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Macroeconomic Policy versus Fuel Poverty in Poland—Support or Barrier

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Abstract: Energy and climate policies play an increasingly important role in the world in the era of climate change and rising energy prices. More often, the importance of the development of the energy sector and climate protection is seen from the point of view of the expenditures that will need to be absorbed in the economy, with the potential for increased energy prices. However, it should be remembered that this is also related to the issue of fuel poverty and the inability to meet basic energy needs by parts of society. The aim of the paper is to assess the importance of macroeconomic policy instruments in reducing fuel poverty, using Poland as an example. It will be examined whether and how the government influenced this phenomenon (directly or indirectly), through which instruments, and which instruments (fiscal, monetary or energy-climate policy) played the most important role in shaping the scale of fuel poverty in Poland, with an emphasis on the role of monetary and fiscal policy instruments. The analysis covered the period from 2004 to mid-2021. The results of the research showed that in Poland there is a lack of policy directly aimed at reducing fuel poverty, and the government affects the scale of fuel poverty indirectly mainly through macroeconomic policy instruments, i.e., fiscal and monetary policy instruments. The main and most effective instruments for reducing fuel poverty in Poland are social transfers. Other instruments that have a statistically significant impact on this poverty rate are the level of tax burdens and short-term interest rates. The analysis also revealed some opportunities for effective fuel poverty reduction policies. It was proven that in addition to fiscal policy, monetary policy, which would stimulate a decrease in short-term interest rates, is also an effective way to reduce the fuel poverty rate in Poland.

Keywords: fuel poverty; macroeconomic policy; monetary policy; fiscal policy; energy and climate policies; Poland

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1. Introduction

Recently, the issue of the rising prices of energy carriers has become a critical problem in the world, especially in European Union countries. In Poland, this problem concerns mainly electricity, which experienced a 26.3% increase in prices in the national currency for households in 2020–2021 alone, according to Eurostat data (Band DB) [1]. Energy and climate policies play an increasingly important role in the socio-economic policies of the Member States of the European Union (EU) and in the decisions of EU institutions [2–4]. This is due to climate change and the increase in public climate awareness, as well as the increase in demand for energy carriers, especially electricity and gas [5]. This was confirmed by a summit of the European Council that was held in December 2019, which dealt with issues such as climate, budget, economy, and Brexit. One of the decisions taken there was to approve the goal of making the EU climate neutral by 2050. Thus, it was decided to increase the share of renewable energy sources (RES) to 40% by 2030, to cut energy consumption by 9%, and to reduce net EU emissions by 55% (compared to 1990 levels) [6]. However, in the longer term, i.e., by 2050, the aim is obviously to achieve net-zero emissions. In Poland, on the other hand, in order to match these EU targets, the following goals have been set: a 7% reduction in GHG emissions, a 21–23% share of RES in gross final energy

consumption, and a 23% increase in energy efficiency by 2030 compared to the PRIMES 2007 forecast (primary energy consumption baseline) [7]. The desire to achieve these goals is related to the need to give up fossil fuels and technologies using this energy carrier, the need to increase consumption of renewable energy sources, and the desire to improve the competitiveness of EU economies. In addition, there is a need for a major investment effort, especially by countries that use coal as an energy carrier to a large extent. This raises the issue of rising energy prices for these reasons, the issue of energy security, and the question of ensuring that end users have access to energy at affordable prices. Lack of such access threatens energy poverty. This access can be disrupted both by a lack of sufficient energy resources and a lack of financial resources to purchase energy carriers. As González-Eguino [8] points out, in developed countries, including EU economies, energy poverty is most often associated with the latter situation.

The issues of energy poverty and fuel poverty are increasingly being discussed in the literature [9,10]. In this study, the focus is on fuel poverty. This term is not the same as energy poverty. Energy poverty usually refers to energy access issues and usually concerns developing countries. Fuel poverty, which is the subject of this paper, is related to the financial difficulties of covering the expenses for energy carriers, which are becoming increasingly expensive. The literature review indicated that the phenomenon of fuel poverty is not clearly defined. The author started from the approach that the financial capacity of households is decisive. Therefore, following Boardman [11], the author of this study assumes that the energy poor are those households in which the expenditure on energy carriers per person exceeds 10% of their disposable income. The analysis of existing research indicates that the literature is more often concerned with the essence or definition of energy and fuel poverty [12–15], how to measure energy and fuel poverty [16–18], the level of fuel poverty [19], the impact of heating expenditure on fuel poverty [20], territorial diversity of this phenomenon [21,22], the influence of cultural dimensions [23], and ethnic fractionalization [24]. The COVID-19 pandemic has also generated interest in the issue of fuel poverty in the context of the impact of the pandemic on fuel poverty levels [25,26]. The COVID-19 disease has resulted in a widespread renewed interest in affordable access to energy services [27]. Despite interest in this topic, the literature has still not developed a uniform definition of fuel poverty [28], and thus a uniform, universally accepted way of measuring it. However, the importance of this issue is pointed out from a social and economic point of view because fuel poverty has many implications: it affects health, productivity, educational and earning opportunities, social relations [29–31], and has a negative effect on GDP [32].

Despite the importance of this issue in the socio-economic life of societies, governments are reluctant to deal with this issue, as evidenced by the small number of countries that conduct policies oriented directly at reducing fuel poverty or supporting such policies [33,34]. Hence, most often the actions of the state supporting the fight in this phenomenon take place indirectly through the conduct of other types of industrial policy or broadly understood social policy. This is the case, among other places, in Poland, where there is no such policy to support fuel-poor households or to eliminate fuel poverty. Economic policy may affect the scale of fuel poverty, e.g., through support for fuel poor households [35]. The literature indicates the relationship between macroeconomic policy and energy prices [36,37]. These in turn affect the economy [37] and the level of social well-being, as well as fuel poverty [25,38]. As pointed out, there is a relationship between governance economic development, and quality of life [39]. It can therefore be presumed that macroeconomic policy instruments (fiscal and monetary) also affect the energy poverty of a country. Therefore, it is worth examining the relationship between macroeconomic policy and the fuel poverty rate (FPR). The aim of the paper is to assess the importance of macroeconomic policy instruments in reducing fuel poverty on the example of Poland. The specific objectives are: (1) to estimate the fuel poverty rate in Poland in the studied period, (2) to review the literature and identify potential factors that may determine fuel poverty, and (3) to analyse the impact of state policy instruments in reducing fuel poverty in Poland.

Under this objective, it will be examined whether and how the government influenced this phenomenon (directly or indirectly), through which instruments, and which instruments (fiscal, monetary or energy-climate policy) played the most important role in shaping the scale of fuel poverty in Poland, with emphasis on the role of monetary and fiscal policy instruments. Therefore, the following research questions are posed in this paper:

1. What is the fuel poverty rate in Poland during the studied period? Has it changed, and if so, what caused the change in the fuel poverty rate in Poland?
2. Does monetary policy have an impact on fuel poverty?
3. Which type of economic policy (fiscal, monetary or energy-climate) and its instruments play a more important role in shaping the fuel poverty rate in Poland?

The analysis covers the period from 2004 to mid-2021, i.e., since accession to the EU, which means that the study period also includes the already implemented directives on common internal market rules of 2003 for electricity [40] and gas [41] and then those of 2009 [42,43], which suggested for the first time that EU Member States should pay attention to the issue of fuel poverty.

The research conducted here differs from previous papers published on similar topics. This paper concerns the analysis of the impact of macroeconomic policy, i.e., both fiscal policy and monetary policy, on the fuel poverty rate in Poland. The issue analysed in the article will provide added value to the literature for several reasons. Firstly, Poland is not a thoroughly researched country. So far, the literature has studied the central and eastern Europe regions as a whole [44] and selected countries of the region, e.g., Bulgaria [45] and the Czech Republic [34]. However, only a few publications refer directly to Poland. The first concerns a research period 20 years ago [46], the second only concerns the measurement of the scale of fuel poverty for 2012–2016 and without undertaking an analysis of influencing factors [47], and another study concerns the territorial differentiation of fuel poverty [48]. By conducting this study, the author has provided new data on both the scale of fuel poverty and the factors shaping this phenomenon in Poland. Secondly, the topic addressed in this article is not thoroughly studied in the literature. The literature has examined the impact of fuel poverty on different aspects of socio-economic life and the impact of energy prices and energy-climate policies on fuel poverty (additionally analysing the impact of taxes on energy products). In the literature, one can find works on the impact of energy policy, energy prices, especially electricity, and taxation (most often energy taxation) on fuel poverty. However, the impact of instruments related to fiscal and monetary policy, i.e., macroeconomic policy, on fuel poverty has not yet been analysed. There are no studies that consider the complex impact of macroeconomic policy on fuel poverty, including elements related to energy and climate policies, so this study is not limited to analysing the impact of only one instrument (such works are found in the literature). While social benefits have been mentioned a few times in the literature, the issue of monetary policy has never been addressed. There are no studies on the impact of monetary policy, including individual policy instruments such as short-term interest rates, long-term interest rates, currency in circulation (outside banks), and money supply. Since, as Che and Jiang [49] point out, financial spending has a significant positive impact on fuel poverty alleviation, it can be presumed that monetary policy instruments may also play a role in driving fuel poverty mitigation policy. Thus, this manuscript will, on one hand, provide information on the impact of monetary policy instruments on this phenomenon and, on the other hand, provide scope for a new line of future research in the area of this topic.

The work structure is as follows: In the first part, a review of the literature was carried out in terms of the essence of the phenomenon of fuel poverty and the actions taken by EU bodies in relation to fuel poverty. The next section presents the methodology of the research and analyses the actions taken in Poland to combat this phenomenon, while the next section presents the research results for Poland. The last part of the study is a summary, which is a set of conclusions and recommendations.

2. Literature Review

2.1. The Essence and Means of Measuring Energy and Fuel Poverty

No one needs to be persuaded that energy is essential for human life and every citizen would like to have free access to it. Without it, we would not be able to carry out most of our daily activities and the economy would not develop. Worldwide, and especially in the European Union, climate protection is an increasingly important topic in the political and social debate, hence the issues of access to energy, the price of energy, and the related issue of fuel poverty. The literature is not clear in defining the essence of this phenomenon [28]. The classic definition, the one most frequently referred to in the literature, is the definition given by Boardman [11], according to which the energy-poor entities are those who spend over 10% of their income on all energy services. Similarly, fuel poverty is defined in Ireland, France, and the United Kingdom, where it is defined as the "inability to afford adequate warmth in a home, or the inability to achieve adequate warmth because of the energy inefficiency of the home", "difficulties in the accommodation in terms of energy supply related to the satisfaction of elementary needs due to the inadequacy of financial resources or housing conditions" or as "the affordability to keep home adequately warm at a reasonable cost" [14] (p. 421). Energy poverty [50] and fuel poverty [13] are treated in economic and social terms as a lack in funds to meet energy needs, i.e., electricity, heat, and gas. As González-Eguino [8] noted, this understanding of fuel poverty is characteristic of developed economies.

However, as Day et al. [28] (p. 260) stresses, energy poverty can also result from "an inability to realise essential capabilities as a direct or indirect result of insufficient access to affordable, reliable and safe energy services, and taking into account available reasonable alternative means of realizing these capabilities". In particular, manuscripts relating to developing or economically underdeveloped countries emphasise this feature, i.e., the inability to meet energy needs [51]. Hence, energy poverty is also defined as "the point at which people are using the bare minimum energy needed to sustain a healthy life" [12] (p. 2). An example of such an approach to the essence of energy poverty and its measurement as a lack of access to energy are the studies presented by the IEA [52] and Khanna et al. [53]. In these cases, energy poverty is treated as the lack of the access to electricity, to modern cooking systems, or to lighting. As Hesselman et al. [27] (p. 1) note, COVID-19 "gave shape to important concerns about some households' too minimal (insufficient) forms of modern energy access". This is primarily regarding the lack of attention given to clean (renewable) energy services. This indicates, therefore, that energy poverty can be understood not only in terms of access to energy carriers as a means of satisfying energy services as a whole, but only in relation to specific fuels or green energy. It should be added that energy/fuel poverty affects developing countries and advanced economies differently. Households in developing countries are the main target groups for energy poverty [54] (p. 477). It should also be noted that the literature distinguishes between two concepts in relation to energy/fuel poverty: fuel poverty and energy poverty. The literature often uses both as synonyms, although as pointed out by Li et al. [54] and Castaño-Rosa et al. [55], this is a mistake, as they are different concepts. As indicated by Lowans et al. [56], the term fuel poverty has been used since the 1970's and has historically been associated with uncertainty and inequality in fuel/energy supply. In turn, this term has been widespread since 1991 with the emergence of the definition formulated by Boardman [11], according to which it is the situation when a household's fuel expenditure on all energy services to achieve a satisfactory indoor temperature are greater than 10% of its income. As Primc et al. [57] point out, the concept of fuel poverty has historically been associated in the literature mainly with developed countries and this concept is most commonly used in the UK and refers to the affordability of energy. As Guertler [58] notes, it "refers to the inability of a household to afford a socially and materially necessitated level of domestic energy supply" [59] (p. 3). In addition, the concept of fuel poverty is often applied to research on rural electrification and the untapped potential of renewable sources in developing countries for electricity generation. In contrast, the concept of energy poverty tends to

dominate research in developing countries and is concerned with energy access issues and institutional–infrastructural development [57,60]. Households in developing countries are the main target groups for energy poverty. Therefore, it mainly affects people living in Africa, India, and other developing countries in Asia and Latin America. It is different in the case of fuel poverty, which concerns developed countries with higher per capita income levels. Here, the problem is not access to energy, but the difficulty of financing expenditure on energy fuels which are becoming increasingly expensive. There is also variation in the level of fuel poverty within economically developed regions, such as the European Union. As pointed out by Rodriguez-Alvarez et al. [61] (p. 9), "countries with higher economic development (measured by per capita income) and more egalitarian countries have a lower incidence of fuel poverty".

The definitions of energy/fuel poverty presented above indicate that this phenomenon has a significant impact on the quality of life in society, especially as related to the socio-economic development of the whole society [62]. However, it is worth adding that energy poverty is not only associated with a lack of possibility to use energy services or a negative impact on household budgets in the form of high spending on energy carriers, but it also causes other side effects, including poor health, reading difficulties [10,29,63], and reduced earning opportunities [10]. Additionally, as indicated by the experience of households during the COVID-19 pandemic, people experiencing energy poverty in general reveal problems with access to free outdoor spaces or limited access to such spaces due to energy poverty [26].

Such a diversity of definitions of this phenomenon and the potential externalities of its occurrence causes energy poverty to be measured in the literature using many different measures [16]. One such measure is the household or population's access to energy carriers indicator [28] and within this framework, more specific indicators such as access to electricity, access to gas, and access to heat. Another group of measures are those relating to financial capacity. The most popular is based on the definition formulated by Boardman [11]. According to it, fuel poverty is measured as the percentage of people whose energy expenditure exceeds 10% of their income [13,14,25,64]. Another measure in the same group is the share of energy expenditure and annualised cost of end-use equipment in the total household budget [65]. Another is the stochastic model of energy poverty, created by Papada and Kaliampakos [66], taking into account the cost of heating, cooling, electricity, and domestic hot water. The literature also uses multidimensional indicators of this type, i.e., the energy access–consumption matrix [67] or the multidimensional energy poverty index [51]. There are also more elaborate indicators, which take into account several factors in their structure. One such example is the energy development index created by IEA [68], which combines access to electricity and commercial energy consumption (per capita and share in total energy use). Such measures take into account more aspects of energy poverty; however, the disadvantage of such complex indicators is the difficulty of measuring them and comparing them over time or between countries.

Meanwhile, in the European Union, the EU Energy Poverty Observatory does not use a single universal measure, but a set of four measures that examine the various dimensions of energy poverty or, more specifically, its effects. These are [2] (p. 5):

- A high share of energy expenditure in income (2M), that measures part of population with share of energy expenditure in income more than twice the national median;
- Hidden energy poverty (HEP), which shows the part of population whose absolute energy expenditure is below half the national median;
- An inability to keep the home adequately warm, based on self-reported thermal discomfort of households;
- Arrears on utility bills, which measures the inability of households to pay utility bills on time in the last 12 months.

The multiplicity of indicators for measuring energy and fuel poverty is often problematic. As Deller, Turner, and Price [69] point out, the use of different commonly used indicators can imply different targeting policies used by the government to mitigate this

phenomenon. Moreover, they can often target different social groups and do not necessarily have a positive impact on reducing fuel poverty.

2.2. Determinants of Fuel Poverty and Policies to Reduce It

In order to limit the occurrence of this phenomenon, there is a need to identify its sources. The most frequent indications for such factors are low income or generally poor overall socio-economic situation of the household, high energy costs, and low energy efficiency [15,17,70]. It has also been pointed out that the fight against this phenomenon is hampered by the fact that it is territorially diverse [22,71], i.e., it is highly spatially diverse with higher prevalence of fuel poverty in urban areas. This results in the instruments used by the state being either badly targeted or the mitigation measures being applied with an overly reduced budget. However, the government should not abandon its policy of influencing fuel poverty because, as Che and Jiang [49] point out, analysing political and economic uncertainty, the financial expenditure that the government spends has a significant positive impact on alleviating fuel poverty. Moreover, this impact is felt more in emerging economies than in developed economies. Confirmation of the fact that state policies can affect fuel poverty is provided by Fragkos et al. [72] and Dong, Ren, and Zhao's [73] studies on the implications of climate policies. The results of the Fragkos et al. [72] study showed that the transition to climate neutrality may, among other things, increase fuel poverty, especially in low-income households. This may be accomplished through the impact of this policy on increasing income inequality. As they point out, the European Commission, by pursuing a policy of reducing emissions, is indirectly influencing the taxes on energy products, which may increase the risk of fuel poverty. Of course, the aim is not to increase but to reduce fuel poverty. Therefore, they note that through tax policy and social transfers, this negative impact can be neutralised. In contrast, Dong, Ren, and Zhao [73] argue that by implementing low-carbon energy transition in an appropriate way, fuel poverty alleviation can be stimulated. Admittedly, the conclusions of the two studies are largely contradictory, but they do show that state policies can indirectly affect fuel poverty.

How do we fight fuel poverty? Most often, the literature indicates the need to influence the level of energy expenditure. It has been pointed out that rising energy prices increase household spending, and thus push part of the population into fuel poverty as they do not have enough money to pay for energy. Therefore, energy policy measures [33] or reforms in the area of energy price subsidies may be useful [31]. In view of the growing role of climate change, Berry [21] proposes, for example, a regressive carbon tax. Scarpellini et al. [33] propose to reduce various types of taxes and charges, the share of which in the prices of energy carriers is constantly increasing as a result of energy and climate policy. It has been proposed that a unified and more robust (not sham) policy be taken to support the fight against energy poverty [33,34,45]. It has also been noted that monetary policy can be an instrument to stimulate economic growth, but can also influence the prices of energy carriers [36,37], which consequently affects the level of spending on energy carriers. Moreover, the literature indicates that there is a relationship between household income and level of poverty [25,74]: the higher the income, the less likely it is to be fuel poor. In addition, it is stressed that this phenomenon most often concerns people with the lowest incomes [75], while where social policies play an important role, energy poverty is usually low [76].

What is the policy on this issue in the European Union, where Poland is also a member? Activities in this area began at the end of 2009, when Directives 2009/72/EC [42] and 2009/73/EC [43] were adopted. These directives recommend that EU Member States start to develop national action plans to combat fuel poverty, ban disconnection of "vulnerable consumers" from the grid (i.e., people on low incomes), and improve energy efficiency in housing. However, as those were only recommendations, as indicated by Scarpellini et al. [33] (p. 730), such "the EU approach has led to some fragmentation in member States' actions concerning fuel poverty". As practice has shown, this was the wrong approach

by the European Commission, relying only on recommendations instead of introducing obligatory regulations in this area. Additionally, the focus was mainly on energy poverty instead of fuel poverty. As a result, most EU countries have only focused on the last two instruments and have either ignored this phenomenon or have seen it as a social phenomenon not linked to energy services. Only four countries have officially defined energy poverty or fuel poverty: Ireland, France, Slovakia and the United Kingdom. In addition, Belgium and Romania have developed policies directly aimed at supporting fuel poverty. There is either a lack of such actions in the other Member States of the European Union or it is the result of measures being used as part of other economic activities of governments. The absence or inadequacy of such policies in most EU countries is confirmed by numerous studies in the literature [33–35,45]. For example, the need for such a policy is suggested in a study by Rodriguez-Alvarez, Llorca, and Jamasb [61], which showed that financial assistance targeting vulnerable groups, lowering energy prices, and improving energy efficiency have a positive impact on reducing fuel poverty in most European countries. The need to develop the implementation of a specific policy for this phenomenon was also highlighted by Kyprianou et al. [35]. Their analysis of five EU countries indicated that the only action that governments had done was to transpose parts of EU legislation that refer to vulnerable consumers. This has resulted in confusion between the terms "energy poverty" and " vulnerable consumers " and a diversity of definitions of this phenomenon [35] (p. 54).

A change in the approach to fuel poverty should take place in the coming years as a result of the entry into force of some of the eight pieces of legislation from the so-called *Clean Energy for all Europeans* [77]. The idea of the actions the European Union authorities want to take with regard to fuel poverty is outlined in the documents developed by the European Energy Network in 2019 [2] and the European Commission in 2020 [78]. These documents diagnosed that fuel poverty is a result of low income, high energy expenditure, and low energy efficiency. In addition, people living in energy-inefficient buildings were found to be more vulnerable to the effects of climate change. Through the authorities' efforts to achieve climate neutrality and promote clean energy and through the development of the internal energy market, the issue of fuel poverty has been indirectly regulated by law. It obliges EU Member States to pursue policies to combat fuel poverty. The activities recommended so far by the European Commission, e.g., improving the energy efficiency and energy performance of buildings, have also been given the opportunity to regulate energy prices for vulnerable households. Furthermore, Member States have been required to monitor the number of households in fuel poverty and to include this phenomenon in their national indicative targets. This is also supported by the findings and recommendations indicated by the literature [79], according to which these commitments should be translated into concrete actions by the authorities. In addition, a new institution, the EU Energy Poverty Observatory, has been established to monitor this phenomenon in the EU. This is a step in the right direction, because at last it has been legally indicated that there is such a socio-economic phenomenon as fuel poverty and how it can or should be defined. In addition, the European Commission has decided to exchange experiences and good practices between EU members. Therefore, the Commission has increased funding for projects tackling energy and fuel poverty through the Horizon 2020 Energy Efficiency Call, among other such measures.

In Poland, as in most EU countries, fuel poverty is not regulated (in terms of instruments to monitor or influence its level) or even defined. The basic legal act in Poland in the field of energy policy is the Energy Law Act [80], which unfortunately does not contain any regulations on fuel energy. The EU directives on energy policy [42,43] only resulted in the 2013 amendment of the hitherto existing Energy Act [81] to introduce the concept of a "vulnerable consumer" and a system of protection against grid disconnection. Admittedly, fuel poverty is still not regulated. Despite the lack of a definition, the phenomenon of energy poverty has slowly began to be regulated. In later years, through other legislation, indirect references to fuel poverty began to be made (despite the fact that the phenomenon

is still undefined). In 2015, through the Act of Social Assistance [82], an energy allowance began to be granted to cover the poorest households with a part of their bills related to energy costs. Additionally, through an amendment to the Act on Thermal Modernisation in 2018 [83], subsidies began to be paid in Poland for the costs associated with insulating buildings. Still, neither of these pieces of legislation address fuel poverty, which should be considered as a drawback; however, they make it easier for people to avoid being energy poor and mitigate the effects of remaining in this state, which is one of the pros of these measures.

3. Materials and Methods

The previous section of this paper reviewed the literature and analysed the actions taken by the EU in relation to fuel poverty. This allowed for the identification of potential factors that could determine fuel poverty. In the next part of this study, the author intends to examine the impact of macroeconomic policy instruments on the scale of energy poverty in Poland. For this purpose, the following stages of the study will be carried out:

1. Estimation of the fuel poverty rate in Poland from 2004 to mid-2021;
2. Development of a model to analyse the impact of macroeconomic policies on fuel poverty;
3. Create a regression model to analyse the factors (independent variables) determining the level of fuel poverty in Poland (independent variable Y);
4. Analysis of co-correlations between macroeconomic policy instruments and climate and energy policy;
5. Analysis of electricity and gas price developments and decomposition analysis of these prices in Poland in the studied period;
6. Analysis of the impact of macroeconomic policies (including fiscal and monetary policies) on fuel poverty using regression analysis;
7. Interpretation of the results.

The author uses the definition set out in the Introduction section, according to which the fuel poor are those households whose per capita expenditure on energy carriers exceeds 10% of their disposable income. As Sharma et al. [75] pointed out, poverty mainly affects people with the lowest incomes, so the author differentiated consumers by quintile groups (for households) and estimated the share of spending on energy carriers in disposable income for each of the income groups (quintile groups). Next, the groups of households for which the values of this indicator were above 10% per person were determined, which simultaneously made it possible to determine people susceptible to fuel poverty. Knowing the distribution of the structure of these incomes for decile groups (average income of person in households), the author estimates the fuel poverty rate in Poland for each year. The article assumes that the research period is from 2004 to mid-2021, with a time series that is semi-annual. This ensures that this paper consists of 35 observations, which ensures that the statistical analysis is reliable. The object of study, Poland, was a deliberate choice. This is due to several reasons. First, the author did not have enough data for other countries (data for Poland were more recent). Second, Poland is the largest representative of central and eastern Europe as well as a representative of the European Union. Third, there were no such studies for Poland. There were studies for Bulgaria, the Czech Republic, and partially for Romania, but only with respect to fiscal policy. In turn, the research scope from 2004 is due to three reasons. Firstly, the data for analysis came from Eurostat, OECD, and the Central Statistical Office in Poland (despite different data sources, data were comparable). Hence, the need for availability and comparability of data determined such a time range of research (this premise limited the possibility of extending the research period). Secondly, this is the period since Poland joined the European Union, adapting its legislation. Thirdly, during this research period, directives on the common energy and gas market were already in place, which significantly shaped energy policy in the countries of the European Union, including Poland. As the literature review indicated, energy policy influences the price of energy carriers and can therefore also affect the fuel poverty rate. In addition, in the context of fuel poverty, it is worth mentioning that the research period also covered the

implementation of Directives 2009/72/EC [42] and 2009/73/EC [43], which were the start of the European Union institutions' efforts to support the fight against energy and fuel poverty.

The literature review indicated that among the factors that may determine the level of fuel poverty are the level of expenditure on energy carriers and the level of income. The importance of the role of energy policy and associated energy prices is pointed out by Scarpellini et al. [33], Recalde et al. [70], and Pacudan and Hamdan [31]. Meanwhile, the importance of income and economic growth is indicated by Sharma et al. [75] and Nagaj and Korpysa [25], among others. The lower the income and economic growth the higher the level of fuel poverty. Beyond these determinants, the literature strongly emphasises the role of climate change and clean energy spending [21,27]. In this context, Hesselman et al. [26] noted that COVID-19 has resulted in a lack of attention on the part of governments in supporting renewables. And as they add, the right to access renewable energy sources is now one of the basic rights of households. Hence, in the context of studying fuel poverty, the share of energy from renewable sources is an important factor. In addition, the literature indicates [49,72,73] that energy and climate policies themselves can affect citizens' incomes, just as economic prosperity affects the amount of energy consumed and the environmental impact of sectors [84]. For this reason, when establishing a list of independent variables affecting fuel poverty, it is important to keep in mind the interdependence between factors.

As indicated in Section 2.2, the government, through its various measures, influences the scale of fuel poverty, mostly indirectly. The literature here mainly points to taxes [21,33,72], various subsidies, and social benefits [30,74]. Since the literature draws attention to the role of income and GDP growth [25,74], and monetary policy is one of the two basic macroeconomic policies determining GDP growth, the author included instruments related to monetary policy in the analysis, e.g.., changes in money supply and interest rates, among the potential factors that could determine fuel poverty in Poland (as well as in other EU countries.

Figure 1 presents the author's model for analysing the impact of government policy instruments in reducing fuel poverty in Poland. It is assumed that the government impact on fuel poverty through instruments is cumulative of the following policies: energy and climate policy, fiscal policy, and monetary policy. Therefore, the factors considered in the analysis are: those related to energy and climate policy, e.g., share of renewable energy sources in energy consumption and prices of the energy carriers (electricity and gas); fiscal policy measures, e.g., social benefits and taxes (share of taxes and levies in electricity and gas prices, share of taxes in GDP); and instruments applied in the framework of monetary policy, e.g., the change in money supply, the change in the amount of cash in circulation (due to the fact that since poverty occurs in the groups of people with the lowest income, so the form of money supply that went to them and influenced them is mainly cash money) and the level of interest rates (short and long term). The author would like to add that the potential impact of GDP on fuel poverty, as indicated by the literature, has been omitted from the factors. This is because macroeconomic policy measures (fiscal and monetary) determine GDP growth, hence they are highly correlated with real GDP change; thus, this variable must be omitted from the list of potential fuel poverty independent variables used in the regression analysis.

Of course, it should be noted that there can be interdependencies between macroeconomic policy and climate and energy policy, or all of them can determine a given phenomenon (e.g., energy prices can be influenced by both monetary policy and energy policy). Therefore, if the correlation analysis that precedes the regression analysis finds statistically significant high correlations between factors from each of these policies affecting energy poverty, these independent variables will be excluded from the regression analysis.

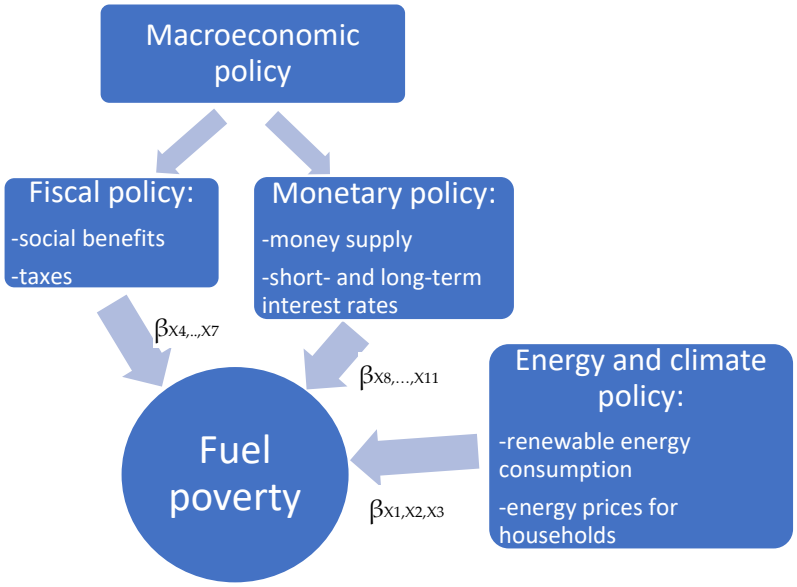

Figure 1. Model for analysing the impact of macroeconomic policy on fuel poverty.

Finally, among the potential factors (independent variables X1–X11) determining the level of fuel poverty in Poland (independent variable Y), eleven variables were identified (the source of access to data is given in brackets):

X1 share of energy from renewable sources (Source: Central Statistical Office in Poland; Eurostat);
X2 electricity prices for household consumers—band DB (Source: Eurostat);
X3 gas prices for household consumers—band D2 (Source: Eurostat);
X4 social benefits to households as % of GDP (Source: OECD);
X5 share of taxes and levies in electricity prices for household consumers (Source: Eurostat)
X6 share of taxes and levies in gas prices for household consumers (Source: Eurostat)
X7 tax revenue as % of GDP (Source: Eurostat);
X8 change in currency in circulation (Source: Central Statistical Office in Poland);
X9 change in money supply (Source: Central Statistical Office in Poland);
X10 long-term interest rates—referring to government bonds maturing in ten years (Source: OECD);
X11 short-term interest rates—based on three-month money market rates (Source: OECD).

The first three independent variables relate to the impact of climate and energy policy, and four each to fiscal and monetary policy. The Pearson correlation coefficient and graphical analysis were used to analyse the relationship between the fuel poverty rate and the potential impact factors. It was used to determine which factors show a statistically significant relationship with the fuel poverty rate and what are the correlations between the independent variables. This made it possible to determine which variables have a statistically significant correlation with the dependent variable and to remove independent variables that show a high correlation with each other. The correlation analysis will thus allow the proper selection of independent variables for the regression analysis. The causality inference itself in this study will be carried out on the basis of regression analysis.

Based on the proposed model and the proposed independent variables, a multiple regression equation was constructed:

$$Y = a + \beta_1 \cdot X_1 + \beta_2 \cdot X_2 + \ldots + \beta_n \cdot X_n, \quad (1)$$

where:

Y—fuel poverty rate (dependent variable);
a, β_1, β_2, . . . , β_n—parameters and coefficients of the regression function (n = 1, . . . , 11);

X_1, X_2, … X_n—independent variables affecting the dependent variable during the period under consideration (n = 1, … , 11).

The results of the regression analysis indicate which variables have a statistically significant impact on the level of fuel poverty in Poland. This will allow us to answer the questions of whether monetary policy has an impact on fuel poverty and which type of economic policy (fiscal, monetary, or energy-climate) and instruments within them play a more important role in shaping the scale of fuel poverty in Poland. Statistica 13.3 software (TIBCO Software, Dublin, Ireland) was used for statistical calculations, and the data for the calculation covered 35 periods, i.e., 2004–mid-2021, with data for each half-year in the studied period. The author would like to add that the time series used in the regression analysis are stationary, with no trend or seasonal effects. Additionally, they are characterised by a rather high variance of observations.

4. Results

First of all, in accordance with the methodology it was calculated how the expenditure on energy carriers and the level of fuel poverty evolved in quintile groups in the research period. The results of calculations concerning the share of expenditures on energy carriers in disposable income in households per one person and the rate of energy poverty in Poland are presented in Table 1.

Table 1. Share of expenditure on energy carriers in disposable income per person in households by quintile groups and the fuel poverty rate in Poland in 2004–mid-2021.

Specification	Share of Expenditure on Energy Carriers in Disposable Income (in %)					Fuel Poverty Rate (in %)
	Quintile Group					
Year	1	2	3	4	5	
2004	-	-	-	-	-	34.7
2005	31.02	16.96	12.32	9.08	4.99	34.9
2006	32.14	17.58	12.77	9.41	5.17	35.1
2007	27.44	15.32	11.29	8.43	4.54	35.7
2008	28.08	15.27	11.29	8.45	4.66	35.9
2009	29.90	16.02	11.81	8.79	4.90	35.9
2010	29.62	16.63	12.26	9.13	4.98	35.7
2011	31.91	16.79	12.37	9.25	5.08	35.6
2012	31.78	16.65	12.16	9.07	4.98	35.5
2013	33.08	16.73	12.12	9.08	4.97	35.5
2014	29.60	15.19	11.04	8.27	4.71	36.1
2015	27.99	14.58	10.70	8.08	4.61	36.4
2016	22.40	12.74	9.72	7.49	4.42	20.7
2017	19.64	11.97	9.26	7.21	4.23	21.6
2018	18.73	10.98	8.49	6.64	3.87	21.4
2019	17.75	10.10	7.80	6.12	3.63	21.4
2020	19.13	9.64	7.37	5.81	3.42	13.3
mid-2021	20.33	9.61	7.31	5.84	3.20	15.4

The data in Table 1 show that the energy poor are mainly people from the first and second income quintile groups, i.e., their expenditures on energy carriers were more than 10% of their disposable income. Until 2015, households in the third decile group also belonged to the energy poor. Analysis of the share of expenditures on energy carriers

in household income indicated that the higher the income quintile group, the lower the percentage of these expenditures. In the studied period, these shares between the first and fifth income quintile groups differed by 4.6–6.7 times. By 2010, the share of these expenses in the first quintile group was about 6.0–6.2 times higher than in the fifth quintile group. In the following years until 2013, this variation increased to a level of 6.7, decreased to a level of 4.6 in 2017, and then increased again to 6.4 in mid-2021. As such, during the period under study there were variation and changes in the importance of expenditure on energy carriers in household disposable income. The analysis of data over time also indicated that with the exception of the first quintile group, expenditures on energy carriers were the biggest burden on revenues in 2011. In the group of people with the lowest income, i.e., the first quintile group, the share of expenses on energy carriers in income was the highest in 2013. It also found that these burdens declined from 2014 to mid-2020 across all income groups in Poland, and began rising again in the final research year. However, despite this downward trend, people with incomes from the first and second quintile groups were energy poor throughout the entire 2004–mid-2021 study period (in the first part of 2020, only people in the first quintile income group). This was different than the people from the third quintile group, because the changes that were taking place caused them to belong to the energy poor until 2015, but since 2016 they have already fallen out of this group.

Changes in the share of energy expenditure in income in Poland were also reflected in the development of the fuel poverty rate. In 2015, the fuel poverty rate ranged between 35.5% and 36.4%. In 2016, there was a sharp drop in this rate in Poland by 15.7 percentage points and it already remained between 20.7% and 21.6%. In mid-2020, that rate again fell by eight percentage points before starting to rise to above 15% in mid-2021. What caused such changes in the level of fuel poverty in Poland? To answer this question, it is necessary to analyse the actions taken by the state with regard to fuel poverty and conduct regression analysis.

The first activities related to support for the policy of reducing fuel poverty in Poland were undertaken in 2013 [81], when the notion of a "vulnerable recipient" was defined and a system providing them protection against disconnection from the grid was introduced. The last action was additionally supported by introducing a social energy benefit granted to persons receiving housing benefits in 2014. All of these activities were carried out on the occasion of the amendment to the Energy Law Act to implement the provisions of the 2009 liberalisation directives for electricity [42] and for gas [43]. However, it was not decided to introduce a definition of energy or fuel poverty into energy law; to date, this has not been done.

Indirectly, however, the concept of an energy-poor household was defined. This was done in the amendment to the Act on Thermo-Modernisation [83], introducing the so-called thermo-modernisation relief. This was part of the government's efforts to improve energy efficiency and combat climate change, the priorities of which were outlined to member states by the European Commission [77].

Summarizing the actions taken by the state with regard to fuel poverty, it should therefore be stressed that in Poland, unfortunately as in most EU countries, no separate, comprehensive policy of reducing fuel poverty has been created. What has caused fuel poverty to fall in Poland? The instruments that were used are therefore only indirect, i.e., they are either related to the conducted energy and climate policy or macroeconomic policy. Correlation and regression analysis will be used to determine which factors, and thus which types of government policies, have influenced the reduction in fuel poverty in Poland.

First, a correlation analysis was carried out. The results are shown in Table 2.

Table 2. Correlation matrix for the variables analysed *.

Variable	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11
X1	1.00										
X2	**0.84**	1.00									
X3	**0.61**	**0.77**	1.00								
X4	0.41	0.14	−0.27	1.00							
X5	**0.72**	0.51	0.09	0.59	1.00						
X6	**0.94**	**0.80**	0.52	0.50	**0.71**	1.00					
X7	0.41	0.14	−0.24	0.56	**0.77**	0.50	1.00				
X8	0.22	0.03	−0.19	0.49	0.23	0.33	0.49	1.00			
X9	−0.20	−0.35	−0.24	0.16	−0.01	−0.12	0.28	0.54	1.00		
X10	**−0.83**	**−0.68**	−0.37	−0.59	**−0.65**	**−0.85**	−0.53	−0.40	**0.91**	1.00	
X11	**−0.82**	**−0.75**	−0.41	−0.54	**−0.63**	**−0.78**	−0.37	−0.24	0.57	**0.91**	1.00
Y	**−0.74**	−0.56	−0.10	**−0.76**	**−0.84**	**−0.78**	**−0.73**	−0.44	−0.05	0.75	**0.73**

* Bold font indicates statistically significant correlation coefficients at $p < 0.05$.

The results of the correlation analysis showed that eight independent variables show a statistically significant correlation with the fuel poverty rate. Within this, seven variables (X1, X4, X5, X6, X7, X10, X11) showed high or very high correlation, i.e., above the value of 0.6: RES in final consumption, social benefits to households as % of GDP, share of taxes and levies in energy prices (electricity and gas), tax revenue as % of GDP, long-term and short-term interest rates. Among them, interest rates show a positive correlation with the fuel poverty rate, while the other independent variables are negatively correlated. It is worth noting that fiscal and monetary policy instruments predominate here. In the case of the climate and energy policy, a relatively strong correlation applies only to one component of this policy (one independent variable): the share of RES in final consumption.

A decomposition analysis of electricity and gas prices in 2004–2021 (Figure 2) shows that energy policy in Poland is weakly correlated with the fuel poverty rate, that it has little or no effect on the fuel poverty rate in Poland, and that taxes play a more important role than energy price changes. In the case of electricity prices, an analysis of the development of these prices over time (Figure 2 left panel) showed that until 2015, the rate of fuel poverty increased only gently when total prices increased. In 2016, the fuel poverty rate declined, despite stabilizing energy prices, while the fuel poverty rate fluctuated in 2019–mid-2021 despite rising electricity spending. Therefore, it difficult to conclude here that the fuel poverty rate in Poland was linked to electricity prices. On the other hand, taxes and levies were the main source of changes and increasing costs for households during the studied period. Their share of the total price in 2004–2021 increased from 22.7% to 44.4%. Although the fuel poverty rate fluctuated over the studied period, it is worth noting that when this rate fluctuated, the share of taxes and levies in the electricity total price was increasing. For gas (Figure 2 right panel), it is hard to detect any dependence. Additionally, the gas price decomposition analysis indicated that during the periods when the fuel poverty rate was changing (2016–mid-2021) the share of taxes and levies in the total gas price changed only slightly, from 18.8% to 20.0%. The analysis of the development of electricity and gas prices and a decomposition of these prices showed that energy prices were not the main determinant of the fuel poverty rate in Poland. The analysis of electricity and gas prices and their decomposition showed that energy prices were not the main determinant of energy poverty in Poland. What may have had a greater impact are changes in fiscal policy or, more broadly, macroeconomic policy.

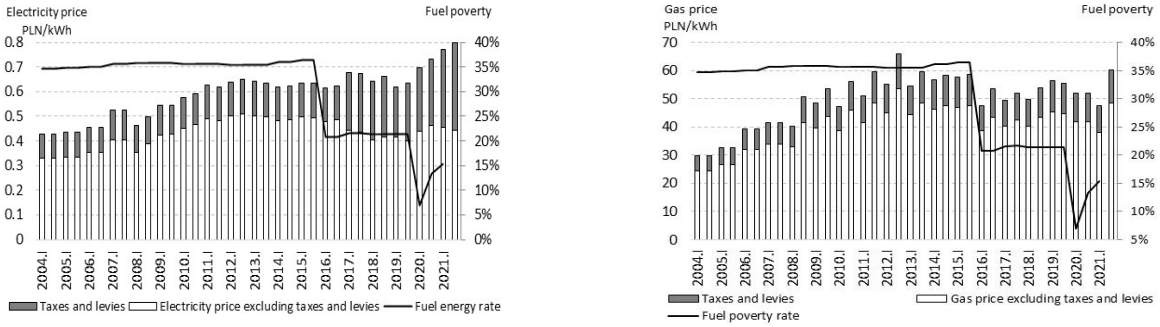

Figure 2. Decomposition of electricity and gas prices vs. fuel poverty rate in Poland in 2004–2021.

Regression analysis was used to determine the potential impact of fiscal and monetary policies on fuel poverty in Poland. The regression analyses used the independent variables that had a strong or very strong correlation with the fuel poverty rate, i.e., X1, X4–X7 and X10–X11. Additionally, the identification of factors will omit those relationships for which there is a statistically significant correlation between the independent variables. The results of the conducted regression analysis are presented in Table 3.

The results of the regression analysis indicated that the independent variables X1, X4, X5, X7, X11 were the factors (instruments of state policy) which showed significant statistical influence on the fuel poverty rate in Poland. However, correlation analysis (Table 2) indicated that there were strong intercorrelations between X1 vs. X5, X11, and X5 vs. X7, X11. Therefore, these dependencies (first, second, and fourth) will be omitted from the regression analysis. Ultimately, for this reason it should be concluded that the independent variables X4, X7, and X11 (social benefits to households as % of GDP, tax revenue as % of GDP, and short-term interest rates), had a statistically significant impact on the fuel poverty rate in Poland in 2004–2021. Social benefits and the tax burden have a negative impact on the FPR, while the short-term interest rate shows a positive effect. Importantly, regression analysis showed that the dominant influence is of fiscal policy instruments, especially social transfers. An increase in social benefits to households as % of GDP by 1 percentage point decreased the fuel poverty rate in Poland by 3.58 percentage points, while an increase in tax revenue by 1 percentage point of GDP decreased the fuel poverty rate by 2.29 percentage points. The relationship between these variables is well illustrated in Figures 3 and 4.

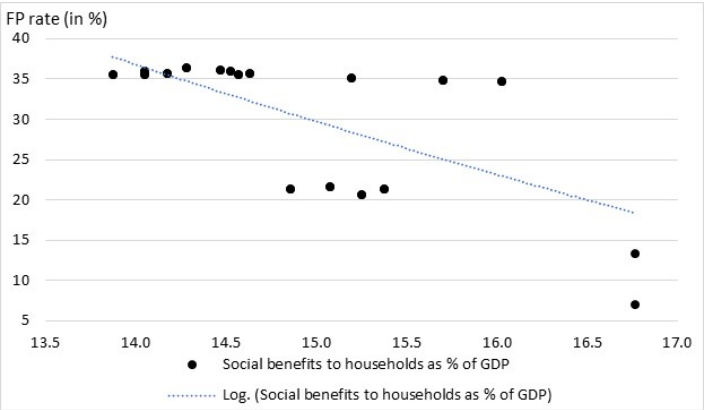

Figure 3. Fuel poverty rate versus social benefits to households in Poland in 2004–mid-2021.

Table 3. Results of regression analysis for independent variables that show a statistically significant correlation with the fuel poverty indicator.

	Coefficients	**Standard Error**	***t*-Statistic**	***p*-Value**
Regression analysis for independent variables X1, X4, X5				
n = 34	Regression statistics: R = 0.9158; R2 = 0.8387; Adjusted R2 = 0.8225;			
	F(3,30) = 51.980; $p < 0.00000$; Standard error: 3.4027			
Constant	110.1493	12.3137	8.9453	0
Variable X1	−0.9403	0.2896	−3.2463	0.0029
Variable X4	−3.6972	0.9021	−4.0986	0.0003
Variable X5	−57.4946	16.1346	−3.5634	0.0012
Regression analysis for independent variables X1, X4, X7				
n = 34	Regression statistics: R = 0.9280; R2 = 0.8611; Adjusted R2 = 0.8472;			
	F(3,30) = 62.004; $p < 0.00000$; Standard error: 3.1569			
Constant	171.0886	14.749	11.6	0
Variable X1	−1.3006	0.208	−6.2554	0
Variable X4	−3.9848	0.7877	−5.0587	0
Variable X7	−2.0320	0.4589	−4.4276	0.0001
Regression analysis for independent variables X4, X7, X11				
n = 34	Regression statistics: R = 0.9139; R2 = 0.8353; Adjusted R2 = 0.8188;			
	F(3,30) = 50.702; $p < 0.00000$; Standard error: 3.4383			
Constant	152.9918	17.6368	8.6746	0
Variable X4	−3.5825	0.8668	−4.1332	0.0003
Variable X7	−2.2891	0.4878	−4.6924	0.0001
Variable X11	2.0152	0.3789	5.3178	0
Regression analysis for independent variables X4, X5, X7, X11				
n = 34	Regression statistics: R = 0.9089; R2 = 0.8629; Adjusted R2 = 0.8440;			
	F(3,30) = 45.625; $p < 0.00000$; Standard error: 3.1904			
Constant	124.1709	20.24885	6.13224	0
Variable X4	−3.0609	0.8327	−3.6758	0.001
Variable X5	−42.9379	17.7648	−2.4170	0.0222
Variable X7	−1.2763	0.6168	−2.0690	0.0476
Variable X11	1.5344	0.404	−3.7979	0.0007

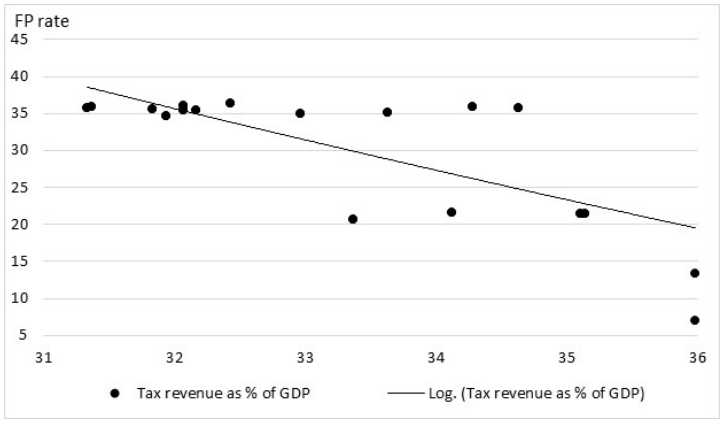

Figure 4. Relationship between fuel poverty rate and tax revenue in Poland in 2004–mid-2021.

Interesting findings concern the impact of tax burdens. Their impact on fuel poverty is negative (Figure 4). The occurrence of such a relationship should be associated with the fact that the higher the tax revenue in relation to GDP, the more resources the government has that can be allocated to social benefits to households.

The results of the regression analysis indicated that the short-term interest rates also have a statistically significant impact on the fuel poverty rate. This dependence is positive (Figure 5). Short-term interest rates are an instrument of monetary policy in Poland which, if measures are applied to reduce them, it results in a reduction in the fuel poverty rate. A change in the short-term interest rate by 1 percentage point resulted in a change in the fuel poverty rate by 2.02 percentage points.

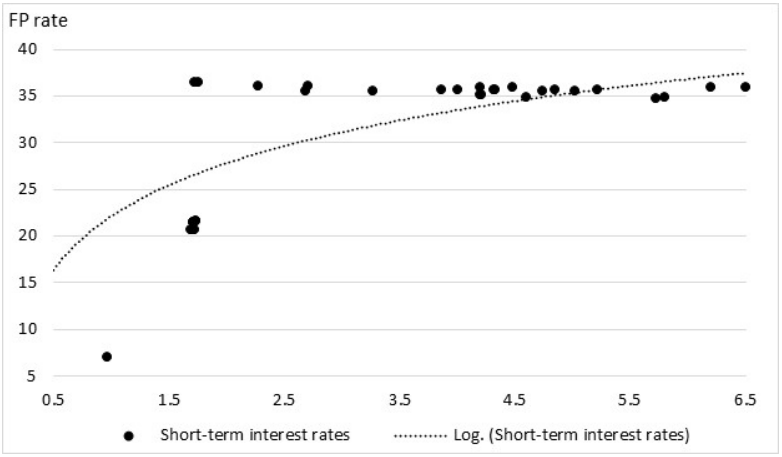

Figure 5. Relationship between fuel poverty rate and short-term interest rate in Poland in 2004–mid-2021.

5. Discussion

The subject of this work was fuel poverty, policy to combat this phenomenon in Poland, and the assessment of the importance of macroeconomic policy in reducing fuel poverty using the example of Poland. This was accompanied by an analysis of energy-climate, fiscal, and monetary policy instruments to determine which factors play the most important role in shaping the scale of fuel poverty in Poland. The literature review indicated that this is a highly relevant topic from a socio-economic perspective, and the increasing importance of energy, climate protection, and the ability to ensure the availability of energy services are in the public debate. It was found that the issue of fuel poverty is not thoroughly researched and unequivocal in terms of definition. Therefore, one should agree with Li et al. [54], Castaño-Rosa et al. [55], and Primc et al. [57] that much of the literature incorrectly uses the terms energy poverty and fuel poverty. Since the focus of this paper was examining the inability to consume energy carriers due to low energy affordability (too low household income), the term fuel poverty was used rather than energy poverty, as in Guertler [58]. This is opposite to, for example, Aristondo and Onaindia [14], Kyprianou et al. [35], and Zhao et al. [85]. It was also found that the main area of researchers' interest is the creation of measurement measures and analysis of territorial differentiation of this phenomenon. Moreover, while the literature analyses the relationship between GDP growth or energy prices and fuel poverty, there is no analysis of the impact of fiscal and monetary policy on the scale of this phenomenon. Therefore, the author undertook this task, performing an analysis using Poland as an example, for which there are generally few studies on energy or fuel poverty. In addition, Poland, as a representative of the European Union and one of the larger countries in the region, is a perfect example for such an analysis.

The analysis of the policies of the European Union countries in the field of fuel poverty reduction and its support has shown that a small number of countries have developed tools directly aimed at reducing this phenomenon. This is in line with the findings of Kyprianou et al. [35], that there is a lack of fuel poverty mitigation strategies and support for

affected households, especially those with low incomes, in EU countries. Therefore, actions supporting fuel poverty mitigation in this phenomenon most often take place indirectly through housing or energy-climate policy. It has been stated that it is similar in Poland, which was the area of interest of the author in this work. Therefore, when measuring the scale of fuel poverty, in accordance with the literature, the author has referred to the financial capacity of households to purchase energy services and supply [11,25]. The author's estimates indicated that the range of fuel poverty in Poland was at a high level and affected over 1/3 of households for most of the studied period. Although the conclusions on the nuisance of the phenomenon are similar to Karpinska and Śmiech [19], the level of fuel poverty was estimated at a slightly lower level. Moreover, it was stated that the phenomenon of fuel poverty concerned mainly people with the lowest income, i.e., from the first and second income quintile group. Thus, this is consistent with the results of Sharma et al. [75] on the existence of such a relationship. This situation was not even changed by the reduction in this ratio in 2016 and subsequently in 2020. People's expenditure on energy carriers is still several times (6.4 times) higher in the group of people with the lowest income (1st quintile group) than in the group of people with the highest income (5th quintile group).

The regression analysis and accompanying correlation and decomposition analysis of energy carrier prices showed that social benefits, tax revenue, and short-term interest rates had a decisive impact on the scale of fuel poverty in Poland in 2004–mid-2021. Thus, it is also partly consistent with the results of Primc and Slabe-Erker [76]. The similarity relates to finding that social policy, e.g., welfare benefits, plays an important role, and that this phenomenon most often affects those with the lowest incomes [75]. However, there are differences with respect to taxes. This is in line with the findings of Che and Jiang [49] and Nagaj [86] that government financial spending has a significant positive impact on alleviating fuel poverty. Similar to Fragkos et al. [72], it was also found that taxes imposed on energy products can increase the risk of fuel poverty. However, there are differences with respect to the total tax burden, as the author's results indicated that it may contribute to lower fuel poverty rate. However, it should be remembered that in the case of Poland, there is no policy directly aimed at reducing fuel poverty, and thus the instruments used by the government are aimed at a different goal, namely social policy and economic development. Thus, the instruments used by the state may not be properly addressed from the fuel poverty point of view. This study also showed that energy policy and its instruments (taxes and levies in electricity prices) can also negatively affect the fuel poverty scale. However, due to the fact that in Poland taxes in energy prices are highly correlated with fiscal policy (as confirmed by the high correlation between these factors), a statistically significant impact of this factor was not confirmed by the regression analysis. Therefore, this does not confirm the results presented by Fragkos et al. [72]. What is true, however, is that energy and climate policy (especially increasing the share of RES in the energy-mix) affects the level of taxes on energy products, which may increase the risk of fuel poverty. Considering the findings of Espinosa et al. [87] that policies to support renewable energy may promote rent-seeking incentives in businesses through increased regulation, and thus force consumers to pay increasingly expensive energy bills; therefore, it can be conjectured that energy-climate policy may be a major factor shaping the fuel poverty scale in Poland in the future. Therefore, we should agree with Scarpellini et al. [33], who proposed that in order to reduce fuel poverty, various types of taxes and charges should be reduced in the prices of energy carriers.

6. Conclusions

The aim of this article was to assess the importance of macroeconomic policy instruments in reducing fuel poverty using Poland as an example. The author examined whether and how the state influenced this phenomenon (directly or indirectly) and through which instruments (fiscal, monetary or energy-climate policy), with an emphasis on assessing the

role of macroeconomic policy instruments. To achieve this objective, the following research tasks were carried out:

- The fuel poverty rate in Poland in 2004–mid-2021 was estimated by simultaneously estimating the share of expenditure on energy carriers in the disposable income of households in various income groups;
- The actions taken by the government to reduce fuel poverty in Poland were examined;
- The impact of energy, climate, and macroeconomic policies was assessed, identifying potential instruments that may affect fuel poverty through literature review. In addition, the impact of energy, climate, fiscal, and monetary policy instruments on the scale of fuel poverty in Poland was assessed.
- The results of the study showed that:
- The fuel poor are primarily people in the first and second income quintile group, and until 2015, people in the third group were also fuel poor. The share of expenditure on energy carriers among the poorest persons is, depending on the year, 4.6–6.7 times higher than persons in the highest income quintile group;
- The fuel poverty rate in Poland is decreasing. Until 2015, there was a slight increase of a total of one percentage point, but then there was a sharp decline in the scale of this phenomenon. Since the second half of 2020, there has been an increase in the fuel poverty rate, and it was 15.4% in mid-2021. This was also accompanied by a decrease in the share of energy expenditure in household disposable income;
- The issue of fuel poverty is not regulated or even legally defined in Poland. There are therefore no instruments that directly affect this phenomenon. In later years, the government addressed fuel poverty by introducing an energy benefit for the poorest households and by subsidising the costs of insulating buildings;
- The decisive impact on the fuel poverty rate in Poland has been driven by macroeconomic policy rather than energy and climate policy. It was also found that monetary policy affects fuel poverty;
- Social benefits had the greatest impact on reducing fuel poverty in Poland. Slightly smaller, although also statistically significant, was the impact of taxes and short-term interest rates. Thus, fiscal policy is more important than monetary policy;
- Monetary policy can be an effective tool in combating energy poverty. The results indicated that the short-term interest rate, which is shaped by the Central Bank, has a statistically significant effect on the fuel poverty rate. The relationship in this case is positive. Therefore, it is worth using this instrument to indirectly limit this negative phenomenon;
- Long-term (throughout the study period), energy-climate policy affects taxes on energy products (mainly from 2017), which may increase the risk of fuel poverty. In Poland, it is closely linked and correlated with fiscal policy, hence when analysing the combined impact of energy-climate policy in conjunction with macroeconomic policy instruments, we cannot claim that there is a statistically significant impact of energy policy on the fuel poverty rate. Nevertheless, the growing importance of this policy is evident.

The issue taken up by the author in the article adds to the literature, as it is proved that through monetary policy it is also possible to indirectly influence the scale of fuel poverty in an effective way. Moreover, a country that has been poorly studied throughout the literature has been studied here.

The analysis also reveals practical implications. These relate to the applicability to policy makers. As the phenomenon of fuel poverty has so far been ignored in Poland, as in most EU countries, these results may provide guidance on how the government can reduce the fuel poverty rate. As noted in the findings, an effective instrument could be a monetary policy that would stimulate a decrease in short-term interest rates. These findings are particularly relevant at the present time, when prices of energy carriers, especially gas, are rising around the world due to political turmoil. The findings may be particularly useful for Poland, which has to make a big effort to meet the requirements of the EU Green Deal.

There is a research limitation within the study conducted in this manuscript: the research is limited to the analysis of one country. It is possible that for other countries, the results will be slightly different. As an excuse, it should be noted that this is a study for a large country, a representative of the European Union. Therefore, further research on this topic is undoubtedly still needed in order to confirm the conclusions obtained here over an even longer research period and to compare these results with those for other countries, especially in the European Union. This is a research limitation that should be taken into account in further studies on this topic. Future lines of research should, in the author's opinion, focus on two elements: firstly, whether in the face of rising energy prices macroeconomic policy will still be effective in reducing fuel poverty, and secondly, whether and to what extent this effectiveness occurs within the entire European Union. Similar studies for developing countries may also be a further line of research.

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