

IMPACT OF ENERGY PRICES ON ABSOLUTE POVERTY IN MOLDOVA

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Abstract

Moldova is a country that imports energy. The energy crisis and repeated increases in end-user tariffs have impacted the population's well-being. This topic is relevant because it examines the vital role of energy security in ensuring citizens' economic well-being. This study aims to evaluate the impact of rising energy prices on absolute poverty in Moldova. Energy prices are one of the main factors affecting household expenditure, particularly for vulnerable groups who spend most of their income on meeting basic needs. The study focuses particularly on the relationship between energy prices and poverty, demonstrating how price fluctuations can exacerbate socio-economic inequality. To achieve this, econometric methods such as ordinary least squares (OLS) and two-stage least squares (2SLS) were employed while addressing issues such as multicollinearity and endogeneity. The results show that rising energy prices reduce disposable income by increasing expenditure on essential goods and services, thereby increasing the financial burden on households. Logically, an increase in absolute poverty will not only decrease the well-being of the population, but also undermine economic stability. Understanding these patterns is crucial for policymakers developing strategies to reduce poverty and ensure inclusive growth. This study proves that, in order to achieve energy security and social equality in Moldova, strategies must be promoted to ensure the availability of energy resources and increase households' resilience to economic shocks.

Keywords: energy prices, poverty, energy security, socio-economic analysis, economic well-being

I. Introduction

The relationship between energy prices and economic well-being is an increasingly popular topic in global and regional research, especially in fragile economies such as Moldova. Energy prices affect household budgets, the cost of the consumer basket, and the standard of living. In Moldova, where a significant portion of the population lives below the poverty line, fluctuations in energy prices have a substantial effect on the poverty level, and citizens who previously had a decent life now find themselves below the poverty line. In Moldova, there is even a phenomenon known as in-work poverty.

Absolute poverty is defined as the inability to meet basic needs such as food, housing, and clothing. This indicator, along with the relative poverty indicator, is used to assess the well-being of the population. Over the past ten years, fluctuations in the poverty rate have been due to economic shocks (energy crisis, COVID-19, climate cataclysms) and policy measures. Geopolitical crises have also had a negative impact on the economy and the well-being of the population, increasing the number of poor people [1]. The rise in energy prices during this period has aggravated the financial burden of households, reduced disposable income, and increased the cost of basic goods and services. As a result, the poverty rate has increased significantly: in 2015, every fourth citizen was poor, and in 2024, every third citizen became poor [2].

Energy security is, on the one hand, an integral part of economic security, and on the other hand, it ensures economic stability. At the same time, Moldova is a candidate country for joining

the European Union. The economy of Moldova is integrating into the EU economy, and the volatility of energy prices in Europe is very high. The high dependence of the Moldovan economy on energy imports makes it particularly sensitive to global price shocks. Unlike its neighboring countries, Moldova has limited domestic energy production and a low level of diversification of energy sources. This circumstance aggravates the impact of energy price volatility on the economy of Moldova [3]. Global experience in combating energy poverty shows that one of the solutions is the development of green energy [4], and this requires subsidies and investments in renewable energy sources [5].

There are few studies on the relationship between changes in energy prices and poverty, and most of these few studies examine the impact of energy poverty, not absolute poverty. The countries for which such studies have been conducted are the European Union [6], the United States [7], and Asian countries [8]. There are no such studies for Moldova. The only work on a related topic studies the relationship between green energy and human development [9]. This proves the novelty of the study in this article. The purpose of the study is to examine the impact of rising energy prices on absolute poverty in Moldova.

II. Materials and methods

This study examines the relationship between the Producer Price Index for electricity, gas, steam, and air conditioning supply (PPIES) and the absolute poverty rate in Moldova. In order to profoundly investigate the socio-economic factors affecting poverty, in addition to the price index, the study covers additional variables such as foreign direct investment (FDI), unemployment rate (UR), and personal remittances (PR). To obtain reliable conclusions about the dynamics of the relationship between PPIES and poverty, econometric methods were used, including ordinary least squares (OLS) and two-stage ordinary least squares (2SLS). To examine the impact of energy prices on the absolute poverty rate in the Republic of Moldova, we first use standard OLS regressing *PPIES* on Absolute Poverty Rate (APR), as shown in the main equation below:

$$y = \delta \times PPIES + \sum_{i=1}^n \beta_i \times x_i + \xi \quad (1)$$

where,

y – absolute poverty rate, %,

$PPIES$ – production price index for electricity, gas, steam, and air conditioning supply, %,

x – the value of other control variables, such as *FDI*, *UR*, *PR*, etc. (n variables),

δ – the regressor; it shows the effect of *PPIES* on the *APR*,

β – parameters,

ξ – stochastic term.

We consider the absolute poverty rate as a critical measure for assessing welfare in the Republic of Moldova. The National Bureau of Statistics (NBS) presents the results of the Household Budget Survey (HBS). This research identifies disadvantaged households and individuals while assessing the impact of policies and programs on the socio-economic conditions of the population. Additionally, the HBS provides data for calculating the Consumer Price Index (CPI), estimating household final consumption, and measuring poverty and social exclusion. Conducted on a random sample of urban and rural households across Moldova (excluding areas on the left bank of the Nistru River and Bender municipality), the survey encompasses all members of selected households, including temporarily or long-term absent individuals who maintain household ties and contribute to the household budget.

From 2014 to 2022, the NBS changed the methodology for calculating many indicators reflecting the socio-economic development of the country. Statistical studies of households are related to the method for calculating the country's population. Until 2019, the NBS calculated the stable population. In 2017-2018, it tested a new methodology, which was finally adopted in 2022. The recalculation of indicators was carried out for data starting from 2014. That's why the data

covers the period between 2014 and 2024 inclusive. A brief description of the variables is provided in Table 1. Lack of data prevented an extension of this analysis beyond the current period. The Absolute Poverty Rate and the PPI for energy supply are taken from the NBS.

Table 1: *Variable description*

Variable	Mean	Sample standard deviation	Min	Max
Absolute Poverty Rate, %	27.71	3.33	23.0	33.6
Producer Price Index for electricity, gas, steam, and air conditioning supply, % previous year=100%	113.10	35.53	92.7	212.0
Foreign Direct Investment, % of Gross Domestic Product (GDP)	2.60	1.10	1.1	4.4
Unemployment Rate, %	3.99	0.70	3.0	5.1
Personal Remittances, % of GDP	16.22	3.30	10.5	22.1

Source: The authors' computation

According to the NBS, the average absolute poverty level is 27.71%. The dynamics of the poverty level provide an idea of the country's economic sustainability and the effectiveness of social support systems. For our primary independent variable, we selected the PPIES. It measures the overall evolution of the prices of industrial products and services manufactured and delivered at the first trading stage by domestic producers during a specified period, compared to a reference period. The sample standard deviation (Bessel's correction) of the PPI for energy supply is too much (35.53), which is evidence of the volatility of prices.

The first control variable we used in our analysis is Foreign Direct Investments, net inflows (% of GDP of Moldova). These represent the net inflows of investment aimed at acquiring a lasting management interest (defined as ownership of 10 percent or more of voting stock) in an enterprise operating outside the investor's home economy. FDI includes the sum of equity capital, reinvested earnings, other long-term capital, and short-term capital as reported in the balance of payments. This metric reflects the net inflows (new investments minus disinvestments) made by foreign investors into the reporting economy. It serves as an indicator of investor confidence and the effectiveness of policies aimed at improving the business environment.

The second control variable used is unemployment rate, i.e, the share of the total labor force that is without work but available for and seeking employment. We believe this affects the absolute poverty rate, as higher unemployment leads to reduced household income, making it more challenging for individuals and families to meet basic needs, thereby increasing the likelihood of experiencing poverty. The last and not least control variable used is personal remittances, as part of GDP. Personal transfers refer to all current transfers, either in cash or in kind, made or received by resident households from nonresident households. This category encompasses all current transfers between resident and nonresident individuals. Compensation of employees covers the income earned by border, seasonal, and other short-term workers employed in a country where they are not residents, as well as income from residents working for nonresident employers. The data on personal remittances represent the sum of these two components, as defined in the sixth edition of the IMF's Balance of Payments Manual. It is a well-known fact that the Republic of Moldova's GDP is massively dependent on personal remittances; hence, we decided to include it as a relevant control.

III. Evolution of absolute poverty and potential predictors

A comparative analysis of the dynamics of the absolute poverty rate and PPI for energy supply suggests that there is a relationship between these indicators. Still, the extent of this relationship will be understood by further analysis in the next section. In 2022, a two-fold increase in PPI for energy supply and an increase in the absolute poverty rate by 6.6 percentage points

were recorded (see Fig.1). The energy crisis died down in the second half of 2023, so the price index in 2024 is below 100%. Still, the prices for energy resources themselves remain higher than before the energy crisis.

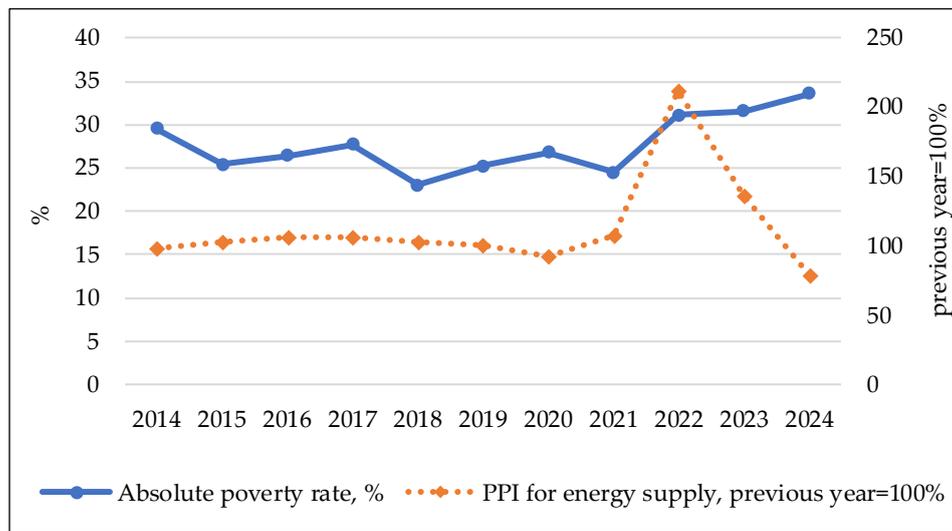


Fig. 1: Evolution of absolute poverty rate and PPI for energy supply, 2014-2024

Over the 11 years analyzed, significant declines in foreign direct investment (% of GDP) were recorded in 2016 (by 1.8 percentage points), 2020 (by 3.0 percentage points), and 2023 (by 1.9 percentage points). During these same years, the absolute poverty rate increased by 1.0, 1.6, and 0.5 percentage points, respectively (see Fig.2). This pattern suggests that there is an inverse relationship between these two indicators. We will test this assumption in the next section.

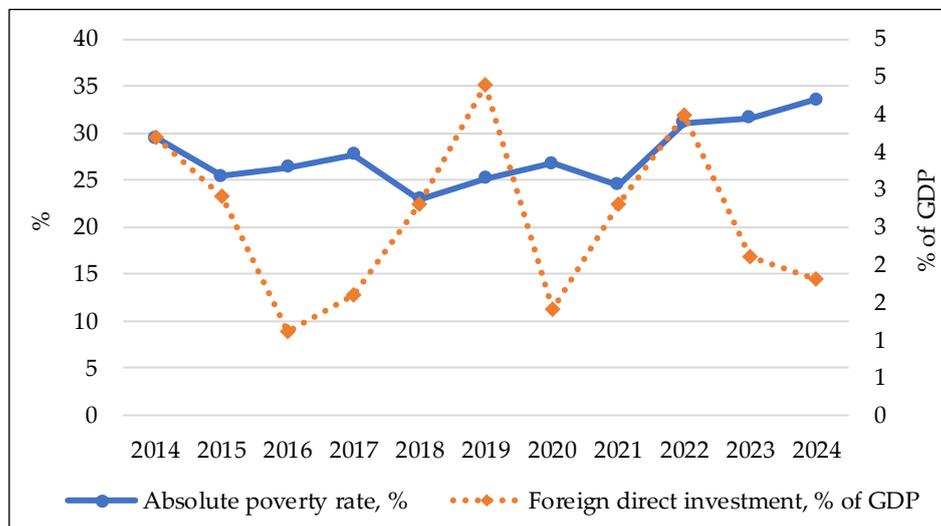


Fig. 2: Evolution of absolute poverty rate and foreign direct investment, 2014-2024

The trends in the evolution of the absolute poverty rate and personal remittances look identical for 2014-2021. Still, over the past three years, there has been a clear inverse relationship between them (see Fig.3). We will answer the question of whether there is a relationship between these indicators and whether it is significant in the next section using the methods listed in the previous section (OLS and 2SLS).

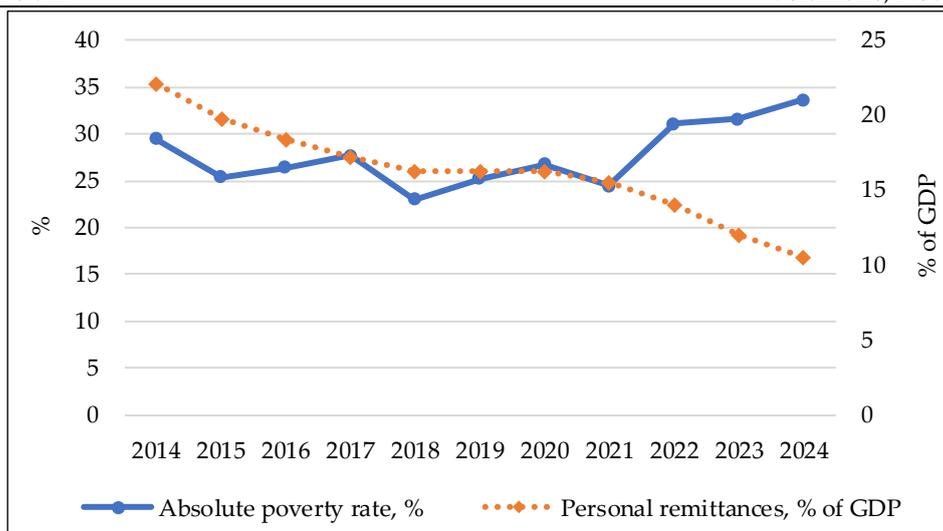


Fig. 3: Evolution of absolute poverty rate and personal remittances, 2014-2024

Further analysis of the drivers behind the (non-) stationarity of these trends and the tools the governments can employ to counteract the negative repercussions of the subsequent effects is a subject matter that can be explored in the next section.

IV. Results and discussions

The method of ordinary least squares (OLS) was used to examine the impact of energy prices and other predictors on the absolute poverty rate in Moldova. The results are presented in Table 2, and these show that while energy prices have a positive association with the absolute poverty rate in Model 1, this relationship becomes more nuanced as additional variables are introduced in subsequent models. In model 1, the relationship between the energy price index and the poverty level is positive and statistically significant, indicating that higher energy prices are associated with higher poverty levels in Moldova. However, when the second predictor, “Foreign Direct Investment,” is included in model 2, this relationship weakens, and the significance of the coefficient considering energy prices decreases. We could suggest that FDI may play a role in moderating the impact of energy prices on poverty. In Model 3, when we include the predictor “Unemployment Rate,” energy prices continue to show a positive relationship with poverty. Still, the effect is somewhat reduced, suggesting that unemployment may also affect poverty.

Table 2: Results of applying the OLS method for elaborating Models 1-4

Variable / Model	Model 1	Model 2	Model 3	Model 4
Production Price Index for energy supply, %	0.0505*	0.0553*	0.0660**	0.0688*
Foreign Direct Investment, % of GDP		-0.4277	-0.3058	-0.3510
Unemployment Rate, %			3.2614	3.1338
Personal Remittances, % of GDP				0.0656
R-squared	0.396	0.422	0.537	0.539
Adjusted R-squared	0.320	0.257	0.305	0.171
F-statistic	5.242	2.554	2.317	1.463
Prob (F-statistic)	0.0513	0.147	0.175	0.338

Note: **: 5% sig. *: 10% sig. P-values based on regression analysis

Source: The authors' computation

Finally, in Model 4, adding a fourth predictor, “personal remittances,” further reduces the significance of the estimated coefficient, suggesting that remittances may help cushion the impact

of energy price increases on the absolute poverty line. Other variables, such as FDI, unemployment, and personal remittances, do not show consistent or statistically significant relationships with the absolute poverty rate across the different models, and their effects appear economically insignificant in most cases.

Moreover, the model exhibits high multicollinearity, which can affect the robustness of the results. Figure 4 illustrates plots of the covariance matrix and variance inflation factors of each independent variable, including the geopolitical risk index [1], which we will use further in our analysis. The Variance Inflation Factor (VIF) is a statistical measure used to assess the level of multicollinearity in a set of explanatory variables in a regression model. Specifically, the VIF quantifies how much the variance of a regression coefficient is inflated due to multicollinearity with other predictor variables. A higher VIF indicates greater multicollinearity, which means that the variable is highly correlated with other variables in the model.

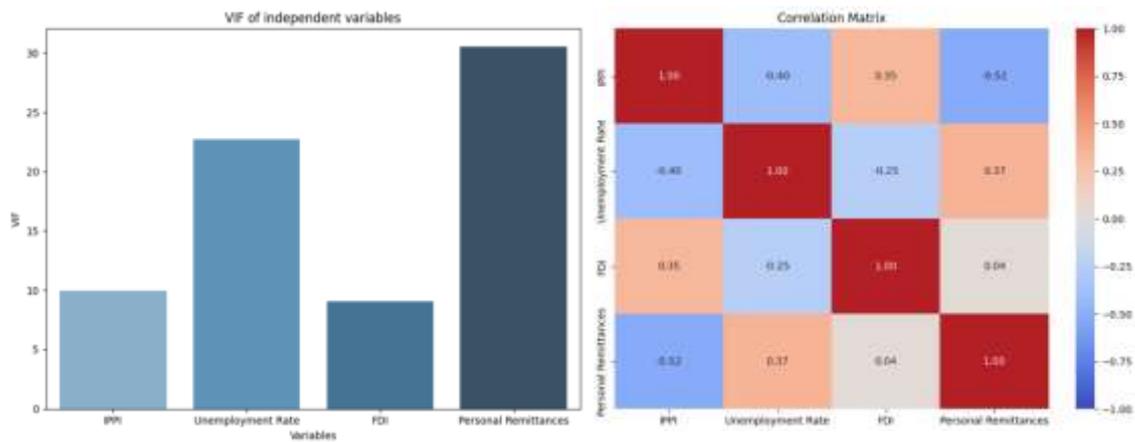


Fig. 4: VIF and Correlation Matrix of independent variables (including personal remittances)

High multicollinearity was found for the unemployment rate and personal remittances variables, with VIF values of 22 and 31, respectively. To ensure the stability of the 2SLS results, we excluded the personal remittances variable. As a result, Figure 5 illustrates that the VIF values are now below 10, and the correlation between each variable falls within the range of -0.8 to 0.8.

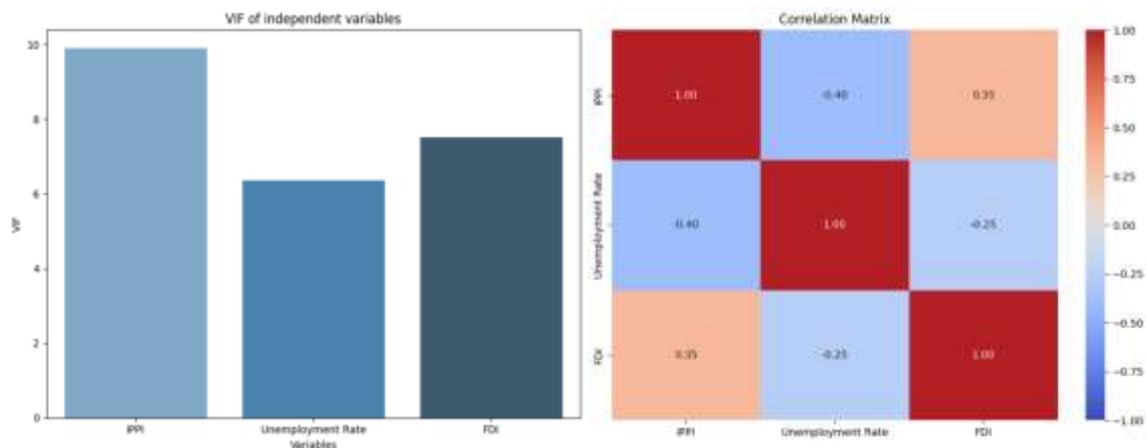


Fig. 5: VIF and Correlation Matrix of independent variables (excluding personal remittances)

To ensure a robust estimate of the relationship between potential predictors and poverty, we employ 2SLS regression. This method addresses potential endogeneity issues. Endogeneity occurs

when independent variables are correlated with the error term of the regression model, leading to erroneous estimates of the coefficients. In our case, endogeneity can arise either from omitted variables or reverse causality.

Results of the 2SLS regression are shown in Table 3. The 2SLS method uses instrumental variables to account for endogenous predictors, thereby reducing endogeneity. In our case, the instrumental variable for PPIES is the geopolitical risk index (GRI). We assume that the Geopolitical Risk Index is relevant as an instrument, meaning it is correlated with the PPIES variable, but is not directly affecting the poverty rate (the dependent variable) except through its effect on PPIES.

Table 3: Results of applying the 2SLS method for elaborating Models 1-3

Variable / Model	Model 1	Model 2	Model 3
Production Price Index for energy supply, %	0.2203***	0.1133***	0.1066***
Foreign Direct Investment, % of GDP	0.1528	-	0.3816
Unemployment Rate, %	-	9.9260***	9.7598***
R-squared	0.9475	0.9896	0.9897
Adjusted R-squared	0.9344	0.9870	0.9853
F-statistic	107.58	1160.5	1418.1
Prob (F-statistic)	0.0000	0.0000	0.0000

Note: ***: 1% sig. **: 5% sig. *: 10% sig. P-values based on regression analysis

Source: The authors' computation

According to the data in Table 3, in all three models, PPIES is positively correlated with the poverty level with coefficients of 0.2203, 0.1133, and 0.1066. All these coefficients are statistically significant at the 1% level. This suggests that higher energy prices contribute to an increase in poverty. Specifically, a 1-point increase in the PPIES is associated with an approximate 15% rise in the absolute poverty rate – a notably high figure.

On the other hand, Foreign Direct Investment (FDI) shows coefficients of 0.1528 and 0.3816 in Models 1 and 3, respectively. Still, these are not statistically significant, indicating that FDI does not have a substantial impact on poverty. The unemployment rate is included in Models 2 and 3, where it has a strong positive effect on poverty, with coefficients of 9.9260 and 9.7598, both statistically significant at the 1% level. The models exhibit strong explanatory power, with R-squared values ranging from 0.9475 to 0.9897 and F-statistics indicating high overall significance (p-value = 0.0000 for all). The results provide evidence that energy security plays a vital role in reducing poverty in Moldova.

V. Conclusion

This study proves that there is a direct relationship between the energy price index and the absolute poverty rate in Moldova. According to the results, the coefficient in regression model 1 is statistically significant, thus higher energy prices will lead to an increase in the poverty rate. However, including additional predictors (FDI) in the model allows us to understand the relationship better. The predictor “unemployment rate” amplifies the impact of rising energy prices on the decline in household welfare.

To mitigate the negative impact of rising energy prices on poverty in Moldova, the government should promote policies aimed at increasing energy availability and sustainability. To increase the availability of energy resources, it is necessary to provide direct financial assistance to low-income households and vulnerable groups. The government should attract investment in the development of “green” energy, and develop and implement strategies for the diversification of energy sources. These measures have a dual purpose: on the one hand, they will reduce dependence on unstable energy markets, and on the other, they will stabilize prices in the long term.

The following measures should be implemented to improve energy efficiency: introduce energy-saving technologies, and use insulation for home renovation. These measures help reduce overall household energy consumption. Model 3 shows that there is a strong positive correlation between unemployment and poverty. Thus, increasing employment, creating new jobs, especially in green energy, will reduce poverty. Vulnerable groups should be offered vocational training programs to help them find employment. Finally, attracting domestic and foreign investment in sectors that create new jobs, including in green energy, will improve living standards and inclusiveness in Moldova.

VI. Acknowledgements

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CONFLICT OF INTEREST.

Authors declare that they do not have any conflict of interest.

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