (Folwell, 1999:5). This 'relative' definition has now become standard in the literature, although there are other ways of defining poverty (for a wider discussion see Percy-Smith, 2000; Townsend, 1979; Barr, 1998). Conceptualising poverty in a 'relative' way has opened the space for interpreting energy poverty through what Healy (2003:36) terms the 'consensual' approach, which aims to capture the 'wider elements' of domestic energy deprivation, such as 'social exclusion and material deprivation, as opposed to approaches based solely on home-heating expenditure or household temperature'. This framework also benefits over other methods 'in that it is based on the households' actual feelings and statements … as opposed to being based solely on arbitrary calculations or estimations' (ibid.).

Based on this definition, domestic energy deprivation can be seen as the inability to heat the home up to a socially- and materially-necessitated level. A household is considered energy-poor if the amount of warmth in its home does not allow for participating in the 'lifestyles, customs and activities which define membership of society'. Such a definition comprises both the biologically-determined temperature necessary to maintain comfort and health (Boardman, 1991; but also see Rudge and Nicol, 1999; Healy, 2003), and the subjective minimum below which an individual feels unable to perform his/her everyday life. This means that a household may suffer from energy poverty even if its domestic temperature is above the biologically-determined limit, provided that the temperature in the home is insufficient for performing usual social customs and practices.

The presence of energy poverty can be detected through subjective surveys of well-being or patterns of household expenditure, as direct nationally-representative data about domestic temperature levels is non-existent (Healy, 2003; Rudge and Nicol, 1999; Lewis, 1982; Townsend, 1979). In this paper, I suggest a framework that operates with a combination of analyses based on household expenditure surveys. These methods stipulate that the extent of poverty among a given population can be determined in at least three different ways:

- First, the 'absolute' method—which operates with a commodities-based approach—states that a household can be considered 'poor' if its total earnings fail to reach a pre-determined minimum income. Such a theoretical understanding has a normative equivalent: the 'absolute poverty line' (APL), which is usually calculated by adding up the minimal amounts of money needed to satisfy a given set of pre-defined 'basic needs', for households of different sizes. The resulting monetary amount is then adjusted on a seasonal and annual basis, to reflect consumer price changes.
- Second, in the case of the 'relative' method, the poverty threshold is defined in a relational manner, in line with the 'utility' framework outlined in Chapter 1. In this case, the poverty line is seen a percentage of a higher income level, where deprivation is not supposed to occur. According to the most commonly-used standard, the relative poverty line (RPL) can be set at 50% of the median income of the entire population (Jones and Revenga, 2000).
- Third, the 'subjective' approach attempts to extend beyond the reductionism of income and/or utility criteria, by stressing the 'capabilities' dimension. It determines poverty on the basis on the principle that, basically, an individual is poor if 'he/she considers him/herself poor' (Mateju, 2000). At the heart of this theory is the notion that 'life may be seen as consisting of a set of interrelated functionings, which in turn are composed of beings and doings' (Saith, 2001: 38). The latter may include both physical elements—as in 'being adequately fed and sheltered'—as well as 'more complex social achievements, such as taking part in the life of the community, being able to appear in public without shame, and so on' (ibid: 110).

I have combined all three approaches in quantifying and qualifying domestic energy deprivation, because absolute, relative, and subjective energy poverty information alike can be extrapolated from published poverty data in household expenditure surveys. However, the key moment in defining and describing energy poverty is the affordability of the final energy service, because, simply, a household is energy-poor if it cannot afford to purchase the necessary amount of warmth in the home.

Thus, aside from secondary sources, the demographic structure of energy poverty in the two countries has been estimated with the aid of the 'compensating variation', which quantifies 'the price a consumer would need to be paid … to be just as well off after … a change in prices of products the consumer might buy' (Economics Glossary, 2005). In this paper, the compensating variation expresses the percentage by which a given household's income would have to rise in year y, in order for it to be able to purchase the amount of energy that it was buying in a previous year x, before energy prices were increased. The higher the compensating variation for a given group of households, the greater its loss of welfare during the period between x and y. Comparing the compensating variations for different income strata can help estimate of the size and type of populations affected by energy price increases.

Household expenditure surveys in Macedonia and the Czech Republic

In the remainder of this paper, I look at the patterns of domestic energy deprivation in Macedonia and the Czech Republic—two post-socialist states with divergent reform paths in the transition process. Comparing two such different contexts, it is hoped, can shed further insights into the effectiveness of the proposed energy poverty method.

The two countries have different ways of understanding and measuring poverty. The Czech Republic possesses an APL, also known as the 'subsistence minimum', which is calculated via a combination of normative and empirical criteria. It has been devised 'by finding out, with the help of scientific methods, the rational nutritional standards, and on their basis other needs important to be able to maintain a minimum standard of living' (Adam, 1999:162). The resulting monetary amount is 'a socially-recognised and legally-established minimal income boundary under which deprivation occurs' (CSO, 2005). The APL mainly serves as a basis for distributing social benefits and allowances.

However, both Macedonia and the Czech Republic also have RPLs which have been set by the state at, respectively, 70 per cent and 60 per cent of the level of median income established by nationwide surveys of household expenditure. Families whose incomes fall below this figure are considered 'poor' for statistical and social policy purposes. It has a lower level than the RPL: in 2000, 3.4% of Czech households had incomes under the subsistence minimum, as opposed to approximately 7% under the RPL (ibid.).

As I have already pointed out before, the inadequate political awareness about energy poverty has resulted in the absence of nationally-representative data about domestic deprivation. Neither Macedonia nor the Czech Republic have undertaken any direct, purpose-made surveys of energy poverty to date. It is thus necessary to rely on proxies, rather than direct information, to estimate the extent of insufficient domestic warmth in both countries. This can be done with the aid of data provided by the Macedonian Household Expenditure Survey (HES) and the Czech Family Budget Survey (FBS).

The HES is executed by the Macedonian State Statistical Office on an annual basis, using a two-staged random sampling frame of 1000 households, which was increased to 4200 in 2004 (SSO, 2005). It divides households into groups according to their principal economic activity: 'agricultural' (families whose entire income originates from commercial or subsistence farming), 'mixed' (part of the earnings are based on agricultural production), and 'non-agricultural' (the family's revenue is generated by activities in industry or services). As for the FBS, it a sampling frame of 3000 households representative of the entire Czech population (CSO, 2005). The Czech Statistical Office has published its results annually throughout the post-socialist

period, with income and expenditure data being disaggregated according to income deciles, quintiles, and quartiles, as well as four key demographic categories (families headed by employed adults, self-employed adults, farmers, and pensioners).

The HES and FBS alike classify households into deciles of income. The statistics for each decile are a weighted mean of all the households in that group: the mean income of the households in a given decile decreases as its number falls, with the tenth decile being the 'richest' and the first the 'poorest'. It is important to note that the two countries allocate households into deciles in different ways:

- In Macedonia, the decile boundaries are determined by dividing the income interval between the maximum and minimum earner into ten equal bands, so that the total number of households in each decile varies but the income intervals for each band are the same;
- The Czech Republic obtains its deciles by splitting the total number of households into ten equal groups according to income, so that the intervals between the top and bottom earner in each decile are different, but the total number of households per decile is equal.

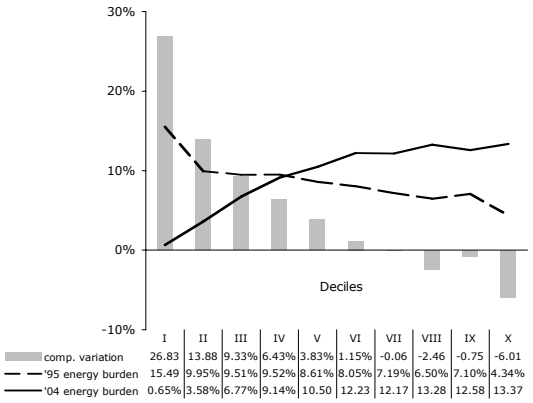
There are two main methods of grouping households into deciles. The first one categorises households depending on their total, or 'aggregate' income. In the second approach, they are divided into income bands according to the equivalent income per household member, which is obtained by dividing total household income with the number of 'equivalent consumption units' in each family, to account for the economies of scale achieved in household consumption. Macedonia and the Czech Republic use different methods for calculating consumption units, although they are both similar to the 'OECD modified' equivalence scale. This system assigns a value of 1 consumption unit to the household head, 0.5 to each additional adult member, and 0.3 to each child (Hagenaars, 1994; Atkinson et al., 1995).

A second set of standardised instruments for judging the extent of domestic energy deprivation in both countries is provided by national surveys of subjective well-being. Such polls are usually undertaken on an annual basis by state statistical agencies in order to assess households' experiences and judgements of deprivation (see CSO, 2005; SSO, 2005). Within this paper, they form an additional basis for assessing and comparing the patterns of energy poverty in the two countries. The HES, FBS, and surveys of subjective well-being are the only nationally-representative and mutually-comparable methods of assessing the demographic extent of energy poverty in the two countries.

Energy expenditure patterns in Macedonia

The change in the 'energy burden'—the share of energy expenditure within the total household budget—during the transition provides interesting insights about the spread of domestic energy deprivation in Macedonia. According to the HES, in 1995, when implicit energy subsidies were still widespread, only the first equivalent income decile had an energy expenditure higher than 10% (this is the 'cut off' point for energy poverty according to the mainstream literature—for example see Boardman, 1991). However, 2004 saw a reversal of the distribution of energy burdens across deciles. The top six deciles had expenditures higher than 10%, while the bottom four actually spent much lower shares of their household incomes on energy (see Figure 1).

Figure 1:
Energy burdens, and compensating variation for energy expenditure per equivalent income decile, Macedonia, 1995-2004 (Author's calculations based on household expenditure data from SSO, 1996; 2005).



	I	II	III	IV	V	VI	VII	VIII	IX	X
comp. variation	26.83	13.88	9.33%	6.43%	3.83%	1.15%	-0.06	-2.46	-0.75	-6.01
'95 energy burden	15.49	9.95%	9.51%	9.52%	8.61%	8.05%	7.19%	6.50%	7.10%	4.34%
'04 energy burden	0.65%	3.58%	6.77%	9.14%	10.50	12.23	12.17	13.28	12.58	13.37

This is a paradoxical situation in standard welfare economic terms, as it would be expected that the poor would spend a higher, rather than lower, share of their income on energy. It can be explained by the extensive reliance on illegal fuelwood among the income-poor, who either obtain this resource at a heavily discounted cost by avoiding official channels, or use it through subsistence forestry in the cases of rural settlements in woodland areas. Also, Macedonian households with lower equivalent incomes tend to be large extended families living in overcrowded housing, where the expenditure per household member may be very low. Household with high equivalent energy expenditures and burdens tend to be urban pensioners, who in this case are grouped in the higher income deciles as their pensions are in monetary form, and are part of the formal economy.

For these reasons, it is better to rely on the compensating variation as a means of obtaining a statistical estimate of the size of the population affected by energy deprivation. This can be done by comparing the absolute energy expenditure of all Macedonian households in 2004, to the same figure in 1995. Figure 1 depicts the percentage by which incomes would have to change in 2004, in order for households to be able to retain the same ratio of energy expenditure relative to the national average in 1995. In other words, it shows whether income would have to be given to, or taken from, a household in order for it to retain its energy expenditure level relative to a normative value (in this case, the national average).

It has transpired that the 60 per cent of households with lowest incomes, i.e. those in the first 6 deciles, would have to receive additional funds—ranging between 27 to 1 per cent of total equivalent income—in order for the ratio of their energy expenditure to the national average to remain equal to the 1995 level. At the same time, however, income would have to be 'taken away' from the top 30 per cent in order for their ratios to remain the same. This means that the relative energy expenditures of better-off households have increased in comparison to the 1995 level. Such households have responded to energy price increases by allocating additional income for energy expenditure.

The 60% figure is matched by surveys of subjective well-being. For example, only 38% of all Macedonian households thought that they were able to keep their home 'adequately warm' in 2003, although the same figure stood at 46% only three years earlier (SSO, 2004).

Such figures are significant in three ways. First, they demonstrate that energy poverty has a much wider demographic extent than statistically-defined income poverty, which does not include households above the third decile. This points to the inadequacy of the RPL defined by the state, which, it appears, has failed to include at least half of the households suffering from energy poverty. Second, the compensating variation shows that energy expenditures have become more polarised, because the top 30 per cent of households with highest incomes now have a greater energy expenditure compared to the 1995 level, while the bottom 60 per cent have been forced to cut back on their energy purchases. This leads to the third finding: that res-

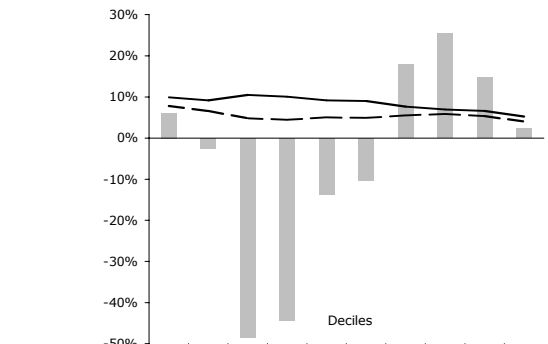
idential energy efficiency improvements have yet to be felt among the wealthiest parts of the population. In normal circumstances, their energy expenditures would be expected to decrease as a result of more efficient building installations and/or fuel switching.

Energy expenditure patterns in the Czech Republic

In the Czech Republic, energy burdens have increased across all deciles between 1995 and 2004. The greatest rises were in the third and fourth income deciles, whose energy burdens increased beyond the 10% mark. However, the first and second deciles also bean to approach this level. Their lower energy burdens may be explained, once again, by the greater size of the unofficial economy among this group.

The values of the compensating variation for the period 1995-2004 (Figure 2) indicate that Czech households have responded to energy price increases in one of three ways. First, the bottom decile has decreased its energy expenditure by 6 per cent of monetary income. a sign of energy poverty. This drop in energy expenditure among the poorest Czech decile probably reflects a real decrease in energy consumption because nearly all forms of energy in the Czech Republic necessitate monetary payment: the fact that these households fall under the poverty line means that they have very low incomes, which are insufficient to cover energy costs. Second, deciles 2-6 have seen a relative rise in their energy expenditure, reaching as much as 49 per cent in the third decile. Although this increase is probably related to the rapid growth of energy prices since 1995, the negative value of the compensating variation also signifies that such households have allocated additional income for energy. The fact that such figures are significantly higher than the maximum value of the compensating variation in the Macedonian case (27%) attests to the growing inequality of energy expenditures in the Czech Republic. This is because the reference value for the compensating variation is the 1995 national average for each country.

Figure 2:
Energy burdens, and compensating variation for energy expenditure per equivalent income decile, Czech Republic, 1995-2004 (Author's calculations based on household expenditure data from CSO, 2005).



	I	II	III	IV	V	VI	VII	VIII	IX	X
comp. variation	6.14%	-2.69	-48.60	-44.39	-13.87	-10.40	17.96	25.29	14.82	2.31%
'95 energy burden	7.79%	6.62%	4.82%	4.46%	5.02%	4.92%	5.51%	5.85%	5.34%	4.05%
'04 energy burden	9.88%	9.18%	10.49	10.06	9.15%	8.99%	7.63%	6.95%	6.59%	5.24%

However, there is also a third, relatively unexpected trend: the energy expenditures of the top four deciles have actually fallen since 1995. This expenditure decrease is unlikely to have been associated with a drop in energy consumption, because the incomes of such households have increased at a greater rate than those in the lower deciles. Instead, it is more probable that the availability of cheaper and/or more efficient fuels, coupled with the improved technical quality of the residential stock, have helped reduce the energy bills of the richest 40 per cent of the population.

The concentration of energy poverty in the lowest income decile is verified by the surveys of well-being within the FBS, which have established that 8.2% of households are not satisfied with the level of heating in their homes. This is slightly higher than the 4 per cent and 7 per cent of households estimated to be living

under the APL and RPL, respectively (CSO, 2005). However, 37% of households interviewed within the FBS well-being survey stated that housing costs represent a 'significant financial burden' on their family budget, while 11.7% thought that they couldn't afford an 'adequate' amount of heating in the home.

Conclusion

This paper investigated the extent of energy poverty among the populations of Macedonia and the Czech Republic with the aid of household expenditure survey data. Several theoretical approaches were embodied into the design of the compensating variation method and energy burden comparisons, which were supplemented with subjective evidence about the state of domestic warmth.

The reviewed evidence points to the existence of a direct link between domestic energy deprivation, on the one hand, and increasing energy prices and falling real incomes, on the other. Both Macedonia and the Czech Republic have experienced changes in household energy consumption and expenditure, following the abolishment of universal socialist-era subsidies of energy tariffs, and the drop in mean real incomes due to transition-related poverty and unemployment. But this is where the similarities end, as the socio-economic features of domestic energy poverty are strikingly different in the case of each country.

In Macedonia, the population living in inadequately heated homes is clearly much bigger than the cca. 30% of households considered 'poor' according to the RPL set by the state, and may even include 60% of all households. Energy poverty in this country has thus assumed both a low- and middle-income character, because it extends beyond the boundaries of relative and absolute poverty lines. In other words, relative income poverty in Macedonia is a subset of energy poverty. Conversely, domestic energy deprivation in the Czech Republic is a socially-marginal phenomenon, because it exists between the APL and RPL. The rate of energy poverty can range between 4 and 11 percent of households, depending on the way in which the problem is being defined and measured.

Domestic energy deprivation in both countries has been triggered by a common predicament: the decreased affordability of energy in post-socialism. Households have responded to this situation in three ways. Some families have continued to consume energy as before, because they have been able to afford it. Others have switched towards more efficient or cheaper fuels, because they have disposed of either the capital stock, or the necessary funds to make such a move. For a third group of households, however, most (or all) forms of energy have become unaffordable post-1990, even when they have been able to substitute fuels. These families have been forced to decrease their energy purchases, in some cases below the biologically-acceptable limit, which means that they have been pushed into energy poverty.

Clearly, domestic energy deprivation is a complex phenomenon that does not conform to standard poverty lines and measurement methods. Estimating its size and extent requires a combination of methods and conceptual approaches. Yet a clear statistical figure about the extent of domestic energy deprivation may lead to an increased political awareness about the prolem, as it will imprint an obvious and unavoidable number into the minds of the public and policy-makers alike. It may thus be useful to work towards a common methodology for energy poverty measurement in the East European context, extending beyond affordability. This framework would help estimate the size and extent of populations affected by energy poverty by interpolating a number of different indicators, including actual consumption, expenditure, demographic structure, and the state of the dwelling. Considering that most of these indicators are already included in household expenditure surveys, it could be devised by extending the extent of such surveys to include a slightly wider set of datapoints. However, data gathering personnel would also have to be trained to collect this information, which isn't always straightforward and simple.

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