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IMPACT OF THE MACROECONOMIC FACTORS ON THE LEVEL OF ENERGY POVERTY-CASE OF THE CZECH REPUBLIC, POLAND AND SLOVAKIA

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ABSTRACT: Energy poverty is a socio-economic topic that is not only related to the sustainability problem of natural resource extraction but also human activities. It reflects a situation in which households are unable to fully meet their energy needs. It mainly affects countries with a lower level of development, as well as those whose energy mix is largely based on non-renewable sources (such as coal). These undoubtedly include the Czech Republic, Poland and Slovakia. Investigations are still being conducted to explain the causes of the problem of energy poverty. The paper's main aim is to assess the impact of selected macroeconomic factors on the level of energy poverty. A backward stepwise regression procedure was used to achieve this aim. Models have been developed for each of the three countries: the Czech Republic, Poland, and Slovakia separately and for all of them together. These models are intended to identify the most prominent macroeconomic factors across all three countries. Results from all four models have highlighted two prominent variables which may impact the level of energy poverty in selected countries. They are following: electricity prices for household consumers with all taxes and net electricity imports. In three of the four developed models, they explained the level of energy poverty in a statistically significant manner. In conclusion, it can be suggested that the governments of these countries take action on these variables, which can help manage energy poverty. Their identification and subsequent impact may help to reduce this problem in the analysed post-coal economies.

KEYWORDS: energy poverty, macroeconomic factors, regression, multivariable models

Introduction

In the European Union [EU], coal still represents 24% of the EU electricity generation mix and 76% of CO_2 emissions from the EU electricity sector (Tagliapietra, 2017). Countries (regions) with strong coal industries have become synonymous with air pollution, land degradation, and socio-economic decline. As the world gradually moves away from fossil fuels due to their impact on health and the environment, nowhere needs more support in this transition than the areas where the coal industry shaped the local history, identity, and jobs (Chapman & Okushima, 2019).

One of the socio-economic problems affecting the mentioned coal mining areas is the so-called "energy poverty" of people living in them. Energy poverty is not only a topic related to the sustainability problem of natural resource extraction but also human activities, especially vulnerable consumers. Although energy poverty affects many different economic sectors, its most relevant (and perhaps least known) repercussion is its impact on household living and behaviours. Its first interpretation was referred to as being able to keep the household adequately warm (Lewis, 1982), while now, as the European Commission (2022a) considers, it comprises all basic energy needs of a household.

The European Union aims to reinforce the inclusiveness and cohesion of European society to allow all people to enjoy equal access to opportunities and resources. Measuring poverty is one of the topics that is addressed as a priority by the European Parliament. At the EU level, it has been noticed that energy poverty is becoming an increasingly serious problem in EU countries. It is estimated that between 50 and 125 million people in Europe suffer from energy poverty (EPEE, 2009).

Some of the EU countries that are most affected by energy poverty are post-coal countries like the Czech Republic, Poland, and Slovakia. Based on the European Energy Poverty Index, which is calculated by averaging the energy shortfall and energy inconvenience of a household, the Czech Republic, Poland, and Slovakia ranked 15th, 14th, and 26th, respectively, among all EU countries in terms of progress in alleviating domestic and transport energy poverty (OPENEXP, 2019). The problem of energy poverty in these countries is not new. Based on Eurostat (2010) data, Poland, the Czech Republic, and Slovakia were ranked 25th, 26th, and 27th, respectively, among EU countries in terms of the level of energy expenditure in total household expenditure (Lis & Miazga, 2015). The percentage of these expenditures in each of the three mentioned countries exceeded 10%, which, according to many definitions of energy poverty (Department for Business Enterprise & Regulatory Reform, 2008; Miazga & Owczarek, 2015; Phoumin & Kimura, 2019), is the basis for recognising the existence of energy poverty.

Existing literature (i.e. Malik et al., 2019; Mashoodi et al., 2019; Papada & Kaliampakos, 2020; Sokołowski et al., 2020; Ying et al., 2024) lacks research on energy poverty factors, which may affect the level of energy poverty, especially in post-coal countries like the Czech Republic, Poland, and Slovakia. To fill this research gap, it is necessary to undertake consideration in this area. The main intention of the conducted considerations is to identify macroeconomic factors that may have the greatest impact on the level of energy poverty in a specific country. This will enable governments to pay more attention to them in order to reduce this problem.

Therefore, the main goal of this paper is to assess the impact of selected macroeconomic factors (GDP per capita, inflation rate, unemployment rate, etc.) on the level of energy poverty in the case of post-coal countries like the Czech Republic, Poland and Slovakia where the problem of energy poverty is still more current than in the developed countries of Western Europe (Szamrej-Baran & Baran, 2014; Boguszewski & Herudziński, 2018).

The main hypothesis is intended to help achieve the purpose of the article. It reads as follows: in the surveyed countries, it is possible to identify macroeconomic indicators that have a significant impact on shaping the level of energy poverty.

Verification of the statistical significance of selected variables in the analysed countries will be carried out using backward stepwise regression (backward elimination). The research period will cover the years 2005-2022 and will concern the three countries indicated above: the Czech Republic, Poland, and Slovakia.

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The theoretical framework of the research

Energy lies at the core of macroeconomic growth, poverty, and inequality in both developed and developing countries. While energy conditions vary across nations, the primary aim of energy policies undoubtedly remains the enhancement of welfare and the improvement of quality of life (Doğanalp et al., 2021). Arguably, energy constitutes the most imperative component of daily human life, being utilised in various aspects such as lighting and business activities (Rasool et al., 2019). However, it is crucial to acknowledge that energy resources are finite, and energy shortages are prevalent worldwide. A related problem is the so-called energy poverty in many parts of the world. Given the current environmental and social emergencies, it is imperative to explore strategies for sustainable development and limit the occurrence of this phenomenon (Otamendi-Irizar et al., 2022).

The ongoing debate surrounding the definition of energy poverty is attributed to its multidimensional nature and its close ties with social exclusion, the environment, and health (Thomson & Snell, 2013). Notably, energy poverty and poverty are intertwined issues, with poverty being a critical aspect of energy poverty reduction, and both can be addressed simultaneously (Wu et al., 2011). It generally denotes the lack of access to adequate energy services among people within a society (Bouzarovski et al., 2012). Another definition characterises energy poverty as the inability to access energy services to a socially necessary level within households (Reddy et al., 2000; Buzar, 2007).

An overview of the literature reveals various attempts by researchers to define and measure energy poverty. Initially, Lewis (1982) conceptualised energy poverty as the ability to adequately heat a household. Over time, multiple methods have been employed to measure energy poverty (Niu et al., 2013; Thomson & Snell, 2013; Ghodsi & Huang, 2015; Murtaza & Faridi, 2015; Dubois & Meier, 2016; Bouzarovski, 2014; Bouzarovski & Tirado Herrero, 2017a; Doğanalp et al., 2021), with each approach focusing on different aspects of the phenomenon, such as its association with low income, unemployment, or the proportion of income spent on energy costs.

Further economic aspects of energy poverty have been noted on the EPMI index of Bollino and Botti (Bollino & Botti, 2017) and the HER index by Sánchez-Guevara Sánchez et al. (2020). In turn, Song et al. (2023) distinguished three economic-driven approaches: the energy consumption of people in proximity to the poverty line, the energy budget share and the energy demand that is extricated from income pressures.

One widely used index, proposed by Boardman (1991), assigns a value of one to households where the ratio of total household energy consumption to total household income exceeds 10%, indicating energy poverty. Papada and Kaliampakos (2020) describe this as the percentage of income spent on household maintenance.

Households experiencing energy poverty often rely on traditional energy fuels due to challenges in accessing clean energy, which can result in indoor air pollution (Oum, 2019). Consequently, the lack of access or affordability to clean energy can exacerbate poor living conditions, leading not only to physical discomfort but also to adverse health effects (Boch et al., 2020; Xu et al., 2022). Filčák and Živčič (2017) stress the increasing significance of energy poverty in EU energy sector planning. In this regard, it is crucial to devise innovative social, economic, and environmental policies to comprehend the factors influencing energy poverty and its impacts. It is common for households to struggle to meet their basic energy needs, exacerbated by inefficient heating appliances and systems prevalent in inefficient housing stock, particularly in Eastern and Central Europe (Bouzarovski & Petrova, 2015). However, such challenges are not confined to this region alone, as evidenced by high levels of fuel poverty in areas of Germany, Belgium, France, the UK, and Ireland (Healy & Clinch, 2002). This highlights the infeasibility of a uniform energy transformation across the EU (Bouzarovski & Tirado Herrero, 2017b).

The issue of inadequate domestic energy services is often examined under the umbrella of energy poverty or fuel poverty (World Bank, 2023a). Disparities in energy resources disproportionately affect developed and developing countries, referred to as fuel poverty in developed nations and energy poverty in developing nations (Legendre & Ricci, 2015; Ozturk, 2017).

In the late 21st century, attention shifted towards energy poverty in low-income countries, primarily focusing on the lack of grid connection. Conversely, the issue of energy poverty in high-income countries received earlier attention, with research emerging as early as the 1970s in Great Britain (Boardman, 1991; Birol, 2007; Lee et al., 2020). There is a growing consensus that the interconnected

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micro- and macro-level factors influencing energy poverty should be thoroughly studied due to their significance in shaping national and international climate and social policies (Thomson & Snell, 2013; Dubois & Meier, 2016; Bouzarovski, 2014; Bouzarovski & Tirado Herrero, 2017a).

For this purpose, the authors used multidimensional indexes, which were intended to reflect the multi-threaded nature of energy poverty (Sokołowski et al., 2020). Variables in these indexes should be useful to quantify and analyse performance. Single indicators are easy to operate, but they provide a clear, unbiased message that is very simple to interpret especially to one specific dimension phenomena. They are appropriate many times for measurable economic data cases but often unsuitable for less tangible issues, such as energy poverty (Dagoumas & Kitsios, 2014). Based on that, authors used a specified type of model to assess the impact of economic variables on the energy poverty level, like the ARIMA-ARNN hybrid model (Popirlan et al., 2023), Alkire-Foster method (Alkire et al., 2015) or on representative survey data collection (Moore, 2012). All of them indicated a statistically significant impact of individual economic variables on the level of energy poverty.

Moreover, energy poverty can give rise to various social problems, impacting various economic sectors and constraining developmental potential (González-Eguino, 2015). Given the finite nature of energy resources, coupled with the global challenge of energy shortages, there is an urgent need to seek sustainable development strategies within the context of current planetary environmental and social emergencies (Otamendi-Irizar et al., 2022). Eliminating the problem of energy poverty seems to be impossible without recognising the factors that can influence its level (Virjan et al., 2023). These, in turn, may be other for different countries. It is, therefore, necessary to define variables (especially those of a macroeconomic nature) whose level may have a stronger impact on energy poverty.

Research methods

To achieve the main objective of the paper, it is imperative to validate the initial hypothesis. The research hypothesis, as presented in the preceding section, will be tested using the backward stepwise regression (backward elimination) method. The application of regression model construction, with a single dependent variable explained by a set of independent variables, has been extensively discussed in numerous works, spanning across disciplines including economics and management (Lindeman et al., 1980; Younger, 1985; Stanisz, 2007; Kosmala, 2012; Szewieczek & Lisicki, 2019). As mentioned earlier, the construction of multivariable models (in this case, using macroeconomic variables) has already been used to measure energy poverty (Sokołowski et al., 2020; Popirlan et al., 2023). Additionally, the wide use of backward stepwise regression in many areas of research (Walkowiak & Zydroń, 2012; Kuś & Pawlik, 2016) does not exclude its use in this area as well.

This method represents a variant of regression analysis where only statistically significant predictors (explanatory variables) are included in the model. The objective is to optimally determine the level of the explained variable. Following its procedure, several fundamental stages need to be conducted (Juszczyk & Balina, 2009), which include:

- identifying the initial model (multiple regression),
- using a "stepwise" procedure, i.e. changing the initial model (in subsequent steps of the previous model) by removing the predictor with the lowest statistical significance,
- ending the procedure when all explanatory variables of the model show statistical significance at the adopted p-value level (e.g. $p<0.05$).

In the presented model, the variable under examination is the level of energy poverty in the Czech Republic, Poland, and Slovakia. An overview of the literature reveals various attempts by researchers to define and measure energy poverty. In this study, the interpretation provided by the European Commission (2022a) was adopted to determine the level of energy poverty in the selected countries. This interpretation suggests that the percentage of inhabitants unable to meet all their basic energy needs within their households, including heating in winter and cooling in summer, reflects the level of energy poverty in the country.

The explanatory variables selected to best reflect the level of energy poverty in the Czech Republic, Poland, and Slovakia were macroeconomic indicators identified in previous literature studies addressing energy poverty (Holtedahl & Joutz, 2004; Kanagawa & Nakata, 2008; Primc et al., 2019; Doğanalp et al., 2021). A summary of these indicators is presented in Table 1.

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Table 1. List of explanatory (X) variables used in the backward stepwise regression model to explain the level of energy poverty (Y variable) in the Czech Republic, Poland, and Slovakia

X1	X2	X3	X4	X5	X6	X7
Energy efficiency-final energy consumption (Index 2005= 100)	Eletricity prices for household consumers (Euro/kWh)	Energy use per person (kWh)	Adjusted gross disposable income of households per capita in PPS (% of EU average)	Real GDP per capita (% EU average)	Unemployment rate (by age 20-64 in BAEL)	Inflation rate (HICP)
X8	**X9**	**X10**	**X11**	**X12**	**X13**	**X14**
Population (% of whole EU population)	Final energy consumption by households in Kg of oil equivalents per capita (% EU average)	Population by educational attainment level (% of countrys' inhabitants with tertiary education)	Heating degree days (% of EU average)	Arrears on utility bills (% of total)	Population density (people per sq. km of land area)	Share of total population living in a dwelling with a leaking roof, damp walls, floors or foundation (% of total population)
X15	**X16**	**X17**	**X18**	**X19**	**X20**	**Y**
People at risk of poverty or social exclusion (% of total population)	Carbon intensity of electricity (grams of CO2/kWH of eletricty)	Net electricity imports (share of a country's electricity demand)	Share of electricity production from fossil fuels (% of total)	Government deficit/surplus (in % of GDP)	Government consolidated gross debt (in % of GDP)	Population unable to keep home in adequately temperature (% of whole population)

Source: authors' work based on Kemmler (2007), Bouzarovski (2014), Dubois and Meier (2016); Boguszewski and Herdziński (2018), European Commission (2022a); (Jia et. al., 2022).

Data on the aforementioned indicators, covering the years 2005-2022, were sourced from databases including the European Commission (2023), the World Bank (2023b), and the European Environmental Agency (2023) for three countries: the Czech Republic, Poland and Slovakia. The data used for the calculations are presented in the appendix to this study.

The initial step in the research procedure involved the elimination of highly correlated variables. A threshold of Pearson's correlation coefficient (R) at least 0.7 (or more)/-0.7 (or less) was set for this purpose. Subsequently, utilising the method of least squares, the linear regression coefficients of the function were calculated. The subsequent stage involved gradually removing variables with the lowest statistical significance until all variables in the regression model were significant at a level of p-value <0.05. The results obtained from this study are detailed in the subsequent section of the paper.

Results of the research and discussion

The paper and its results have focused on the significance of macroeconomic variables such as GDP per capita, inflation rate, electricity imports, etc., to assess their impact on energy poverty, as measured by the variable "Population unable to keep home adequately warm by poverty status" – the dependent variable (European Commission, 2022b). Multiple linear regression models were computed for each country individually, as well as for all three countries combined, in order to identify the most significant variables across the board. Therefore, there are four models in our regression results: one for the Czech Republic, one for Poland, one for Slovakia, and one combining all three countries into a single model. Below is the list of variables included in our model.

Before presenting the final variables to backward stepwise regression, a correlation test using correlation matrices was conducted to ensure there were no covariates. In this case, Pearson's correlation test was used. Subsequently, backward stepwise regression modelling processes were

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employed in each model to identify the most significant variables. Below, we will discuss the significant variables in each model.

Research Results for the Czech Republic

After rejecting highly correlated explanatory variables (8 out of 20), the procedure was carried out according to the backward stepwise regression method. Starting from 12 explanatory variables that did not show a higher than expected level of correlation, a regression model was built to explain the level of energy poverty in the Czech Republic. After eliminating statistically insignificant variables, the final version of the model was prepared. There are 5 variables that were highly significant with a 95% confidence interval (P-value <= 0.05) for the Czech model (presented in Table 2).

Table 2. Multiple Regression results of Czech Republic

Regression Statistics						
Multiple R	0.99413					
R Square	0.98830					
Adjusted R Square	0.98342					
Standard Error	0.27702					
Observations	18					
	Coefficients	**Std Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept	-10.8483	0.8307	-13.059	0.0000	-12.6583	-9.0384
Share of total population living in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames of floor (% of total population)	0.1671	0.0546	3.0592	0.0099	0.0480	0.2861
People at risk of poverty or social exclusion (% of total population)	0.8415	0.0540	15.572	0.0001	0.7238	0.9593
Net electricity imports (share of a country's electricty demand)	0.0708	0.0315	2.2475	0.0441	0.0021	0.1395
Government deficit/surplus (in % of GDP)	0.1310	0.0403	3.2503	0.0069	0.0431	0.2188
Government consolidated gross debt (in % of GDP))	0.1085	0.0224	4.84349	0.0004	0.0597	0.1574

Source: authors' work based on obtained data World Bank (2023b) and European Commission (2023).

The results from Table 2. for the Czech Republic indicate that the overall model is a good fit, with an R-squared value of 0.98, suggesting that the explanatory variables have accounted for a substantial proportion of the variance in the dependent variable (Population unable to keep home adequately warm by poverty status). Additionally, upon examining the regression results' P-values, it is evident that all variables are statistically significant.

For each unit increase in the share of the total population living in a dwelling with a leaking roof, damp walls, etc., there is a 0.167 unit increase in the population unable to keep their home adequately warm due to poverty status. Similarly, the variable indicating people at risk of poverty or social inclusion has a significant impact on the population unable to keep their homes adequately warm. Each unit increase in this variable leads to a 0.84 unit increase in the dependent variable, demonstrating its substantial impact.

Another significant factor is government consolidated gross debt; an increase in one unit of total gross debt (typically accounted for at year-end) leads to a 0.108 unit increase in the population una-

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ble to keep their home adequately warm due to poverty status. This underscores the significant impact on people, especially those with low incomes, who are affected by the government's debt status.

These results can be seen in the multiple regression equation form:

$$\hat{y} = -10.84 + 0.167(x_1) + 0.841(x_2) + 0.071(x_3) + 0.131(x_4) + 0.108(x_5) \quad (1)$$

where:
$\hat{y}$ – population unable to keep home in adequate temperature (% of the whole population),
x_1 – share of the total population living in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames of the floor (% of the total population),
x_2 – people at risk of poverty or social exclusion (% of total population),
x_3 – net electricity imports (share of a country's electricity demand),
x_4 – government deficit/surplus (in % of GDP),
x_5 – government consolidated gross debt (in % of GDP).

Research results for Poland

A similar elimination procedure (as in the case of the Czech Republic) resulted in the rejection of 10 out of 20 explanatory variables with a high level of correlation. Starting from 10 explanatory variables and after eliminating statistically insignificant variables, the final version of the energy poverty model for Poland was prepared. There are 5 variables that were highly significant with a 95% confidence interval (P-value <= 0.05) for the Poland model (presented in Table 3).

Table 3. Multiple Regression results of Poland

Regression Statistics						
Multiple R	0.98999					
R Square	0.98009					
Adjusted R Square	0.97179					
Standard Error	1.49396					
Observations	18					
	Coefficients	Std Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-23.2791	17.244	-1.349	0.2019	-60.8512	14.2929
Electricity prices for household consumers with all taxes (consumption 2500-4999 kWh) (Euro/kWh)	93.9375	17.456	-5.381	0.0002	-131.97	-55.902
Energy use per person (kWh)	-0.9988	0.3882	-2.572	0.0244	-1.8447	-0.1529
Inflation rate (HICP)	0.3770	0.1371	2.7495	0.0176	0.0782	0.6758
Net electricity imports (share of a country's electricty demand)	-0.3849	0.1497	-2.570	0.0245	-0.7112	-0.0586
Share of electricity production from fossil fuels (% of total)	0.8565	0.1182	7.2437	0.0001	0.5988	1.1141

Source: authors' work based on obtained data World Bank (2023b) and European Commission (2023).

The results from Table 3. for Poland indicate that the overall model is a good fit, with an R-squared value of 0.98, suggesting that the explanatory variables have accounted for a significant proportion of the variance in the dependent variable (Population unable to keep home adequately warm by poverty status). Additionally, upon examining the regression results' P-values, we observe that all variables are statistically significant.

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Some of the variables have made a significant impact on the variable "Population unable to keep home adequately warm by poverty status" (dependent variable). For instance, a one-unit increase in electricity prices for household consumers with all taxes leads to a 93.93 unit increase in the population unable to keep their homes adequately warm due to poverty status. This indicates that as the input value increases, the output value decreases. This situation could arise when electricity prices, combined with all other taxes (as opposed to specific taxes solely for electricity), benefit consumers and help alleviate energy poverty situations. Similarly, another variable indicates that an increase in usage by one unit of the share of electricity production from fossil fuels leads to an increase in the population unable to keep their homes adequately warm by poverty status by 0.85 units.

These results can be seen in the multiple regression equation form:

$$\hat{y} = -23.27 + 93.94(x_1) - 0.998(x_2) + 0.377(x_3) \\ -0.384(x_4) + 0.856(x_5) \quad (2)$$

where:
$\hat{y}$ – population unable to keep home in adequate temperature (% of the whole population),
x_1 – electricity prices for household consumers with all taxes (consumption 2500-4999 kWh) (Euro/kWh),
x_2 – energy use per person (kWh),
x_3 – inflation rate (HICP),
x_4 – net electricity imports (share of a country's electricity demand),
x_5 – share of electricity production from fossil fuels (% of total).

Research results for Slovakia

After the elimination of 6 (out of 20) highly correlated explanatory variables, the preparations for the regression model started. Finally, there are 5 variables that were highly significant with a 95% confidence interval (P-value <= 0.05) for the Slovakia case (presented in Table 4).

Table 4. Multiple Regression results of Slovakia

Regression Statistics						
Multiple R	0.95622					
R Square	0.91435					
Adjusted R Square	0.87867					
Standard Error	0.82280					
Observations	18					
	Coefficients	Std Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-30.5733	9.4923	-3.2208	0.0073	-51.2553	-9.8913
Electricity prices for household consumers with all taxes (consumption 2500-4999 kWh) (Euro/kWh)	57.0578	9.1514	-6.2349	0.0001	-76.9969	-37.1187
Adjusted gross disposable income of households per capita in PPS (% of EU average)	0.4267	0.1120	3.8091	0.0025	0.1826	0.6708
Final energy consumpiton by households in Kg of oil equivalents per capita (% EU average)	0.2027	0.0324	6.2541	0.0001	0.1321	0.2733
Government deficit/surplus (in % of GDP)	0.3780	0.1126	3.3556	0.0057	0.1326	0.6234
Government consolidated gross debt (in % of GDP)	0.0598	0.0271	2.2062	0.0476	0.0007	0.1189

Source: authors' work based on obtained data World Bank (2023b) and European Commission (2023).

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The results from Table 4. for Slovakia indicate that the overall model is a good fit, with an R-squared value of 0.91, suggesting that the explanatory variables have accounted for a significant proportion of the variance in the dependent variable (Population unable to keep home adequately warm by poverty status). Additionally, upon examining the regression results' P-values, we observe that all variables are statistically significant.

Similar to Poland, a one-unit increase in electricity prices for household consumers with all taxes leads to a 57.1 unit increase in the population unable to keep their homes adequately warm in Slovakia. An increase in final energy consumption by households can potentially lead to an increase in the population being unable to keep their homes adequately warm. If the increase in energy consumption is not accompanied by a corresponding increase in income, it may be difficult for low-income households, in particular, to afford higher heating costs.

The increase in government deficits/surpluses has led to an increase in the number of people who cannot keep their homes warm enough. When governments are under pressure to run deficits, social welfare expenditures may be cut to balance the budget, affecting low- and fixed-income populations. Similarly, if the government becomes heavily indebted, this could lead to currency devaluation and inflation, causing energy prices to rise further, increasing the cost of heating for households and making it impossible for more households to pay for their heating needs. Excessive debt can also result in a reduction in government investment in infrastructure development, which may make it less energy-efficient.

These results can be seen in the multiple regression equation form:

$$\hat{y} = -30.573 + 57.085(x_1) + 0.427(x_2) + 0.203(x_3) \\ +0.378(x_4) + 0.06(x_5) \qquad (3)$$

where:
$\hat{y}$ – population unable to keep home in adequate temperature (% of the whole population),
x_1 – electricity prices for household consumers with all taxes (consumption 2500-4999 kWh) (Euro/kWh),
x_2 – adjusted gross disposable income of households per capita in PPS (% of EU average),
x_3 – final energy consumption by households in Kg of oil equivalents per capita (% EU average),
x_4 – government deficit/surplus (in % of GDP),
x_5 – government consolidated gross debt (in % of GDP).

Research results for all 3 countries together

We also combined the data from three countries, resulting in fifty-four observations. After the elimination of 6 (out of 20) highly correlated explanatory variables, the preparations of the regression model have been started. Finally, there are 7 variables that were highly significant with a 95% confidence interval (P-value <= 0.05) for the three countries case (presented in Table 5).

Table 5. Multiple Regression results of Slovakia

Regression Statistics						
Multiple R	0.95328					
R Square	0.90874					
Adjusted R Square	0.89485					
Standard Error	2.04078					
Observations	54					
	Coefficients	Std Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	86.2115	5.4548	15.8047	0.0001	75.2315	97.1914
Eletricity prices for household consumers with all taxex (consumption 2500-4999 kWh) (Euro/kWh)	51.1176	10.0135	-5.1049	0.0001	-71.2737	-30.9615

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Energy use per person (kWh)	-1.2873	0.1640	-7.8514	0.0001	-1.6174	-0.9573
Adjusted gross disposable income of households per capita in PPS (% of EU average)	-0.3448	0.0883	-3.9062	0.0003	-0.5224	-0.1671
Real GDP per capita (% EU average)	0.2144	0.0717	2.9907	0.0045	0.0701	0.3587
Inflation rate (HICP)	0.3086	0.1070	2.8847	0.0059	0.0933	0.5240
Population by educational attainment level (% of countrys' inhabitants with tertiary education)	-0.6962	0.1287	-5.4086	0.0001	-0.9553	-0.4371
Net electricity imports (share of a country's electricty demand)	-0.5950	0.0541	-11.0069	0.0001	-0.7038	-0.4862

Source: authors work based on obtained data World Bank (2023b) and European Commission (2023).

The results from Table 5. for 3 countries indicate that the model fits well, with an R-squared value of 0.91, suggesting that the explanatory variables have accounted for a significant proportion of the variance in the dependent variable. Additionally, upon examining the regression results' P-values, we observe that all indicated variables are statistically significant. An increase in electricity prices for household consumers with all taxes leads to a 51.1 unit increase in the population unable to keep their homes adequately warm in all three countries. An increase in final energy consumption by households can potentially lead to an increase in the population being unable to keep their homes adequately warm. Real GDP per capita and inflation show a positive correlation with the population unable to adequately heat their homes due to poverty status. The increase in inflation is driving up energy prices, which in turn raises household energy expenditures, making it more difficult for them to stay warm.

On the other hand, adjusted gross disposable income of households per capita and population by educational attainment level exhibit a negative relationship with the population unable to keep their homes adequately warm. Higher education levels and higher disposable incomes lead to increased consumption capacity. Furthermore, net electricity imports are expected to reduce pressure on electricity consumption and alleviate the upward pressure on electricity prices.

These results can be seen in the multiple regression equation form:

$$\hat{y} = 86{,}211 + 51{,}118(x_1) - 1.287(x_2) - 0.345(x_3) + 0.214(x_4) + 0.309(x_5) - 0.696(x_6) - 0.595(x_7) \quad (4)$$

where:
$\hat{y}$ – population unable to keep home in adequate temperature (% of the whole population),
x_1 – electricity prices for household consumers with all taxes (consumption 2500-4999 kWh) (Euro/kWh),
x_2 – energy use per person (kWh),
x_3 – adjusted gross disposable income of households per capita in PPS (% of EU average),
x_4 – real GDP per capita (% EU average),
x_5 – inflation rate (HICP),
x_6 – population by educational attainment level (% of country's inhabitants with tertiary education),
x_7 – net electricity imports (share of a country's electricity demand).

After presenting which of the analysed explanatory variables influence the level of energy poverty in the Czech Republic, Poland, Slovakia, and the three studied countries together, it seems necessary to summarise the frequency of the occurrence of individual variables in the developed models. This will allow us to indicate which macroeconomic variables have a significant impact on the occurrence of the problem of energy poverty in the studied countries. This summary is presented in Table 6.

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Table 6. Summary of variables included in all presented models

Variables/Sample	3 countries	Czechia	Poland	Slovakia	Σ
Electricity prices for household consumers with all taxes (consumption 2500-4999 kWh) (Euro/kWh)	X		X	X	3
Energy use per person (kWh)	X		X		2
Adjusted gross disposable income of households *per capita* in PPS (% of EU average)	X			X	2
Real GDP per capita (% EU average)	X				1
Inflation rate (HICP)	X		X		2
Population by educational attainment level (% of country inhabitants with tertiary education)	X				1
Net electricity imports (share of a country's electricity demand)	X	X	X		3
Share of total population living in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames of floor (% of total population)		X			1
People at risk of poverty or social exclusion (% of total population)		X			1
Government deficit/surplus (in % of GDP)		X		X	2
Government consolidated gross debt (in % of GDP)		X		X	2
Share of electricity production from fossil fuels (% of total)			X		1
Final energy consumption by households in Kg of oil equivalents per capita (% EU average)				X	1
Σ	7	5	5	5	22

In summary, we can see that electricity prices for household consumers with all taxes and net electricity imports have the strongest impact on the population who are unable to keep their homes adequately warm due to poverty status (energy poverty level). Undoubtedly, the energy prices augment their interrelationships with the energy poverty levels, as the more expensive the prices become, the more expenses on energy-related fuels are going to be. The significant importance of energy prices in the context of the problem of energy poverty has already been indicated in previous studies (Sokołowski et al., 2020; Jia et.al, 2022). The authors claimed that affordable pricing of energy resources is effective in further curbing energy poverty levels (Gafa & Egbendewe, 2021). The second most frequently occurring factor (Net electricity imports (share of a country's electricity demand) is quite interesting. It is difficult to find a case in the existing research that would have a significant impact on the problem of energy poverty.

Among the other selected variables that appeared more than once in the constructed models, the following should also be distinguished: energy use per person, adjusted gross disposable income of households per capita in PPS, inflation rate, government deficit/surplus and government consolidated gross debt. In previous studies about energy poverty, they were also indicated as macroeconomic factors of increased importance for the lack of economic exclusion in the world (Kemmler, 2007; Boguszewski & Herdziński, 2018; Adusah-Poku & Takeuchi, 2019; Sarkodie & Adams, 2020). Such variables were particularly often reported as energy use per person or household income, which are not significant only for the model prepared for the Czech Republic. It seems somewhat surprising that the unemployment rate has no significant impact on the level of energy poverty, which has already been raised in previous studies (Popirlan et al., 2023).

Based on the conducted research, it is therefore necessary to confirm the growing consensus to carefully examine the various macroeconomic factors influencing energy poverty, given their importance in shaping national and international climate and social policies (Thomson & Snell, 2013; Dubois & Meier, 2016; Bouzarovski, 2014; Bouzarovski & Tirado Herrero, 2017a). Demonstration of these variables in the study below the other social factors and health (Day et al., 2016), geographical

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locations (Marí-Dell'Olmo et. al., 2022) and political initiatives (Primc et al., 2019) may constitute an important element in combating the problem of energy poverty.

Due to the limited nature of energy resources coupled with the global challenge of energy shortages, there is an urgent need to seek sustainable development strategies in the context of current planetary environmental and social emergencies (Otamendi-Irizar et al., 2022). The economic aspect that ought not to be neglected is the adoption of renewable energy sources for electricity for several reasons. Firstly, the more the GDP per capita rises, the more the utilisation of fossil fuels in final energy consumption is diminished, and vice versa; also, the more the renewable share is rising, the more a household can adequately be kept warm (Halkos & Gkampoura, 2021). Secondly, it is a matter of what the state is going to subsidise; it has been proposed that the state ought to promote economic incentives and subsidies for the adoption of renewables (Mastropietro, 2019).

Conclusions

The main goal of this paper was to assess the impact of selected macroeconomic factors on the level of energy poverty in post-coal countries like the Czech Republic, Poland and Slovakia. Verification of the statistical significance of selected variables in the analysed countries has been carried out using backward stepwise regression (Stanisz, 2007; Juszczyk & Balina, 2009).

Based on the results obtained, it can be indicated that the greatest impact on the phenomenon of energy poverty in the analysed countries is electricity prices for household consumers with all taxes and net electricity. These results are reflected in the current state of research, which indicates the paramount nature of electricity prices in the context of energy poverty. In the study also showed significant significance in the following variables: energy use per person, adjusted gross disposable income of households per capita in PPS, inflation rate, government deficit/surplus and government consolidated gross debt (Sarkodie & Adams, 2020). The obtained research results allow the adoption of the research hypothesis presented at the beginning of the paper, indicating the possible identification of macroeconomic variables that significantly shape the level of energy poverty in selected countries (Czech Republic, Poland, Slovakia).

In conclusion, it can be suggested that the governments of these countries take action on these variables, which can help manage energy poverty. This is an application element of this research, which may have specific adoption in practice. Energy poverty alleviation strategies implemented in line with the low-carbon energy transition should consider important determinants of economic energy poverty and need to be better shaped and targeted, taking into account the diversity of households in terms of region.

There is a need to address energy poverty in integrated and carefully designed strategic planning for the transition to low-carbon energy. Such a plan requires consideration and appreciation of the multifaceted and distinct economic features of the economies of different countries. In developing countries, energy poverty is mainly linked to energy affordability due to limited access to modern energy supply services. In developed economies, energy poverty is mainly related to income poverty and rising energy prices, e.g. due to global energy price shocks, although all households have access to modern energy services. At the same time, residents of developing countries are struggling with problems, such as low levels of electrification and the use of environmentally harmful fuels for cooking, as well as the transition to low-emission energy, which is an additional burden for them.

A limitation of the study that should be noted is that although there are many indicators and designed to assess energy poverty, there is no perfect indicator because energy poverty is highly context-dependent and specific countries experience specific poverty problems in energy.

Future research is needed to analyse the economic drivers of energy poverty further by giving high priority to policies and measuring targeted energy poverty alleviation in post-mining regions, which have their own issues and determinants of energy poverty.

In essence, the economic dimension of energy poverty is an important issue for academic society and policymakers as well. The economic dimension creates complex interconnections with the other dimensions. The practical implications of this research are that on its basis, decision-makers in each country can analyse the situation and assess the effectiveness of the implemented policies and measures.

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The contribution of the authors

Conceptualisation, I.F. and B.L.; literature review, I.F., P.S. and L.Y.; methodology, B.L.; formal analysis, I.F. and B.L.; writing, I.F., B.L., P.S. and L.Y.; conclusions and discussion, I.F., B.L., P.S. and L.Y.

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WPŁYW CZYNNIKÓW MAKROEKONOMICZNYCH NA POZIOM UBÓSTWA ENERGETYCZNEGO NA PRZYKŁADZIE CZECH, POLSKI I SŁOWACJI

STRESZCZENIE: Ubóstwo energetyczne to temat społeczno-gospodarczy związany z problemem zrównoważonego rozwoju wydobycia zasobów naturalnych, ale także działalnością człowieka. Dotyka przede wszystkim kraje o niższym poziomie rozwoju, ale także te, których miks energetyczny opiera się w dużej mierze na źródłach nieodnawialnych (takich jak np. węgiel). Należą do nich niewątpliwie Czechy, Polska i Słowacja. Wciąż prowadzone są badania mające na celu wyjaśnienie przyczyn problemu ubóstwa energetycznego. Niniejsze badanie wkompnowuje się w nurt badań w tym zakresie. Głównym celem artykułu jest ocena wpływu wybranych czynników makroekonomicznych na poziom ubóstwa energetycznego na przykładzie Czech, Polski i Słowacji. By osiągnąć główny cel, zastosowano procedurę regresji krokowej wstecz. Modele zostały opracowane dla każdego z trzech krajów oddzielnie oraz dla wszystkich łącznie. Mają one na celu identyfikację najważniejszych czynników makroekonomicznych oddziałowujących na występowania problemu ubóstwa energetycznego w analizowanych krajach. Wyniki wszystkich czterech modeli uwydatniły dwie istotne zmienne, które mogą mieć wpływ na poziom ubóstwa energetycznego w wybranych krajach. Są to: ceny energii elektrycznej dla odbiorców domowych ze wszystkimi podatkami oraz import energii elektrycznej netto. W trzech z czterech opracowanych modeli w sposób istotny statystycznie wyjaśniały one poziom ubóstwa energetycznego. Podsumowując, można zasugerować, aby rządy badanych krajów podjęły działania w zakresie istotnych statystycznie zmiennych, co może pomóc w zarządzaniu ubóstwem energetycznym. Ich identyfikacja i późniejsze oddziaływanie pozwoli pomóc w ograniczeniu tego problemu w analizowanych gospodarkach.

SŁOWA KLUCZOWE: ubóstw energetyczne, czynniki makroekonomiczne, regresja, modele wielu zmiennych

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Appendix

Table A. Data for calculation the model for Czech Republic

Czech Republic	Y Variable	X1	X2	X3	X4	X5	X6	X7	X8	X9
Time Period	Population unable to keep home adequately warm by poverty status (% of whole population)	Energy efficiency-final energy consumption (Index 2005=100)	Eletricity prices for household consumers with all taxex (consumption 2500-4999 kWh) (Euro/kWh)	Energy use per person (kWh)	Adjusted gross disposable income of households per capita in PPS (% of EU average)	Real GDP per capita (% EU average)	Unemployment rate (by age 20-64)	Inflation rate (HICP)	Population (% of whole EU population)	Final energy consumpiton by households in Kg of oil equivalents per capita (% EU average)
2005	9.3	100.00	0.059	50.547	-	56.71	7.6	1.6	2.34	106.39
2006	8.9	101.50	0.074	51.379	-	60.37	6.9	2.1	2.35	107.67
2007	6.1	99.74	0.116	50.659	-	63.36	5.2	2.9	2.36	100.95
2008	6	99.17	0.141	49.488	-	64.40	4.3	6.3	2.38	101.89
2009	5.2	95.39	0.149	47.288	-	61.03	6.5	0.6	2.40	103.86
2010	5.2	96.58	0.152	49.084	75.60	62.40	7.1	1.2	2.40	115.85
2011	6.4	93.53	0.164	47.824	76.06	63.61	6.5	2.2	2.41	106.71
2012	6.7	93.38	0.167	47.515	76.34	63.02	6.8	3.5	2.38	110.61
2013	6.2	92.61	0.166	46.623	78.16	62.98	6.8	1.4	2.39	112.83
2014	6.1	90.20	0.138	45.634	80.84	64.31	6	0.4	2.39	101.57
2015	5	92.55	0.140	44.729	80.85	67.68	5	0.3	2.39	104.71
2016	3.8	94.94	0.142	44.110	80.85	69.26	3.9	0.6	2.40	109.36
2017	3.1	97.53	0.146	46.583	83.80	72.66	2.8	2.4	2.40	110.74
2018	2.7	96.87	0.158	46.421	84.75	74.74	2.2	2	2.41	107.84
2019	2.8	96.64	0.176	45.355	85.84	76.69	2	2.6	2.42	107.04
2020	2.2	93.67	0.182	42.025	85.55	72.29	2.5	3.3	2.43	-
2021	2.2	100.24	0.184	44.385	87.18	74.86	2.8	3.3	2.38	-
2022	2.9	100.65	0.345	44.242	85.09	76.69	2.2	14.8	2.39	-

Czech Republic	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19
Time Period	Population by educational attainment level (% of countrys' inhabitants with tertiary education)	Heating degree days (% of EU average)	Arrears on utility bills (% of total)	Population density (people per sq, km of land area)	Share of total population living in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames of floor (% of total population)	People at risk of poverty or social exclusion (% of total population)	Carbon intensity of electricity (grams of CO_2/kWH of elericty)	Net electricity imports (share of a country's electricty demand)	Share of electricity production from fossil fuels (% of total)	Government deficit/surplus (in % of GDP)
2005	11	110.60	7.2	132.167	-	19.8	537	-18.23	66	-3.0
2006	11.4	111.21	5.8	132.542	-	18.3	527	-17.78	64.65	-2.2

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2007	11.6	106.51	3.8	133.318	-	16	542	-22.55	66.29	-0.6
2008	12.4	105.74	2.6	134.446	-	15.4	522	-15.97	63.65	-2.0
2009	13.4	107.07	4	135.214	14.6	14.1	502	-20.06	60.96	-5.4
2010	14.5	109.48	4.2	135.626	11.8	14.5	495	-21.27	60.22	-4.2
2011	15.8	108.98	4.3	135.907	11.9	15.6	487	-24.47	59.02	-2.7
2012	17	105.00	4.1	136.097	10.5	15.6	462	-24.64	55.67	-3.9
2013	18.1	111.23	4	136.160	10	14.9	443	-24.46	53.4	-1.3
2014	19.1	103.71	4.7	136.303	9.2	15.1	446	-23.72	53.53	-2.1
2015	19.8	106.53	3	136.589	8.9	13	466	-17.87	56.07	-0.6
2016	20.6	107.08	3	136.852	8.2	12.4	485	-15.44	59.16	0.7
2017	21.4	108.76	2.1	137.216	8	12.1	458	-17.93	55.74	1.5
2018	21.7	101.86	2.1	137.676	7.7	11.8	449	-19.07	54.7	0.9
2019	21.6	103.05	1.8	138.227	7.3	12.1	429	-18.03	52.98	0.3
2020	22.1	111.59	1.9	138.576	6.8	11.5	397	-14.5	49.56	-5.8
2021	23.4	110.43	1.5	136.108	-	10.8	406	-15.25	50.51	-5.1
2022	23.5	107.90	1.9	136.150	-	11.8	415	-18.9	51.25	-3.6

lack of following data.
Source: authors' work based on European Commission (2023), the World Bank (2023b) and the European Environmental Agency (2023).

Table B. Data for calculation the model for Poland

Poland	Y Variable	X1	X2	X3	X4	X5	X6	X7	X8	X9
Time Period	Population unable to keep home adequately warm by poverty status (% of whole population)	Energy efficiency-final energy consumption (Index 2005=100)	Eletricity prices for household consumers with all taxex (consumption 2500-4999 kWh) (Euro/kWh)	Energy use per person (kWh)	Adjusted gross disposable income of households per capita in PPS (% of EU average)	Real GDP per capita (% EU average)	Unemployment rate (by age 20-64)	Inflation rate (HICP)	Population (% of whole EU population)	Final energy consumpiton by households in Kg of oil equivalents per capita (% EU average)
2005	33.6	100.00	0.050	27.591	-	31.20	17.7	2.2	8.76	83.41
2006	28.4	104.66	0.053	28.977	-	33.11	13.8	1.3	8.76	87.56
2007	22.7	105.34	0.138	28.914	-	35.48	9.6	2.6	8.76	83.02
2008	20.1	106.83	0.128	29.419	-	36.98	7	4.2	8.75	84.26
2009	16.3	105.18	0.121	28.365	-	37.64	8.1	4	8.76	85.88
2010	14.8	113.32	0.136	30.214	63.10	38.72	9.5	2.6	8.73	94.48
2011	13.6	110.57	0.141	30.370	66.57	40.67	9.5	3.9	8.76	86.44
2012	13.2	110.15	0.147	29.494	69.47	41.30	10	3.7	8.64	89.41
2013	11.4	108.13	0.146	29.579	69.41	41.67	10.2	0.8	8.64	88.10
2014	9	105.23	0.141	28.535	71.24	43.29	8.9	0.1	8.63	81.90
2015	7.5	106.51	0.143	28.851	72.33	45.24	7.4	-0.7	8.63	81.91
2016	7.1	113.87	0.134	30.123	72.85	46.61	6.1	-0.2	8.62	85.59
2017	6	121.21	0.145	31.295	72.75	49.02	4.8	1.6	8.62	86.39

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2018	5.1	128.02	0.140	31.661	73.39	51.93	3.8	1.2	8.62	83.77
2019	4.2	126.05	0.136	30.778	74.42	54.30	3.2	2.1	8.62	78.46
2020	3.2	121.63	0.149	29.514	77.39	53.22	3.1	3.7	8.62	-
2021	3.2	128.49	0.156	32.001	74.16	57.21	3.4	5.2	8.59	-
2022	4.9	129.14	0.153	30.065	77.70	60.66	2.8	13.2	8.55	-
Poland	**X10**	**X11**	**X12**	**X13**	**X14**	**X15**	**X16**	**X17**	**X18**	**X19**
Time Period	Population by educational attainment level (% of countrys' inhabitants with tertiary education)	Heating degree days (% of EU average)	Arrears on utility bills (% of total)	Population density (people per sq, km of land area)	Share of total population living in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames of floor (% of total population)	People at risk of poverty or social exclusion (% of total population)	Carbon intensity of electricity (grams of CO_2/kWH of eletricty)	Net electricity imports (share of a country's electricty demand)	Share of electricity production from fossil fuels (% of total)	Government deficit/surplus (in % of GDP)
2005	110.42	24.2	124.589	-	45.6	788	-7.78	97.52	-3.9	46.6
2006	112.26	20.4	124.514	-	39.9	788	-7.35	97.33	-3.5	47.3
2007	108.25	16.7	124.447	-	34.8	783	-5.85	96.57	-1.9	44.5
2008	104.55	10	124.472	-	30.8	777	-0.44	95.73	-3.6	46.7
2009	110.78	12.5	124.564	17.6	28.1	767	-1.47	94.25	-7.3	49.8
2010	112.17	13.9	124.209	15.6	28.1	759	-0.87	93.07	-7.5	54.0
2011	111.72	12.9	124.296	11.5	27.5	750	-3.32	91.95	-5.0	55.1
2012	109.68	14.1	124.300	10.5	27.1	734	-1.79	89.56	-3.8	54.8
2013	110.85	14	124.229	10.1	26.4	734	-2.84	89.59	-4.3	57.1
2014	109.91	14.4	124.144	9.2	25.3	719	1.35	87.47	-3.7	51.4
2015	107.28	9.2	124.062	11.9	22.5	705	-0.2	86.18	-2.6	51.3
2016	108.34	9.5	124.008	11.6	20.6	700	1.19	86.27	-2.4	54.5
2017	108.00	8.5	124.024	11.9	18.7	691	1.33	85.8	-1.5	50.8
2018	106.21	6.3	124.032	11.6	18.2	698	3.25	87.24	-0.2	48.7
2019	101.46	5.8	124.026	10.8	17.9	671	6.12	84.38	-0.7	45.7
2020	108.96	4.7	123.801	6	17	647	7.79	82.04	-6.9	57.2
2021	111.68	5.2	123.316	-	16.8	660	0.5	82.91	-1.8	53.6
2022	111.99	4.5	122.960	-	15.9	635	-0.95	78.96	-3.7	49.1

lack of following data.

Source: authors' work based on European Commission (2023), the World Bank (2023b) and the European Environmental Agency (2023).

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Table C. Data for calculation the model for Slovakia

Slovakia	Y Variable	X1	X2	X3	X4	X5	X6	X7	X8	X9
Time Period	Population unable to keep home adequately warm by poverty status (% of whole population)	Energy efficiency-final energy consumption (Index 2005=100)	Eletricity prices for household consumers with all taxex (consumption 2500-4999 kWh) (Euro/kWh)	Energy use per person (kWh)	Adjusted gross disposable income of households per capita in PPS (% of EU average)	Real GDP per capita (% EU average)	Unemployment rate (by age 20-64)	Inflation rate (HICP)	Population (% of whole EU population)	Final energy consumpiton by households in Kg of oil equivalents per capita (% EU average)
2005	13.6	100.00	0.070	42.086	-	41.42	15.7	2.8	1.23	77.27
2006	9.7	98.36	0.076	40.946	-	44.87	12.8	4.3	1.23	70.24
2007	4.6	96.94	0.137	38.418	-	49.69	10.7	1.9	1.23	63.23
2008	6	99.05	0.147	39.432	-	52.39	9.2	3.9	1.23	64.65
2009	3.6	91.94	0.155	35.688	-	49.40	11.7	0.9	1.24	65.09
2010	4.4	99.84	0.158	38.081	71.40	52.60	14	0.7	1.24	69.98
2011	4.3	93.15	0.170	36.591	71.18	54.34	13.2	4.1	1.24	64.10
2012	5.5	89.47	0.172	35.105	72.06	54.96	13.6	3.7	1.23	62.49
2013	5.4	91.63	0.169	35.937	72.43	55.26	13.9	1.5	1.23	64.75
2014	6.1	86.15	0.152	33.420	72.19	56.67	12.9	-0.1	1.23	58.82
2015	5.8	87.08	0.151	33.734	74.02	59.58	11.3	-0.3	1.23	59.81
2016	5.1	90.01	0.148	34.015	68.09	60.61	9.5	-0.5	1.23	61.00
2017	4.3	96.27	0.144	35.775	66.06	62.32	7.9	1.4	1.23	63.26
2018	4.8	96.15	0.151	35.121	67.10	64.73	6.4	2.5	1.24	61.64
2019	7.8	96.64	0.158	33.893	68.21	66.31	5.6	2.8	1.24	79.13
2020	5.7	89.73	0.171	33.193	67.68	63.98	6.6	2	1.24	-
2021	5.8	98.82	0.165	35.836	67.41	67.30	6.7	2.8	1.24	-
2022	7.1	99.16	0.184	33.888	67.19	67.89	6	12.1	1.23	-

Slovakia	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19
Time Period	Population by educational attainment level (% of countrys' inhabitants with tertiary education)	Heating degree days (% of EU average)	Arrears on utility bills (% of total)	Population density (people per sq, km of land area)	Share of total population living in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames of floor (% of total population)	People at risk of poverty or social exclusion (% of total population)	Carbon intensity of electricity (grams of CO_2/kWH of eletricty)	Net electricity imports (share of a country's electricty demand)	Share of electricity production from fossil fuels (% of total)	Government deficit/surplus (in % of GDP)
2005	110.38	8.3	111.701	-	32	217	-11.65	28.49	-2.9	34.7
2006	109.70	6.5	111.706	-	26.6	209	-8.07	26.88	-3.6	31.4
2007	103.75	5.7	111.739	-	21.1	213	5.85	27.2	-2.1	30.3

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2008	100.27	3.8	111.834	-	20.2	204	1.78	25.97	-2.5	28.6
2009	102.23	11.3	112.007	6.6	19.4	204	4.92	26.61	-8.1	36.4
2010	99.83	9.6	112.109	5.8	20.6	191	3.65	25.16	-7.5	40.6
2011	109.30	6.4	112.261	7.8	20.8	202	2.52	27.65	-4.3	43.2
2012	101.81	5.8	112.452	8.8	20.6	193	1.36	25.78	-4.4	51.7
2013	102.45	5.9	112.573	7.5	19.9	171	0.32	22.36	-2.9	54.7
2014	96.36	6.1	112.701	7	18.4	161	3.91	19.6	-3.1	53.5
2015	105.44	5.7	112.803	6.3	17.3	166	8.26	20.12	-2.7	51.7
2016	104.73	5.7	112.953	6.2	17.1	166	9.04	19.79	-2.6	52.3
2017	108.05	5.5	113.129	6.7	15.8	171	9.99	20.78	-1.0	51.5
2018	99.42	7.9	113.286	5.1	15.2	180	12.17	22.28	-1.0	49.4
2019	99.65	8.4	113.439	5.7	14.8	167	5.69	22.21	-1.2	48.0
2020	110.43	5.2	113.536	4.9	13.8	159	1.11	21.82	-5.4	58.9
2021	108.20	4.6	113.295	-	15.6	170	2.53	24.14	-5.4	61.0
2022	106.48	5.9	111.810	-	16.5	141	4.94	17.85	-2.0	57.8

lack of following data.
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