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The share of expenditure on food and energy in total spending of Polish households in 2021 taking into account energy poverty

Kornelia Kłopecka^a

Abstract. The article concerns the share of expenditure on food and energy in the total spending of Polish households in 2021. The main objective of the study is to find out which socio-economic characteristics of Polish households determine how big the share of expenditure on food and energy in households' total spending is, as well as to examine how energy poverty affects this expenditure. Tobit models estimated using the maximum likelihood method were used in the empirical study. The estimation results indicate that the household size and type, disposable income, extent of energy poverty, and being a retiree, a pensioner or a farmer is correlated with how big the share of expenditure on food and energy in a household's total expenditure is.

Keywords: energy poverty, household budgets, Tobit model, share of expenditure on food and energy

JEL: D12, D13, Q41

1. Introduction

^a Krakow University of Economics, College of Economics, Finance, and Law, Institute of Quantitative Methods in Social Sciences, ul. Rakowicka 27, 31-510, Krakow, Poland, email: k.klopecka@gmail.com, ORCID: <https://orcid.org/0009-0006-8484-2847>.

The study of the socio-economic determinants of the share of food and energy expenditure in household budgets in Poland is a significant contribution to the literature on quality of life, consumption levels and energy poverty. Expenditure on food and energy reflects basic human needs, and its level directly impacts the physical and mental wellbeing of society. Previous research showed that the share of expenditure on food and energy is dependent on various factors, including the household size, disposable income, location (class), household composition and even membership in specific social groups.

In the literature on energy poverty, studies analysing the impact of energy costs on quality of life and limitations on access to essential energy services are of particular importance (Bouzarovski, 2014). Researchers also identify energy-poor households facing the 'heat or eat' dilemma. This term, frequently used in research, refers to a situation where a family, due to limited financial resources, is forced to make difficult choices between heating their home and buying food. In the United Kingdom, certain organizations already provide free heating services to those in need, including older people and people with disabilities (Champagne et al., 2023).

The innovativeness of this study lies in the fact that it combines the analysis of the share of food and energy expenditure in the total spending of households with that of energy poverty. This allows a better understanding which households are most vulnerable to energy poverty and how the share of their food and energy expenditure in their total spending is shaped. Understanding how energy poverty affects the share of this expenditure can provide valuable insights for policymakers in formulating strategies to combat energy poverty.

This topic was chosen for our research partly due to the aggravating issue of energy poverty in the face of global crises, such as the COVID-19 pandemic and rising energy commodity prices. The inability to satisfy basic needs, such as food, heating and electricity, directly affects the wellbeing of society. High

food prices might lead to malnutrition, while rising energy costs might limit a household's access to heating and electricity, impacting the health and quality of life of its members. Previous research focused predominantly on analysing expenditure on food and energy, but few studies so far have examined the impact of energy poverty on the structure of this expenditure.

The aim of this study is to determine which socio-economic characteristics of Polish households have a significant influence on how big the share of food and energy spending in their total expenditure is. As mentioned before, this research brings a new perspective to the existing literature by combining the analysis of expenditure on food and energy with the problem of energy poverty. To achieve this goal, Tobit models estimated by means of the maximum likelihood method were applied.

The results of the study provide valuable insights that can help to develop solutions to counteract energy poverty and shape effective state policy in this respect. Our research also contributes to the better understanding of the relationships between energy poverty and socio-economic factors, which is crucial for creating policies aimed at sustainable development and improving the wellbeing of societies.

2. Literature review

When analysing choices of food and decisions regarding consumption, it is essential to consider the demographic factors (household size) as well as the psychological (lifestyle), economic (disposable income), social, cultural and globalisation-related factors (Kostakis, 2014). Research findings (Hanus, 2018) have shown that the latter, i.e. the impact of globalisation on consumers' eating habits, is reflected in behaviors such as purchasing food products in supermarkets and seeking convenience and ease in food consumption. New

consumer preference trends, partly driven by globalisation, have forced producers to develop innovative and personalised products to meet diverse consumer needs.

Analysing external factors, certain correlations between food expenditure and household income can be observed (Zani et al., 2019). According to Engel's law, as income increases, the percentage of food expenditure in a household's total spending decreases (Sekhampu, 2012). It is also shown that the higher the level of education of household members, the more balanced diet in this household. Such families tend to spend relatively much on varied types of food products (Maniriho et al., 2021). Another important factor is the household's size – as the number of members increases, so does the percentage of income spent on food (García & Grande, 2010).

In the literature, household consumption expenditure is also analysed according to the classification of location (Borowska et al., 2020; Grzega, 2015; Grzega, 2022). The presented results indicate that the share of food expenditure in the overall expenditure structure is larger among households in rural areas than those in cities. As regards expenditure on housing and energy, on the other hand, rural households overall spend less than households in cities.

The household composition is also mentioned in the literature as a determinant of the share of food expenditure in the total spending of a household (Grzega, 2015). Such studies show that couples without children devote a smaller share of their budgets to food than both couples with children and single parents with dependents.

Other studies highlight the significance of the socio-economic status of a household in the context of expenditure on food and energy (Utzig, 2016). The research shows that households of people in employment devote a smaller share of their budgets to food than households of farmers and pensioners. On the

other hand, households of pensioners spend proportionally more on housing and energy than people in employment and farmers.

Apart from the above-mentioned factors, certain relationships between food expenditure and age can be observed. As the age of the household members increases, so does the level of food expenditure (Turczak & Zwiech, 2014). However, a significant change in the overall structure of food expenditure occurred due to the introduction of the 'Family 500+' benefit. This increase in households' income translated into higher spending on food products, particularly in the case of rural households (Wiśniewska, 2017).

Energy poverty is also significant in the context of household expenditure, and it has gained importance in recent years in the economic and social research. The literature indicates that energy-poor households often face difficult choices between covering energy costs and buying food (Bouzarowski, 2014). Research shows that energy poverty impacts the overall level of household expenditure (Thomson et al., 2017).

A study of household budgets in Poland showed that in 2022, expenditure on food and non-alcoholic beverages had the largest share in the expenditure structure of Polish households, amounting to as much as 26.7%. The level of this expenditure depends on which social group (farmers, pensioners, employed people or the self-employed) members of a household belong to (Główny Urząd Statystyczny, 2023).

The above literature review clearly shows that important determinants affecting the share of spending households devote to food and energy are: the age of household members, the household's size, the level of education of household members, the household's disposable income, the composition of the household, the socio-economic group the household members belong to, the location of the household, and the occurrence or not of energy poverty.

3. Energy poverty

3.1. Definition

Since 2022, Poland has had a legal definition of energy poverty. It was introduced by the Announcement of the Speaker of the Sejm of 19th May 2022 on the publication of the consolidated text of the Energy Act (Journal of Laws from 21st December 2022, Item 1385):

Article 5gb. [Energy Poverty]

‘1. Energy poverty means a situation where a household run by one person or by several people jointly in an independent residential unit or a single-family residential building, where no business activity is conducted, cannot provide itself with a sufficient level of heat, cooling or electricity for powering devices and lighting, and where the household cumulatively meets the following conditions:

- has a relatively low income;
- its energy-related expenditure is relatively high;
- the building where the household is located is of low energy efficiency.

2. The criteria for energy poverty qualifying for energy poverty reduction programs are specified each time in programmes introducing energy poverty reduction instruments’

The above definition means that a household is considered energy-poor and qualifies for social programmes only if all the above conditions are met.

Clarifying these three measures is not an easy task, especially since data for such categories are not collected in Poland. Therefore, it is impossible to apply the definition of energy poverty to data published by state institutions. In such cases, other measures must be used. One of them is a ‘subjective assessment’ of a household (Śmiech et al., 2023).

3.2. Subjective assessment

To identify energy-poor households, three questions were asked to respondents during the survey:

1. In your opinion, is the house you live in sufficiently warm in winter;
2. How do you rate the timeliness of paying housing costs (rent, utility costs, including gas and electricity, etc.) by your household;
3. Which of the following statements best describes the way money is managed by your household.

The first question enabled respondents to either confirm or deny the condition. A negative response classifies the household as energy-poor. In the second question, the responses ‘Rather badly/Badly’ indicate energy poverty, while ‘Well/Rather well/Average, neither well nor badly’ indicate its absence. Two of the responses to the last question, namely ‘We have to manage very frugally on a daily basis/We do not even have enough for basic needs’, classify the household as energy-poor. In contrast, the remaining statements ‘We can afford some luxuries/We can afford many things without special saving/We have enough for daily needs but must save for larger purchases’ do not indicate energy poverty.

The results and distributions of responses to individual questions are presented in Table 1.

Table 1. Distribution of responses to the questions in our survey

Energy poverty	Absence of energy poverty
3.29% ^a	96.71% ^a
0.84% ^b	99.16% ^b
16.90% ^c	83.10% ^c

a Distribution of responses to the question: ‘In your opinion, is the house you live in sufficiently warm in winter?’

b Distribution of responses to the question: ‘How do you rate the timeliness of paying housing costs (rent, utility costs, including gas and electricity, etc.) by your household?’

c Distribution of responses to the question: 'Which of the following statements best describes the way money is managed in your household?'
 Source: author's work based on data from the Household Budget Survey 2021.

4. Data overview and methodology

4.1. Data

The dataset used in the analysis comes from a study focusing on household budgets in 2021 conducted by Statistics Poland. This study serves as a crucial source of information on the level and structure of expenditure and income of individual households, the consumption of basic food items, housing conditions, and subjective assessment of the material condition. Furthermore, the dataset provides information on the household's classification in terms of location, belonging to a particular socio-economic group, and composition.

Numerous studies have shown that the share of expenditure on food and energy in a household's overall spending is influenced by the above-mentioned factors. Additionally, we took into account a variable describing energy poverty, which also significantly impacts the spending structure of households. The variables used in the analysis are presented in Table 2.

Table 2. Variables used in the study with descriptions

Variable	Description
X ₁	Number of individuals in a household
X ₂	Disposable household income
X ₃	Subjective energy poverty
X ₄	Location (class)
X ₅	Socio-economic group
X ₆	Household composition
X ₇	Share of food expenditure in total expenditure
X ₈	Share of energy expenditure in total expenditure
X ₉	Share of expenditure on food and energy in total expenditure

Source: author's work based on data from the Household Budget Survey 2021.

Table 3 presents the basic descriptive statistics for five variables: the number of people in a household, disposable income, the share of food expenditure, the

share of energy expenditure, and the share of combined food and energy expenditure in the household's total expenditure. The average number of people in a household was three. The median was two, meaning that half of the observations in the study fell below this value, and the other half were above it. The study comprised of single-person households and large families (up to 12 members) as well.

The average disposable income was 5,637.63 PLN, and the median was 4,751.85 PLN. The lowest income was negative (-48,000.00 PLN), while the highest amounted to 209,648.90 PLN. Such discrepancies in the minimum and maximum values resulted, among other things, from the specific nature of agricultural work, where farmers can earn high incomes in certain months and incur losses in other.

The average share of food expenditure in a household's total expenditure was 28%, which turned out very close to the value reported by Statistics Poland for 2022 (26.7%). This may be due to relatively stable consumption trends in households. The minimum values were 0, and the maximum 1. This distribution justifies the use of the Tobit model later on, because it accounts for limitations in dependent variables, whose specificity could distort classical regression models.

Table 3. Descriptive statistics of five quantitative variables

Variable	Minimum	First quartile	Median	Average	Third quartile	Maximum
Household size	1.00	2.00	2.00	3.00	3.00	12.00
Disposable income	-48000.00	2850.00	4751.85	5637.63	7200.00	209648.90
Share of food expenditure in total expenditure	0.00	0.19	0.27	0.28	0.36	1.00
Share of energy	0.00	0.06	0.09	0.11	0.15	0.75

expenditure in total expenditure Share of combined food and energy expenditure in total expenditure	0.00	0.28	0.39	0.40	0.51	1.00
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Source: author's work based on data from the Household Budget Survey 2021.

For a deeper analysis of qualitative variables, including X_3 (subjective energy poverty), X_4 (location), X_5 (socio-economic group), and X_6 (household composition), the frequencies of all households participating in the study were calculated and presented in charts based on each variable.

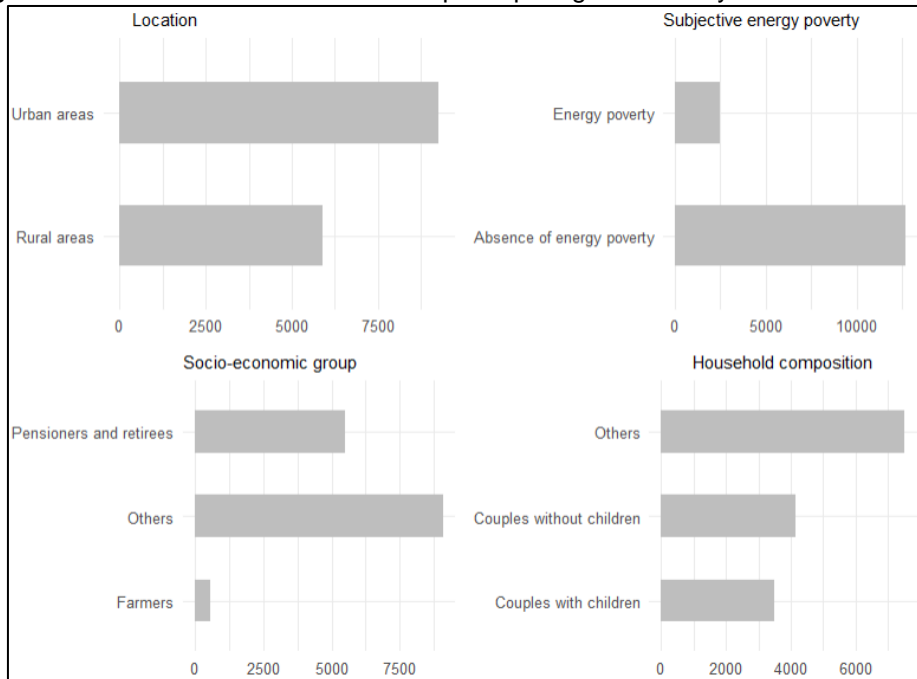
Figure 1 illustrates, among other things, the number of households in specific types of locations. There are the following categories of towns and cities: small towns with up to 20,000 inhabitants, medium-sized towns ranging between 21,000 and 99,000 inhabitants as well as between 100,000 and 500,000 inhabitants, and large urban agglomerations with populations exceeding 500,000. Most respondents lived in urban areas (9,270 households), while about 3,000 fewer resided in rural areas (5,877 households).

Figure 1 also shows the number of energy-poor and non-energy-poor households. The criteria for belonging to either group are based on the aforementioned subjective material assessment of individual households. The vast majority of respondents did not fall into the energy-poor category. Only about 17% of households rated themselves as energy-poor.

When analysing socio-economic groups, it can be seen that the largest group consists of members of 'other households', which are the households of people in employment, the self-employed, and people relying on non-earned income sources. The second largest group are the households of retirees and pensioners, and the smallest group consists of households of farmers.

In terms of household composition, the largest group is also called ‘other households’. This category consists of single individuals with dependent children and single-person households. Meanwhile, the number of couples without children is slightly larger than that of couples with children.

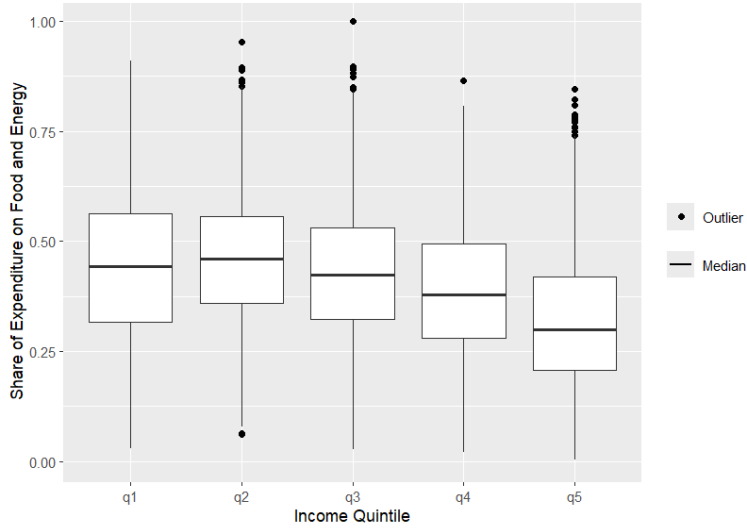
Figure 1. The number of all households participating in the study



Source: author's work based on data from the Household Budget Survey 2021.

Figure 2 illustrates the level of spending on food and energy of Polish households. From the second income quintile onwards, i.e. as the income quintile increases, the share of spending on food and energy in total expenditure decreases. This suggests that wealthier families allocate a smaller percentage of their budget to basic needs, and a larger percentage to entertainment, travel, or savings.

Figure 2. The share of spending on food and energy in total expenditure by income quintile



Source: author's work based on data from the Household Budget Survey 2021.

4.2. Tobit model

Variables limited in their range often appear in statistical research. Examples include truncated, censored or binary variables. The appropriate tool for describing these is the Tobit model (Maddala, 1983). The standard Tobit model for a discrete-continuous variable y_i can take the form of (Tobin, 1958):

$$\begin{cases} y_i^* & \text{if } y_i^* > \gamma \\ 0 & \text{if } y_i^* \leq \gamma \end{cases}, \quad (1a)$$

$$y_i^* = \alpha + X_i\beta + \varepsilon_i, \quad (1b)$$

where y_i^* is a latent response variable, γ is a nonstochastic constant, β is a vector of parameters for this model, and X_i is a vector of explanatory variables, $\varepsilon_i \sim N(0, \sigma^2)$.

When analysing economic data, the value of γ is often unobservable. It is then assumed to be 0 (Carson & Sun, 2007). The Tobit model then takes the form:

$$\begin{cases} y_i^* & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases}, \quad (2a)$$

$$y_i^* = \alpha + X_i\beta. \quad (2b)$$

In the literature, the Tobit model and its generalisations are usually considered under the assumption of a normal distribution for the error term ε_t (Jeong & Jeong, 2015). In this case, the maximum likelihood estimation (MLE) method is natural for estimating this model, as it ensures the asymptotic normality of the parameter estimates.

The assumption of a normal distribution for the error term ε_t was not met, despite numerous attempts to transform the model. This could also be attributed to the sample size (15,147 observations). As a result, we can say that the model's efficiency is slightly reduced.

5. Empirical results

5.1. Tobit model

To understand which factors influence the share of expenditure on food and energy in the total expenditure of Polish households, Tobit models were estimated. Identifying the determinants of the share of food and energy expenditure in the total expenditure is an important element of studying household consumption behaviours. This is particularly significant in the context of the current shocks on energy commodity markets. Additionally, it is possible to identify households struggling with the 'heat or eat' dilemma. The obtained results can thus help guide social and economic policies

addressing the most vulnerable households and minimise the risk poverty will spread and deepen among Polish families.

To estimate the Tobit models, six characteristics of Polish households were used: the number of household members, the logarithm of disposable income, location, belonging to a particular socio-economic group, household composition and the occurrence or not of energy poverty. Three exogenous variables were used, namely the share of food expenditure, the share of energy expenditure, and the share of combined food and energy expenditure in the total expenditure. Thus, three different Tobit models were estimated and compared.

During the analysis of qualitative variables, reference values were chosen as benchmarks for interpreting the results. These were: socio-economic group – others, location – rural area, household composition – others, and energy poverty – none.

Table 4. Estimated parameters of Tobit models for three exogenous variables

Description	Exogenous variable ^a		
	Share of food expenditure	Share of energy expenditure	Share of combined food and energy expenditure
Intercept	0.650***	0.218**	0.870***
Number of household members	0.016***	-0.001*	0.015***
The logarithm of disposable income	-0.046***	-0.012***	-0.058***
Energy poverty	0.007**	0.014***	0.021***
Location (size)	-0.039***	-0.008***	-0.048***
Farmers	-0.074***	-0.027***	-0.100***
Pensioners	0.021***	0.026***	0.046***
Married couples without children	0.014***	-0.005***	0.009***
Married couples with children	-0.018***	-0.021***	-0.039***

a *** – significance at a 1% level, ** – significance at a 5% level, * – significance at a 10% level.

Source: summary of the results generated in the Gretl.

The analysis of the first variable shows that as the number of household members increases by one, the predicted share of food expenditure and the combined food and energy expenditure increases by 0.016 and 0.015, respectively. This result is also confirmed by the literature (see García & Garcia and Grande, 2010). On the other hand, the share of energy expenditure in the total expenditure decreases by 0.001. This result is 'intuitive', because energy expenditure is divided among the household members, so the more people in a household, the smaller the percentage burden.

The logarithm of disposable household income can be described as a reducing factor across all the models. As income increases, the predicted values of the three dependent variables decrease. This was also confirmed in section 4.1, where the share of food and energy expenditure in the total expenditure was changing across income quintiles. The interpretation of Figure 2 is analogous to the obtained parameter estimates. This result is consistent with Engel's law, as described in other studies (Sekhampu, 2012).

The variable related to energy poverty has a different interpretation. The predicted values of the three dependent variables are higher for households affected by energy poverty than for households not suffering from it. This interpretation is consistent with the literature review. Households experiencing energy poverty are typically classified as low-income households, which is why their shares of food expenditure, energy expenditure, and combined food and energy expenditure in the household's total spending are relatively high.

Analysing the next variable, we can observe that the predicted shares of food expenditure, energy expenditure, and the combined food and energy expenditure in the total spending of households in cities are lower by 0.039, 0.008, and 0.048, respectively, than those of households in rural areas. This may be due to the fact that urban residents are generally wealthier, and thus allocate a part of their resources to other needs. Additionally, they may have

different consumption preferences, such as eating out more frequently, which leads to doing less food shopping. The results of other studies (Borowska et al., 2020) also showed that food expenditure of urban households is proportionally lower than that of rural households.

As regards farmer households, there is a similar interpretation. The predicted values of the three above-mentioned shares of expenditure in farmer households' total expenditure are lower by 0.074, 0.027, and 0.100 than those of other social groups (people in employment, the self-employed, and those whose income comes from non-labor sources). This is likely due to the fact that farmers often use their own food products and may allocate their financial resources to household needs other than food.

In contrast, the estimated parameters for the variable that describes belonging to the social group of pensioners and retirees differ from those for the variable that describes belonging to the group of farmers. The predicted shares of food expenditure, energy expenditure, and the combined food and energy expenditure in a pensioner or retiree household's total spending are higher than in the case of other social groups. This is also confirmed by Utzig (2016).

The predicted values of the first dependent variable are higher for couples without children by 0.014, and the predicted values of the second dependent variable are lower by 0.005 than those for single-person households and single parents with children. This may be due to the fact that couples without children travel more frequently than single people, and thus consume less energy. On the other hand, higher shares of food expenditure in the total spending of couples without children may result from the fact they have a smaller need to save, therefore feel less restricted in food shopping.

However, the predicted shares of food, energy, and combined food and energy expenditure in the total spending of married couples with children are

lower by 0.018, 0.021, and 0.039, respectively, than those of single-person households and single parents with children. The surveyed married couples form relatively wealthy families, so this result is not surprising. It might also be related to Poland's social policy, which provides cash benefits to families with children. This finding is also consistent with the literature (Grzega, 2015).

Most of the estimated parameters indicate that the study is reliable, as the obtained results and interpretations are similar to what earlier research showed, and they might to some extent be verified by life experience and common sense.

5.2. Tobit model with interactions

For a more detailed analysis of Polish energy-poor households, several Tobit models with interactions were estimated. The same explanatory and exogenous variables were used as in the previous model (Table 4). The reference values remained unchanged. The variables describing the logarithm of disposable income and the number of persons in the household are included in each model. Other models are based on the characteristics of the location (class), belonging to a particular social group and household composition. The last three models include all the above factors and their interactions with the variable describing energy poverty.

The estimated parameters of the first three Tobit models with interactions are presented in Table 5. Energy-poor households in cities incur proportionally lower expenditure on food and food and energy combined, but higher expenditure on energy alone than families living in rural areas. This is a slightly surprising result. One would expect that there are more houses in rural areas and more blocks of flats in cities, which seem to incur lower energy costs, but the opposite is true. Inhabitants of urban areas often live in blocks of flats,

which involves fixed expenses on energy and a limited capability for energy-saving solutions. In contrast, households in rural areas can reduce energy costs by using solid fuels, such as wood for heating. This situation is described by the term ‘hidden energy poverty’, which refers to extremely low share of energy expenditure in a household’s total spending (Eisfeld & Seebauer, 2022).

Table 5. The estimated parameters of Tobit models with interactions for household location for three exogenous variables

Description	Exogenous variable ^a		
	Share of food expenditure	Share of energy expenditure	Share of combined food and energy expenditure
Intercept	0.668***	0.265***	0.934***
Number of household members	0.008***	-0.008***	-0.001
The logarithm of disposable income	-0.030***	-0.015***	-0.061***
Energy poverty	0.027***	0.011***	0.038***
Location (size)	-0.030***	-0.010***	-0.041***
Energy poverty*Location (size)	-0.030***	0.013***	-0.017**

a As in Table 4.

Source: summary of the results generated in the Gretl.

Table 6 presents the parameter estimates for the Tobit model with interactions for variables related to the social group the members of the household belong to. The share of expenditure on food and the share of the combined expenditure on food and energy in the total spending of energy-poor households of retirees and pensioners are lower than those of other social groups. In contrast, the occurrence of energy poverty among farmers increases their predicted shares of food expenditure in the total spending, at the same time decreasing their predicted share of energy expenditure in the total spending (compared to other social groups). This observed lower energy expenditure may result, as mentioned before, from using the available solid

fuels (e.g. wood) to heat their households, in order to minimise their energy costs.

Table 6. The estimated parameters of Tobit models with interactions for socio-economic group for three exogenous variables

Description	Exogenous variable ^a		
	Share of food expenditure	Share of energy expenditure	Share of combined food and energy expenditure
Intercept	0.624***	0.215***	0.841***
Number of household members	0.017***	-0.003***	0.014***
The logarithm of disposable income	-0.047***	-0.013***	-0.060***
Energy poverty	0.012***	0.017***	0.030***
Farmers	-0.056***	-0.016***	-0.071***
Pensioners	0.030***	0.029***	0.059***
Energy poverty*Farmers	0.043***	-0.026**	0.016
Energy poverty*Pensioners	-0.012**	-0.001	-0.013**

a As in Table 4.

Source: summary of the results generated in the Gretl.

Table 7 presents the estimated parameters of Tobit models with interactions for the composition of a household and energy poverty. In this case, the estimated parameters with interactions turned out to be statistically insignificant, which means that the impact of these variables on the share in expenditure cannot be fully confirmed in the studied sample. Nevertheless, if we were to interpret the results despite the lack of statistical significance, we would be able to observe that households of married couples with children who experience energy poverty had lower predicted shares of energy and food expenditure in their total spending than single-person households or single parents with dependent children. This may be related to the effect of scale, i.e. decreasing unit costs as the number of household members increases, and sharing costs (if both parents are employed).

Table 7. The estimated parameters of Tobit models with interactions for household composition for the three exogenous variables

Description	Exogenous variable ^a		
	Share of food expenditure	Share of energy expenditure	Share of food and energy expenditure
Intercept	0.668***	0.257***	0.927***
Number of household members	0.017***	-0.003***	0.015***
The logarithm of disposable income	-0.051***	-0.016***	-0.067***
Energy poverty	0.010***	0.019***	0.030***
Married couples without children	0.019***	-0.000	0.020**
Married couples with children	-0.025***	-0.026***	-0.050***
Energy poverty* Married couples without children	-0.003	-0.006	-0.010
Energy poverty* Married couples with children	-0.004	-0.006	-0.001

a As in Table 4.

Source: summary of the results generated in the Gretl.

Table 8 presents the parameter estimates for Tobit models with interactions for all the variables used in the previous models. The estimated parameters of the interaction variable describing energy-poor households in urban areas are very similar to those obtained for the first model (Table 5). The direction of the impact of explanatory variables on dependent variables is the same in both models. A similar situation can be observed for the interaction of energy poverty with farmers (Table 6). In contrast to previous models, the remaining estimated interactions were statistically insignificant.

Table 8. The estimated parameters of Tobit models with interactions for three exogenous variables

Description	Exogenous variable ^a		
	Share of food expenditure	Share of energy expenditure	Share of combined food and energy expenditure
Intercept	0.644***	0.219***	0.866***
Number of household members	0.016***	-0.001*	0.015***

The logarithm of disposable income	-0.046***	-0.012***	-0.058***
Energy poverty	0.025***	0.010**	0.034***
Location (size)	-0.035***	-0.010***	-0.046***
Farmers	-0.076***	-0.025***	-0.101***
Pensioners	0.022***	0.025***	0.048***
Married couples without children	0.014***	-0.005**	-0.009
Married couples with children	-0.018***	-0.021***	-0.038***
Energy poverty*Location (size)	-0.025***	0.011***	-0.014**
Energy poverty*Farmers	0.029*	-0.018	0.010
Energy poverty* Pensioners	-0.006	-2.810·10 ⁻⁵	-0.006
Energy poverty* Married couples without children	-0.005	-0.004	-0.010
Energy poverty* Married couples with children	-0.000	-0.002	-0.002

a As in Table 4.

Source: summary of the results generated in the Gretl.

6. Conclusions

The aim of this study was to identify the socio-economic determinants of how big the share of expenditure on food and energy in households' total spending is, as well as to examine how energy poverty affects the level of this expenditure. All the variables proposed in the analysis, namely the size of a household, the logarithm of the household's disposable income, the occurrence or not of energy poverty, the composition of a household, as well as belonging to a particular socio-economic group (in our case pensioners and farmers) turned out to be statistically significant. This indicates that the share of expenditure on food and energy in a household's total spending depends on a range of factors, thus attesting to the complexity of the problem under study.

The study's objective was successfully verified in the course of our analysis. The constructed models indicated a decrease in the ratio of expenditure on food to a household's total expenditure as the household's income was increasing.

As mentioned before, this result is not surprising, as wealthier households tend to allocate some of their income to needs other than basic, such as culture, entertainment or travel. Therefore, the share of food expenditure in their total spending is relatively low. Another finding is that households located in rural areas spent proportionally more of their income on food than those in urban areas. This probably results from the characteristics of affluent urban households, which typically devote some part of their income to needs other than basic, e.g. their members eat out more frequently. An interesting outcome was the situation where the share of energy expenditure in a household's total expenditure was higher for energy-poor households in cities than in rural areas. This might be because city residents often live in blocks of flats, where energy costs are fixed – inhabitants cannot implement their own energy-efficient solutions. In contrast, rural households can reduce energy costs by using solid fuels, such as wood, to heat their homes affordably.

For a deeper analysis of energy-poor households, Tobit models with interactions were used. Compared to the results yielded by previous models, not all parameter estimates turned out to be statistically significant. The obtained models showed that experiencing energy poverty by farmers increases the predicted share of expenditure on food in their total spending, while for other social groups, i.e. people in employment, the self-employed and people relying on non-earned income, it decreased the share of expenditure on energy compared to other social groups. On the other hand, the expenditure on food and both food and energy combined of energy-poor families living in cities turned out to be lower than the analogous expenditure of energy-poor families living in rural areas, but higher than expenditure on energy alone of those latter families. This, as mentioned above, might be due to fixed energy costs in blocks of flats or multi-family homes in cities, versus the possibility for rural residents to use solid fuels for heating. Married couples struggling

with energy poverty, both with and without children, tend to spend proportionally less on food and energy than single-person households or single parents with dependents.

The results obtained in this study expand our knowledge on consumer behaviour by providing valuable insights into how various socio-economic factors affect the share of households' expenditure on food and energy in their total spending. Comparing these results with the literature, we can see that they are generally compliant. Both the literature and our study indicate the share of households' expenditure on food and energy in their total spending differs across social groups, locations of households and their types. Additionally, the estimates regarding the impact of disposable income on food expenditure show consistency with Engel's Law, which supports economic theories concerning spending in relation to income.

The literature often highlights the general impact of energy poverty on consumption expenditure. The results of our analysis focus on the share of households' expenditure on food and energy in their total expenditure, demonstrating that the former is determined to a large extent by the occurrence or not of energy poverty, which also correlates with the socio-economic characteristics of households. Notably, we demonstrated that households experiencing energy poverty in urban areas spend more on energy than those in rural areas.

The results obtained in our study can be used as guidelines for developing social policies addressed to excluded groups. Moreover, our findings might serve as a foundation for further research aimed at creating strategies to prevent the negative consequences of state-driven crises.

References

- Borowska, A., Mikuła, A., Raczkowska, M., & Utzig, M. (2020). *Konsumpcja dóbr i usług w gospodarstwach domowych w Polsce*. Wydawnictwo SGGW. https://www.ieif.sggw.pl/wp-content/uploads/2021/01/Konsumpcja-d%C3%B3br-i-us%C5%82ug_druk.pdf.
- Bouzarovski, S. (2014). Energy poverty in the European Union: landscapes of vulnerability. *WIREs Energy and Environment*, 3(3), 276–289. <https://doi.org/10.1002/wene.89>.
- Carson, R. T., & Sun, Y. (2007). The Tobit model with a non-zero threshold. *Econometrics Journal*, 10(3), 488–502. <https://doi.org/10.1111/j.1368-423X.2007.00218.x>.
- Champagne, S. N., Adefolalu, O., Macdiarmid, J. I., Phimister, E., & Guntupalli, A. M. (2023). Heating or eating? The framing of food and fuel poverty in UK news media. *Proceedings of the Nutrition Society*, 82(OCE3), E208. <https://doi.org/10.1017/S0029665123002781>.
- Eisfeld, K., & Seebauer, S. (2022). The energy austerity pitfall: Linking hidden energy poverty with self-restriction in household use in Austria. *Energy Research & Social Science*, 84, 1–12. <https://doi.org/10.1016/j.erss.2021.102427>.
- García, T., & Grande, I. (2010). Determinants of food expenditure patterns among older consumers. The Spanish case. *Appetite*, 54(1), 62–70. <https://doi.org/10.1016/j.appet.2009.09.007>.
- Główny Urząd Statystyczny. (2023). *Sytuacja gospodarstw domowych w 2022 r. w świetle wyników badania budżetów gospodarstw domowych*. <https://stat.gov.pl/obszary-tematyczne/warunki-zycia/dochody-wydatki-i-warunki-zycia-ludnosci/sytuacja-gospodarstw-domowych-w-2022-r-w-swietle-badania-budzetow-gospodarstw-domowych,3,22.html>.
- Grzega, U. (2022). Consumer expenditures and consumption of Polish Urban and Rural Households. *Economic Studies*, (2), 36–49. <https://doi.org/10.15290/oes.2022.02.108.03>.
- Grzega, U. (2015). Typ biologiczny oraz miejsce zamieszkania gospodarstwa domowego jako determinanty unowocześniania konsumpcji w Polsce. *Studia Ekonomiczne. Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach*, (231), 30–55. https://www.ue.katowice.pl/fileadmin/_migrated/content_uploads/02_35.pdf.
- Hanus, G. (2018). The impact of globalization on the food behaviour of consumers – literature and research review. *CBU International Conference On Innovations in Science and Education*, 6, 170–174. <https://doi.org/10.12955/cbup.v6.1151>.
- Jeong, D. Y., & Jeong, J. (2015). A Test on the Normality in the Tobit Model. *The Korean Journal of Economics*, 22(1), 61–71.

- Kostakis, I. (2014). The determinants of households' food consumption in Greece. *International Journal of Food and Agricultural Economics (IJFAEC)*, 2(2), 17–28. <https://www.foodandagriculturejournal.com/vol2.no2.pp17.pdf>.
- Maddala, G. S. (1983). *Limited-Dependent and qualitative variables in econometrics*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511810176>.
- Maniriho, A., Musabanganji, E., Nkikabahizi, F., Ruranga, C. & Lebailly, P. (2021). Analysis of the Determinants of Household Expenditures in Rwanda. *UKH Journal of Social Sciences*, 5(1), 8–17. <https://doi.org/10.25079/ukhjss.v5n1y2021.pp8-17>.
- Obwieszczenie Marszałka Sejmu Rzeczypospolitej Polskiej z dnia 19 maja 2022 r. w sprawie ogłoszenia jednolitego tekstu ustawy - Prawo energetyczne (Dz.U. 2022 poz. 1385).
- Sekhampu, T. J. (2012). Socio-Economic Determinants of Household Food Expenditure in a Low Income Township in South Africa. *Mediterranean Journal of Social Sciences*, 3(3), 449–453. <https://doi.org/10.5901/mjss.2012.v3n3p449>.
- Śmiech, S., Ulbrych, M., Goworek, A., Kłopecka, K., Ślusarek, J., Wiącek, A. & Śmiech, L. (2023). *Energetyczna biedna. Sytuacja gospodarstw domowych w 2021 roku*. Politechnika Opolska. <https://warsawinstitute.org/pl/energetyczna-bieda-sytuacja-gospodarstw-domowych-w-2021-roku-2/>.
- Thomson, H., Bouzarovski, S. & Snell, C. (2017). Rethinking the measurement of energy poverty in Europe: A critical analysis of indicators and data. *Indoor and Built Environment*, 26(7), 879–901. <https://doi.org/10.1177/1420326X17699260>.
- Tobin, J. (1958). Estimation of relationships for limited dependent variables. *Econometrica*, 26(1), 24–36. <https://doi.org/10.2307/1907382>.
- Turczak, A., & Zwiech, P. (2014). Wpływ wielkości spożycia i cen na wydatki żywnościowe i napoje bezalkoholowe w gospodarstwach domowych. *Wiadomości Statystyczne*, 59(6), 84–96. <https://doi.org/10.59139/ws.2014.06.7>.
- Utzig, M. (2016) Zróżnicowanie struktury wydatków konsumpcyjnych gospodarstw domowych w Polsce według grup społeczno-ekonomicznych. *Nierówności Społeczne a Wzrost Gospodarczy*, (3), 454–465. <https://doi.org/10.15584/nsawg.2016.3>.
- Wiśniewska, A. (2017). Wydatki na żywność w polskich gospodarstwach domowych z uwzględnieniem świadczenia wychowawczego „Rodzina 500+”. *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach*, (346), 112–122.
- Zani, M., Saediman, H., Abdullah, S., Daud, L. & Yunus, L. (2019). Determinants of Household Food Expenditure in a Cassava Growing Village in Southeast Sulawesi.

Academic Journal of Interdisciplinary Studies, 8(3), 302–310.
<https://www.richtmann.org/journal/index.php/ajis/article/view/10585>.