Energy poverty of Polish farms?

Tomasz Kuszewski[1], Agata Sielska[2]

Abstract

The objective of the paper is to determine whether the definitions of energy poverty adopted for households are appropriate to analyse this phenomenon in case of agricultural producers. Energy poverty in relation to a farm, being both a producer and a consumer, has no fixed definition. In the paper, we have modified two alternative definitions used in studies of households.

The paper uses the data derived from the Polish FADN (Farm Accountancy Data Network) database for 2004--2013. We analyse farms specialising in field crops. Due to the dependence of the energy consumption from the volume of output, the study is conducted for farms belonging to four separate economic size classes as specified on a basis of the FADN typology.

The results show that adopted definitions of energy poverty of households are not appropriate for the diversification of farms in terms of the share of energy expenses when compared to the current financial possibilities of the agricultural producer. Farms belonging to the group characterized by the lower profitability rate and the higher rate of energy expenses, i.e., those which in case of households would be included into the group at risk of energy poverty, in this case are regularly, on average, more profitable than other farms.

Keywords: *agricultural producer, energy poverty, efficiency*
JEL Classification: D13, Q12, I32

1. Introduction

The issue of energy poverty[3] of households appeared in the economic literature in the last decades of the 20th century. In Great Britain, it was noted that in the winter months some households did not have sufficient financial resources to ensure adequate living conditions in flats, i.e. to prevent dampness and maintain the appropriate temperature. The reasons for such a situation were sought in the difficult economic situation of households, technical condition of the place of residence and bad habits with regard to the energy consumption. Over time, it has

[1] Warsaw School of Economics, Institute of Econometrics, al. Niepodległości 162, 02-554 Warszawa, Poland, e-mail: Tomasz.Kuszewski@sgh.waw.pl.
[2] Corresponding author: Institute of Agricultural and Food Economics – National Research Institute, Mathematics Application in Agricultural Economics Department, Świętokrzyska 20, 00-002 Warszawa, Poland, e-mail: Agata.Sielska@ierigz.waw.pl.
[3] The issue of poverty has been present in the social statistics for a long time. Poverty is regarded as the fact that certain needs have not been satisfied at the desirable level. More on this subject could be found in Panek (2007).

become obvious that the problem of energy poverty occurs, with varying intensity, in all countries of the European Union (Bouzarovski, 2014; Bouzarovski et al., 2012; Healy and Clinch, 2002; Phimister et al., 2015; Dagoumas and Kitsios, 2014; Gerbery and Filcak, 2014).

In Poland, the issue of energy poverty of households was noticed a few years ago (Figaszewska, 2009). Recently, the studies have appeared on the issues of measurement and variability of the energy poverty of Polish households (Miazga and Owczarek, 2015; Lis et al., 2016).

In the initial period of studies, households which spent more than 10% of their available income on energy were regarded as affected by energy poverty. Recently, the two-criterion indicator – LIHC (low income, high costs) – has been applied, as recommended in (Hills, 2012; Kang Li et al., 2014; Schuessler, 2014). According to the LIHC indicator, firstly, equivalent income of an energy-poor household is lower than 60% of median income in the given group of households. Secondly, energy expenses in the analysed household are higher than the median energy expenses in the given group of households. Both above-mentioned indicators are relative in that sense that their value is determined by the group of analysed households and the value of these indicators vary over time.

The objective of the paper is to examine whether the definitions of energy poverty formulated for households are appropriate for individual farms. A farm is a specific object of studies, as it is an entity both consuming and producing consumer goods and obtaining profits in this way. Available income of the farm comes largely from the agricultural activity[4]. This type of income is a difference between the value of agricultural output plus subsidies related to the farm activities and inputs incurred on agricultural output plus taxes related to this output. Also, farm's energy expenses include not only the expenses for energy needed for living and housing purposes[5] but the expenses for energy used in production processes as well. Therefore, energy poverty of the farm will be determined by such factors as the value of output, technical condition of production facilities and managers' knowledge and skills.

[4] Naturally, apart from income from agricultural activities, income may also include any other types of income (cf. Methodological comments on the household budget survey, Central Statistical Office).

[5] Diversification of energy poverty of households from urban and rural areas has been noticed in Great Britain (Roberts et al., 2014), but the analysis was limited to expenses for energy consumed for housing and living purposes.

The CSO household budget statistics covers only the first group of the above-mentioned, divided into electricity and gas expenses, heating energy expenses and fuel expenses[6]. In the present study, the Farm Accountancy Data Network (FADN) data were used, where we may distinguish between electricity charges, fuel material expenses and propellant expenses. In this way, energy poverty of the farm becomes a phenomenon which may affect not only the health and well-being of its members, but also their ability to conduct production processes effectively. Therefore we need to modify those definitions of energy poverty which are adopted for the households in general[7].

Farms in Poland are, in terms of diversification of income, much more diversified if compared with e.g., households of employees. In 2004-2013, the value of the Gini coefficient[8] for farmers ranged between 0.491 and 0.599, while for households of employees only between 0.340 and 0.371. At the same time, income poverty risk indexes measured using the relative poverty lines[9] are in the analyzed period by about 10 percentage points higher for households of farmers than for households of employees.

It is assumed that decisions made at the farm are rational. In this respect, the case of energy wastefulness in general and its waste at the farm in particular is eliminated from further considerations. If the farm fully satisfies its energy needs for production, housing and living purposes, then it may be concluded that this farm is balanced in energy terms. If, on the other hand, the farm is not satisfying the energy needs at the desirable level, then there is a problem of energy poverty. If the farm remains in the state of energy poverty, we may suppose that the efficiency of its' management processes is lower than in case of farms balanced in energy terms.

[6] In the methodological comments and classification of expenses in household budget surveys it is clearly mentioned that it is necessary to take into account expenses for consumer goods and services based on the COICOP classification (Classification of Individual Consumption by Purpose).

[7] The definition applied in Great Britain specifies the criterion of the sufficient heating level by providing minimum temperatures in living premises, as well as includes into the energy expenses also the expenses for other heating purposes such as cooking, heating of water and lighting (Figaszewska, 2009).

[8] The Gini coefficient is calculated based on the value of available income per 1 household member (cf. CSO, 2014, p. 287).

[9] The income poverty risk index is defined as the percentage of all persons in households of a given type having expenses below the specific limit. In accordance with the CSO methodology, the relative poverty line accounts for 50% of average monthly expenses determined on an equivalent basis.

An assumption of the existence of this difference is a basis for the methodology of this study. Therefore, it is postulated that the definition of energy poverty is objective[10] in this sense that the assessment of the level of satisfying the needs of analyzed farms is made regardless of the personal evaluations made by farmers and their families. Measurement of energy poverty of farms is carried out in absolute and relative terms at a time. It is carried out in absolute terms because the state of satisfying the energy needs has been defined in quantitative terms and in relative terms because the level of satisfying the energy needs of the farm is compared with the level of satisfying these needs by other farms. The relative nature also results from the fact of predicting the diversification of the energy poverty threshold due to the time of the study, agricultural region, type of the dominant production activity and the size of the farm.

For conducting the study of the energy poverty of farms, we need the individual representative data on the Polish farms.

2. Data

The analysed data on farms come from the Farm Accountancy Data Network (FADN) database. The FADN functions in each EU Member State, and the data collected are representative on the levels of: agricultural type, economic size and location of the farm.

Farms are classified under the FADN into one of six classes in accordance with the values of so-called Standard Output (SO). The analyzed economic size classes have been defined as follows. “Very small” farms are those in which the annual value of SO exceeds EUR 2,000 and does not exceed EUR 8,000. The value of SO of “small” farms ranges from EUR 8,000 to EUR 25,000, of “medium-small” from EUR 25,000 to EUR 50,000, and of “medium-large” from EUR 50,000 to EUR 100,000. Due to the insufficient number of farms belonging to certain groups in the selected years, the sample does not include “large” and “very large” classes. Moreover, it may be presumed that the production processes taking place in these farms differ in terms of scale and regularities from those ones in farms belonging to other listed classes.

The value of SO is also used to determine the type of the farm’s activity, i.e. the agricultural type. The criterion on a basis of which farms are classified, is the share of SO of a given type in the total value of output. In accordance with that classification, the farm is assigned to one of the

[10] Income poverty of households may also be analyzed in subjective terms. Then, the basic information is the assessments of the financial situation obtained directly from households, e.g. in a form of surveys.

eight specializations as follows: field crops; horticultural crops; vineyards; permanent crops; dairy cows; herbivorous animals; granivorous animals and mixed production. In this study, due to its limited volume, we focus on farms specialising in field crops. Table 1 contains the data on the number of analyzed households in years 2004-2013, broken down by economic size classes.

Economic size	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Very small	260	320	321	366	402	405	288	288	334	494
Small	569	611	641	752	864	925	794	881	933	1145
Medium-small	294	348	343	393	511	555	513	539	547	610
Medium-large	183	193	207	212	272	302	270	284	279	320

Table 1. Economic size classes and number of observations in the study.

Source: own elaboration based on the FADN data.

3. Method of analysis

The idea of identifying agricultural producers at risk of energy poverty is borrowed from the studies on households, with appropriate modifications. In the first version of the analysis we use the equivalent of the criterion of exceeding the threshold of the share of energy expenses in equivalent available income of the household. In case of the farm the selected threshold is the value of the share of energy expenses in relation to the value of output. This indicator was called the energy ratio (ER) of the agricultural producer and 10% of the value of ER has been adopted as the threshold. This means that under the first definition, the farm is at risk of energy poverty if annual energy expenses exceed 10% of the value of output. The group of those farms was marked symbolically as >10.

Also, the two-criterion procedure similar to the LIHC method was applied. The following discrimination of the set of agricultural producers has been applied. Firstly, for each analyzed farm specializing in field crops, the value of output per 1 ha of agricultural land in use has been determined. This value was called the income index (II). Candidates potentially at risk of poverty are these farms for which the II is lower than 60% of the median value[11] of this index in a given

[11] Determining the threshold of 60% of the median value is accidentally compliant with the threshold determined in the LIHC method. In case of this study, the threshold has been selected on a basis of simulation so as to obtain the clear diversification of all farms into LIHC and RES groups.

set of agricultural producers. Producers being at risk of energy poverty are chosen from this group on the basis of the value of II. A producer is considered energy poor if his II is higher than the ER of the producer who is characterized by the median value of the income index[12]. At the end of the procedure, for each of two definitions we obtain two subsets of analyzed farms: those at risk of energy poverty (the group was marked LIHC) and those not at risk of energy poverty (marked RES).

The test of the validity of this division of agricultural producers is the efficiency of management in each distinguished group. It may be expected that the production processes in farms not at risk of energy poverty are characterized on average by better values of ratios which traditionally measure the economic efficiency of the entity than median values of the same ratios for farms at risk of energy poverty. On the basis of the individual data for each year of the analyzed period, the values of three ratios have been determined[13]. The efficiency ratio (ER) is measured by the value of cash flow[14] per unit of fixed assets. The profitability ratio (PR) is measured by the value of cash flow per unit of the value of output of the farm. The debt ratio (DR) is the ratio of total liabilities to the equity value.

4. Results

The application of the first definition of the farm at risk of energy poverty divides farms in each economic size class into two groups of the comparable size. The share of farms from the group of >10 in the total number of farms for all years of the study period is included in Table 1. If we are to interpret the obtained result literally, this would mean that we should sometimes suspect that more than half of farms in each economic size class are at risk of energy poverty.

It seems that the first definition of energy poverty does not match the situation of farms. The share of energy expenses in the value of output exceeding 10% in case of farms specializing in field crops is determined technologically. An analysis of the value of efficiency indicators in the group of farms >10 and others does not authorize us to claim the existence of significant

[12] Should more than one such producer exist, we use the average of the closest values.
[13] Measurement of liquidity using the ratio of current assets to short-term liabilities has proven unfounded in the given group of farms.
[14] In the FADN nomenclature, cash flow shows the farm's ability to self-finance its activity and to create savings. It is calculated as the difference between income (from sale of products, animals and other) and costs, adjusted by the balance of subsidies and taxes. Cash flow for the farms may be treated as an equivalent of net profit.

differences between the average values of management efficiency measures in both groups. This outcome makes us abandon the first of the formulated definitions as useless in relation to farms.

Economic size	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Very small	63	50	50	55	44	37	49	45	41	33
Small	63	45	47	65	39	44	52	46	50	44
Medium-small	71	50	53	70	50	40	60	52	56	46
Medium-large	69	53	49	72	47	50	56	48	58	48

Table 2. Share (%) of farms from the group >10 in the total number of farms in the economic size class (first definition).

Source: own elaboration based on the FADN data.

The application of the second definition of energy poverty brings the division of farms in each economic size class into groups of farms with the clearly different size. The structure is given in Table 3. The share of farms from the LIHC group ranges throughout the period of 2004-2013 between 10% and 20% of farms, with a few exceptions[15].

Economic size	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Very small	12	18	26	15	13	19	19	16	15	18
Small	14	18	16	14	13	17	20	16	14	16
Medium-small	11	14	17	11	14	15	13	12	9	9
Medium-large	x	18	15	10	9	13	13	13	10	8

Table 3. Share (%) of farms from the LIHC group in the total number of farms in the economic size class (second definition).

Source: own elaboration based on the FADN data.

The analysis of the average values of efficiency ratios brings surprising results. Farms from the LIHC group, i.e. those characterized by the lower values of the profitability ratio and higher values of the energy consumption index in each class of economic size prove to be, on average,

[15] „x" stands for too low share in case of which according to the FADN rules the results cannot be presented.

more profitable than farms belonging to the RES group. The higher average profitability is maintained throughout the period of 2004-2013. As we may see in Fig. 1, the variability of the average profitability ratio over time is higher for farms from the LIHC group than for those from the RES group, but the values and variability of the average efficiency ratios are very similar in both groups. The same applies to the average debt ratio. Their average values in both groups are similar and close to those of efficiency ratios, and therefore the values of debt ratios were not included in charts in Fig. 1, which improves its clarity.

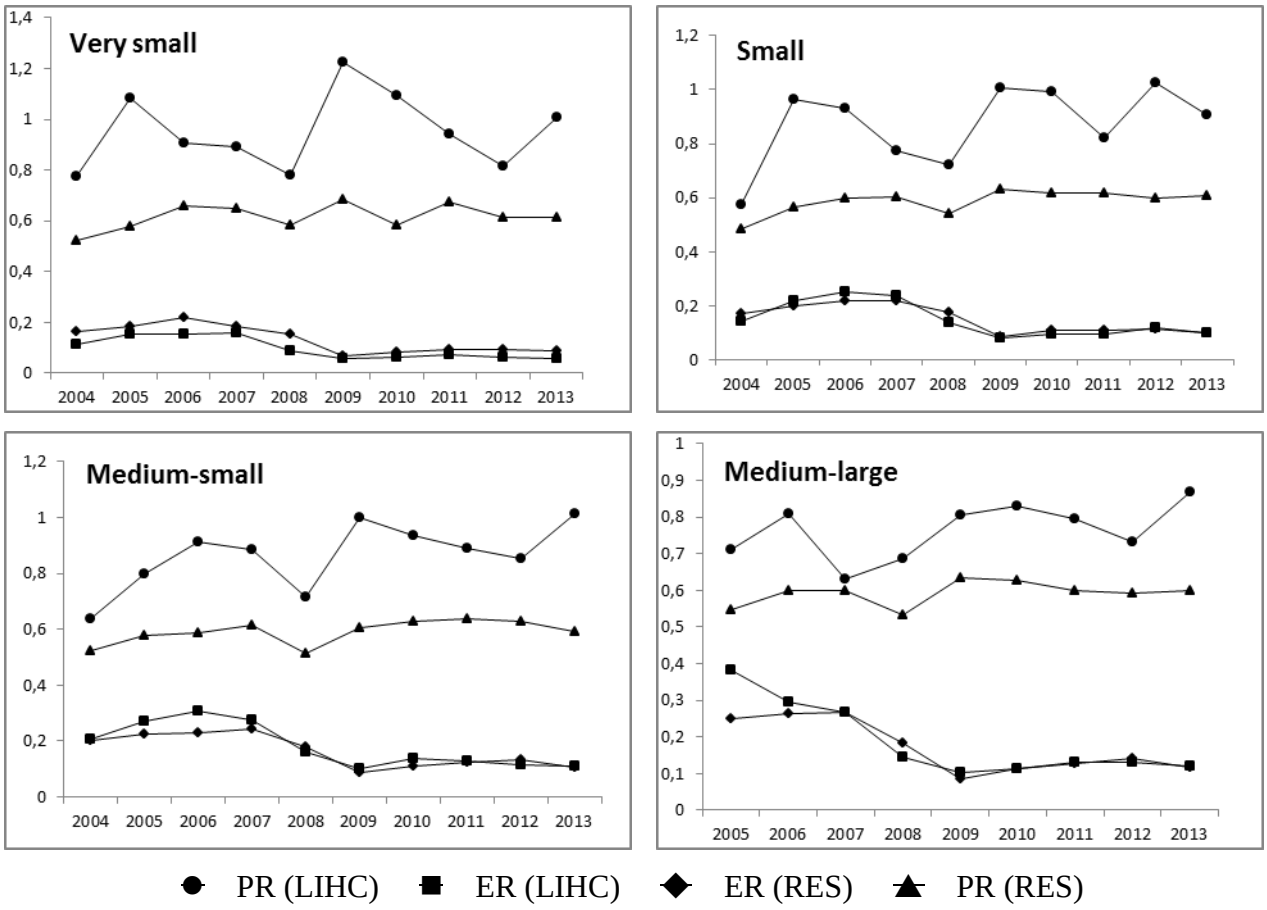

Fig. 1. Median efficiency ratios, 2004-2013.

Source: own elaboration based on the FADN data.

Conclusion

The study demonstrated that the definitions of energy poverty used in case of households are not appropriate for diversifying farms in terms of the share of energy expenses as compared with the current financial capacity of the agricultural producer. The results suggest that farms belonging to

the group of farms with the lower profitability ratio and higher rate of energy expenses, i.e. those which in case of households would be included into the group of farms at risk of poverty, in this case, are regularly, on average, more profitable than other farms.

The non-compliance of the presented energy poverty criteria results probably from the fact that increased energy expenses incurred by farms bring additional revenue from production, while in case of households increased energy expenses are an additional burden on the budget and they admittedly improve the quality of life but this fact is not included in the available income account.

We may assume the existence of energy-poor farms in the sense attributed to households. Measurement of this phenomenon and identification of its size requires the formulation of the definition of energy poverty of agricultural producers and a comprehensive analysis of management of energy from various media, similar to the analysis included in Michalski (1991).

Acknowledgements

This publication was prepared as a contribution to the research conducted within the Multi-Annual Programme "The Polish and the EU agricultures 2020+. Challenges, chances, threats, proposals" in IAFE-NRI.

References

Bouzarovski, S. (2013). Energy poverty in the European Union: Landscapes of vulnerability. *WENE Wiley Interdisciplinary Reviews: Energy and Environment, 3*(3), 276-289.

Bouzarovski, S., Petrova, S., & Sarlamanov, R. (2012). Energy poverty policies in the EU: A critical perspective. *Energy Policy, 49*, 76-82.

Dagoumas, A., & Kitsios, F. (2014). Assessing the impact of the economic crisis on energy poverty in Greece. *Sustainable Cities and Society, 13*, 267-278.

Figaszewska, I. (2009). Ubóstwo energetyczne – co to jest? *Biuletyn Urzędu Regulacji Energetyki, 5*(67), 2-20.

Gerbery, D., & Filčák, R. (2014). Exploring Multi-dimensional Nature of Poverty in Slovakia: Access to Energy and Concept of Energy Poverty. *Ekonomick*ỳ *Časopis, 18*, 579-597.

Hills, J. (2012). *Getting The measure of fuel poverty. Final Report of the Fuel Poverty Review* (CASE report no. 72). Centre for Analysis of Social Exclusion, The London School of

Economics and Political Science. Retrieved from CASE website: sticerd.lse.ac.uk/dps/case/cr/CASEreport72.pdf.

GUS (2014). *Budżety gospodarstw domowych w 2013*. Warszawa.

Healy, J.D., & Clinch, J. (2002). Fuel poverty, thermal comfort and occupancy: Results of a national household-survey in Ireland. *Applied Energy, 73*(3-4), 329-343.

Michalski, K. (1991). *Energochłonność produkcji rolniczej w Polsce*. Warszawa: PAN. IRWiR.

Li, K., Lloyd, B., Liang, X.-J., & Wei, Y.-M. (2014). Energy poor or fuel poor: What are the differences? *Energy Policy, 68*, 476-481.

Lis, M., Ramsza, M., & Miazga, A. (2016). *Dynamiczne własności miar ubóstwa energetycznego* (Research report). Retrieved from http://ibs.org.pl/app/uploads/2016/01/IBS_Research_Report_01_2016_pl.pdf.

Miazga, A., & Owczarek, D. (2015). *Dom zimny, dom ciemny – czyli ubóstwo energetyczne w Polsce*. Warszawa: Instytut Badań Strukturalnych.

Panek, T. (2007). *Statystyka społeczna*. Warszawa: Polskie Wydawnictwo Ekonomiczne.

Phimister, E., Vera-Toscano, E., & Roberts, D. (2015). The Dynamics of Energy Poverty: Evidence from Spain. *Economics of Energy & Environmental Policy EEEP, 4*(1), 153-166.

Roberts, D., Vera-Toscano, E., & Phimister, E. (2015, April). *Energy poverty in the UK: Is there a difference between rural and urban areas?* Paper presented at the 89th Annual Conference of the Agricultural Economics Society, Warwick University. Retrieved from ttp://purl.umn.edu/204213.

Schuessler, R. (2014). Energy Poverty Indicators: Conceptual Issues. Part I: The Ten-Percent-Rule and Double Median/Mean Indicators (Discussion Paper No. 14-037). Retrieved from ZEW Centre for European Economic Research website: ftp://ftp.zew.de/pub/zew-docs/dp/dp14037.pdf.