POLITYKA ENERGETYCZNA – ENERGY POLICY JOURNAL

2025 ✦ Volume 28 ✦ Issue 2 ✦ 91–112

DOI: 10.33223/epj/203623

Piotr Palac[1], Justyna Tomala[2]

Impact of the energy commodity global prices on the disaggregated inflation: the case of Poland

Abstract: The objective of the article is to estimate the impact of energy commodity prices, particularly oil, coal, and natural gas, on disaggregated inflation in Poland. The empirical part was based on multiple regression models constructed using simple OLS methods, providing short-run analysis. The study focused on inflation in the areas of food, housing, transportation, and core inflation. The study revealed that energy commodity prices have a significant impact on three out of four considered inflation categories, with the nature of this interaction varying across sectors. Coal and natural gas prices had a substantial effect on housing sector inflation (*ECPI*), while oil prices exerted the most significant influence on transportation sector inflation (*TCPI*). None of the variables affected inflation in the food area. This type of differentiation underscores the importance of disaggregated inflation analysis. Macroeconomic control variables, such as the output gap, exchange rate, and interest rates, also played a crucial role in the model. A positive output gap increases inflationary pressure, and exchange rates, particularly the real effective exchange rate (*REER*), can suppress price growth, especially in import-dependent sectors like transportation. Interest rates also had a pronounced impact on inflation, highlighting their role

✉ Corresponding Author: Justyna Tomala; e-mail: tomalaj@uek.krakow.pl

[1] Krakow University of Economics, Poland; ORCID iD: 0000-0001-8526-5945; e-mail: piotrpalacfinanse@gmail.com

[2] Department of Entrepreneurship and Innovation, Krakow University of Economics, Poland; ORCID iD: 0000-0001-6090-9337; e-mail: tomalaj@uek.krakow.pl

as a monetary policy tool. The study contributes to the development of knowledge on the impact of energy commodity prices, particularly oil, coal, and natural gas, on disaggregated inflation in Poland.

Keywords: disaggregated inflation, energy sector, energy commodity prices, Poland

Introduction

Inflation is a key macroeconomic indicator that reflects the general rise in the price level of goods and services in an economy over time. It directly affects the purchasing power of households, the cost structure of businesses, and the overall financial stability of the economy. The factors driving inflation can be both domestic and global, and understanding them is essential for practical economic policy. In particular, energy prices have long been recognized as a significant driver of inflationary pressures, as energy commodities such as oil, coal, and natural gas play a crucial role in both production processes and consumption. Energy is an important component of production processes, transportation systems, and household energy use, meaning that changes in energy prices can quickly translate into cost-push inflation (Abosedra et al. 2015; Girdzijauskas et al. 2022; Hansen 2016; Hein 2024; Husaini and Lean 2021; Odhiambo 2021; Romaniello and Stirati 2024; Vestin 2006). In countries like Poland, which primarily rely on the import of energy resources, fluctuations in energy prices can trigger both broad and sector-specific inflationary effects, influencing food prices and housing costs (Bórawski et al. 2023; Grodzicki et al. 2023).

Over the past few decades, energy markets have experienced significant volatility due to geopolitical tensions, supply disruptions, and changing demand (Bernanke and Blanchard 2023; Shapiro 2024; Siksnelyte-Butkiene 2022, 2021; Umar et al. 2022; Wildauer et al. 2023). For Poland, these fluctuations have had complex and far-reaching consequences for inflation dynamics, particularly in the context of its integration with European and global markets (Grodzicki et al. 2023). Despite this, most existing studies focus on aggregate inflation without considering the distribution of effects across different subcategories of the Consumer Price Index (*CPI*). Disaggregated inflation, which measures inflation in specific sectors such as food, housing, and transportation, provides a more detailed view of how energy price changes impact different parts of the economy. Understanding these sectoral inflation trends is crucial for developing targeted fiscal and monetary policies aimed at mitigating the adverse effects of rising energy prices (Ibrahim Anyars and Adabor 2023). Additionally, recent global crises such as the COVID-19 pandemic and geopolitical conflicts, particularly the war in Ukraine, have introduced new dynamics in energy markets, further emphasizing the importance of a detailed analysis of the relationship between energy prices and inflation (Giovanni et al. 2023; Qiao et al. 2023; Umar et al. 2022; Zakeri et al. 2022).

The purpose of this study is to estimate the impact of energy commodity prices, particularly oil, coal, and natural gas, on disaggregated inflation in Poland and to answer the following research question: What role do energy commodity prices play in shaping disaggregated inflation in Poland? The empirical analysis was based on multiple regression models constructed using simple OLS methods. Oil, coal, and natural gas prices were chosen for the empirical analysis because of their substantial influence on inflation across a range of economic sectors. Energy plays a significant role in both production and consumption, making energy prices a major contributor to inflation. Additionally, the Polish energy sector depends heavily on imports of energy raw materials. Price changes for these raw materials have the potential to have both sectoral and overall inflationary effects. Since the effects of energy commodity prices are most noticeable in the transportation, housing, and food sectors, these sectors have been the focus of the analysis.

This article is organized as follows: the next section focuses on the impact of energy commodity prices on disaggregated inflation, with emphasis on oil, coal, and natural gas. The third section presents the data and research methodology used to conduct the empirical analysis. Next, the empirical analysis demonstrates the effect of energy commodity prices on disaggregated inflation in Poland. The final section summarizes the main findings of the analysis and points out directions for further research.

1. Literature review

The energy sector plays a crucial role in stimulating economic growth. The expansion of the energy sector is linked to the overall economic dynamics, and the stability of the energy supply affects inflation, especially in countries dependent on energy imports. Inflation is a key economic indicator reflecting the rate of increase in the general price level of goods and services. Energy commodity prices significantly influence inflation indicators. However, the relationship between energy commodity prices and inflation remains complex and multifaceted. Increases in energy commodity prices and energy price fluctuations can lead to changes in production costs or consumer prices. This is particularly critical since energy commodities remain fundamental factors across various sectors of the economy. Consequently, geopolitical events and unforeseen situations, such as the COVID-19 pandemic and the war in Ukraine, have had a significant impact on the energy sector (Bórawski et al. 2019; Chen and Yang 2024; Karasek et al. 2023; Kuzemko et al. 2022; Lucidi et al. 2024; Przekota and Szczepańska-Przekota 2022; Razzaqi et al. 2022; Shitile and Usman 2020; Umar et al. 2022).

The energy crisis was directly associated with the COVID-19 pandemic, the war in Ukraine, and tensions in the Middle East (Cheikh et al. 2023; Qiao et al. 2023; Umar et al. 2022). High energy prices, along with the emergence and persistence of elevated inflation, have led to numerous studies on the impact of the energy sector on inflation indicators (Cebotari and Paierele 2024).

Neufeld (2022) linked higher energy prices to increased global inflation and slower economic growth. Meanwhile, Markowski and Kotliński (2023) demonstrated that the energy crisis in 2022 was directly correlated with rising energy prices and inflation, with a notable increase in the Harmonized Index of Consumer Prices (*HICP*). Furthermore, Olasehinde-Williams et al. (2024) highlighted the geopolitical factor and the sensitivity of energy prices in Europe to geopolitical threats, which led to inflationary pressures during the energy crisis. Interestingly, Cheikh et al. (2023) found that inflation in the Eurozone is more susceptible to geopolitical threats compared to the United States.

Nevertheless, Munteanu and David (2023) argued that although the energy crisis contributed to inflation, the direct impact of energy prices on inflation is minimal due to their relatively small share in the consumer basket. This also suggests a limited influence on disaggregated inflation. Thus, the literature presents mixed views regarding the impact of energy commodity prices on inflation (Castro et al. 2017).

Despite the relatively low weight of energy commodities in the *CPI* basket, they contribute to approximately 30% of the monthly inflation fluctuations. This variability is particularly evident in sectors of the economy reliant on energy inputs, such as manufacturing and transportation (Chen and Yang 2024). It is important to note that the impact of energy prices on inflation can vary in scope and timing depending on the economic sector. Energy commodity price shocks lead to asymmetric transitional effects on disaggregated inflation, with varying time lags across different *CPI* sub-indices (Shitile and Usman 2020). Additionally, Pallotti et al. (2024) and Shitile and Usman (2020) indicated that energy commodity prices influence food and energy costs. Disaggregated inflation reveals that the impact of energy prices is not uniform across all economic sectors.

Energy commodity prices affect inflation, including disaggregated inflation, in Poland. Fluctuations in the prices of primary energy commodities can lead to overall price level changes. Energy commodities contribute to inflation through both direct price increases and indirect effects on production and transportation costs (Przekota and Szczepańska-Przekota 2022). This is particularly significant for Poland, as its energy mix still heavily relies on conventional energy sources. Consequently, even a minor increase in energy prices can lead to substantial price hikes for final goods. Moreover, Bednář et al. (2022) show that countries with a higher share of conventional energy sources in their energy mix tend to have higher inflation rates.

Przekota and Szczepańska-Przekota (2022) indicates that energy commodities, especially crude oil, have a direct relationship with inflation rates in Poland, impacting production costs and the consumer basket. Additionally, the dominant share of conventional energy sources in the energy mix and the dependence on imports pose further challenges for the economy, given the price volatility of energy commodities on international markets (Elder and Serletis 2010; Przekota and Szczepańska-Przekota 2022). Katarzyński and Przekota (2024) analyzed how changes in energy commodity prices affect inflation levels in Poland. The research revealed that while coal prices significantly predict inflation, especially with a two-month lag, the predicted correlation between electricity prices and inflation indicators was statistically insignificant, indicating a complex relationship and market inefficiency in energy price dynamics in Poland. Turan and Őzer (2022) noted that there is a positive relationship between oil prices and inflation in Poland over the long term, highlighting the impact of global energy price fluctuations on domestic prices. It is also worth adding that the output gap has a positive effect on inflation in the long run.

Based on the literature review, it can be observed that energy price shocks are significant for the Polish economy. However, inflationary processes in the context of energy market fluctuations are characterized by complexity and require further research. The following section of the article describes the materials and methods that should enable the replication of the research and the utilization of its results.

2. Empirical setting and data

The aim of the study is to estimate the impact of energy commodity prices, particularly oil, coal, and natural gas, on disaggregated inflation in Poland. Data used for the analysis of this study is quarterly time series data ranging from Q1 2000 to Q3 2023 (except data for core *CPI*, which is from Q1 2001) obtained from several sources (Table 1 briefly describes all the variables and sources used for the analysis). Data on disaggregated inflation, oil, gas, and coal prices are also presented in Figures 1 and 2. To get a deeper insight into the association between energy commodity prices and disaggregated inflation, we used the econometric model to study the impact of energy commodities price changes on the *FCPI*, *ECPI*, *TCPI*, and *CCPI* while controlling for other variables that influence inflation. Although there are potentially numerous factors that affect inflation, we use the output gap, exchange rate, and interest rate as our control variables that are primarily used in economic literature to control for inflation (Ibrahim and Said 2012; Anwar et al. 2017; Bass 2019; Ibrahim Anyars and Adabor 2023; Palac and Tomala 2024). It is worth noting that there is an ongoing debate about the relationship between oil, gas, and coal prices. Many studies suggest that oil prices play a leading role in the energy market, while gas and coal prices respond to changes in oil prices (Brown and Yttcel 2008; Oberndorfer 2009; Mohammadi 2011). However, in this study, we also aim to examine whether the data for each price contains the same information, meaning that oil prices capture the entire effect. To do this, we analyze the relationship between inflation and energy commodity prices, both individually and combined.

To examine the impact of energy commodity prices on disaggregated inflation, we follow previous studies (Ibrahim and Said 2012; Ibrahim Anyars and Adabor 2023) and specify a general model as:

$$CPI_t^i = f\left(\Delta OG, REER, IR, ECP^j\right) \quad (1)$$

where:

CPI_t^i – represents disaggregated CPI (separate CPI sub-indexes),

$\Delta OG, REER, IR$ – represents output gap, exchange rate, and interest rate,

ECP^j – represents energy commodity prices, which will be added to the models both separately (coal, gas, oil) and together.

Table 1. Variable description

Table 1. Opis zmiennych

Variable	Description	Source
Food *CPI* (*FCPI*)	Food *CPI* is computed as the percentage change in the price level of the average basket of foodstuffs household's purchase – including only food and non-alcoholic beverages (year-over-year quarterly inflation).	Statistics Poland
Housing and energy utilities *CPI* (*ECPI*)	Housing and energy utilities *CPI* is computed as the percentage change in the price level of the average basket of housing, water, electricity, gas and other fuels (year-over-year quarterly inflation).	Statistics Poland
Transport *CPI* (*TCPI*)	Transport *CPI* is computed as the percentage change in the price level of the average basket of vehicle purchases, goods and services for the operation of personal transport equipment, passenger transport services, and transport services for goods (year-over-year quarterly inflation).	Statistics Poland
Core *CPI* (*CCPI*)	As a core *CPI* indicator, we chose inflation excluding the most volatile prices. This index is calculated by excluding the impact of prices for goods and services that are particularly sensitive to various demand and supply shocks and/or exhibit significant and variable seasonality (year-over-year quarterly inflation).	Polish National Bank
Output Gap (*OG*)	Output gap is computed by finding the difference between the actual GDP and Projected GDP adjusted for inflation (US dollars, quarterly). A positive output gap is where the actual GDP is greater than the projected or potential GDP. Similarly, a negative gap is where the projected or potential GDP is greater than the actual GDP. The positive output gap creates an inflationary shock and the negative creates a recessionary gap.	OECD
Real Effective Exchange Rate (*REER*)	Exchange rate is the rate at which a domestic currency is traded against a particular foreign currency. The inclusion of the exchange rate as an independent variable is due to the openness of Poland to the international market.	OECD
Interest Rate (*IR*)	Interest rate is the monetary policy rate set by National Bank of Poland with the main aim of stabilizing inflation, and, hence, a very essential tool in the money, capital, and goods market. In this study we use the reference rate – yield on money bills issued by the National Bank of Poland during main open market operations	Statistics Poland
Oil Price (*OP*)	As a proxy for the oil price in this study, we chose the Brent oil price. Brent Crude is well known as a benchmark for the oil market around the world (US dollars *per* Barrel, quarterly, not seasonally adjusted).	FRED
Coal Price (*CP*)	As a proxy for the coal price in this study, we chose the Australian Newcastle coal price (US dollars per Metric Ton, quarterly, not seasonally adjusted). Australia is one of the biggest exporters of coal in the world and the coal mined there is well known as a benchmark for the global coal market.	FRED
Natural Gas Price (*GP*)	As a proxy, we chose the global price of the natural gas, as provided by FRED (US dollars per Million Metric British Thermal Unit, quarterly, not seasonally adjusted).	FRED

Source: own elaboration; access to data 11 July 2024.

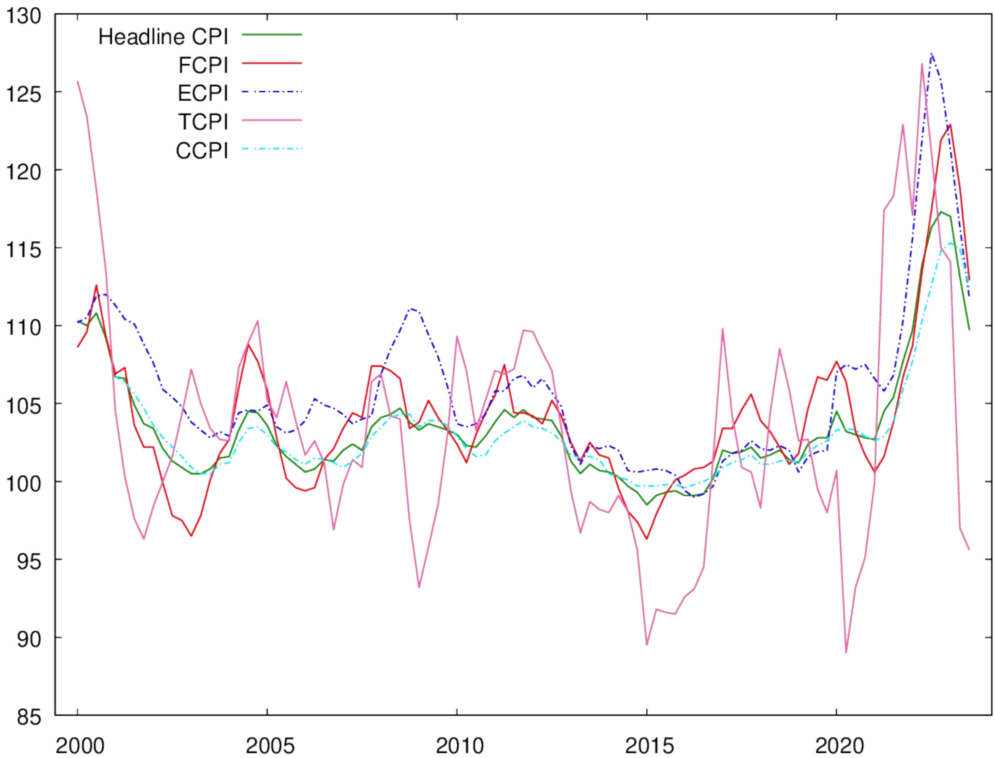

Fig. 1. Headline *CPI* and sub-indexes of *CPI*

Rys. 1. Główny wskaźnik *CPI* i jego subindeksy

Equation (1) is specified below in an estimable form:

$$lnCPI_t^i = \beta_0 + \beta_1 \Delta lnOG_t + \beta_2 lnREER_t + \beta_3 lnIR_t + \beta_4 lnECP_t^j + \varepsilon_t \tag{2}$$

where all the variables are explained earlier in Equation (1). β_0 is intercept and ε_t is the error term. The parameters β_i ($i = 1,2\ldots,4$) are the coefficient of the respective variables. *ln* represent the natural log.

Equations (1) and (2) are the general form of the relationship between disaggregated *CPI* variables and will be adapted in a further part. To estimate the parameters, it was necessary to test the stationarity properties of the variables used in Equation (2). This is so because using non-stationary time series data could generate biases in our estimates, which is associated with drawing an invalid conclusion. Each variable was examined using the Augmented Dickey-Fuller and KPSS tests (Fuller 1976; Kwiatkowski et al. 1992) for the presence of a unit root. The results are presented in Table 2.

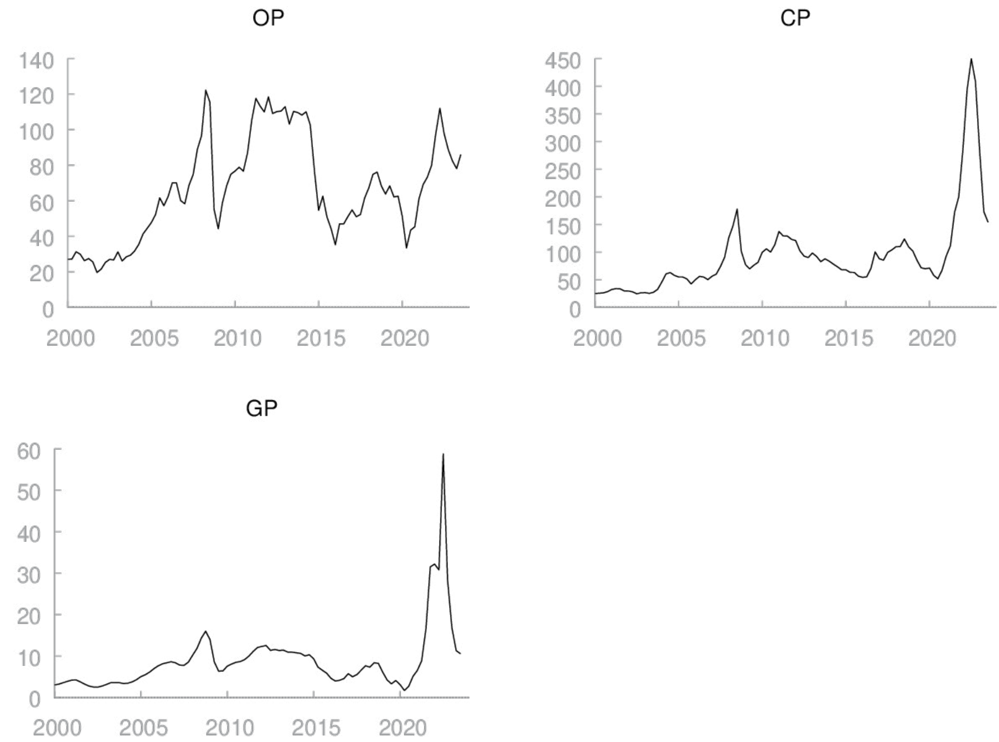

Fig. 2. Energy commodity prices [USD]

Rys. 2. Ceny surowców energetycznych [w USD]

We also investigated a potential long-run relationship using the Engle-Granger (1987) cointegration test. However, we find no stationarity of residuals in conducted long-run equations for each of the disaggregated *CPI* variables – at least, the ADF tests conducted were not consistent, and thus, we could not assume the presence of a long-run relationship for any of the models we ran. Although it is good to mention, there could be a presence of long-run relationship using ARDL bound testing method (Pesaran and Shin 1999; Pesaran et al. 2001), which is more reliable for a low amount of observations. Then, if there is a cointegration among variables, we could perform a threshold cointegration approach (Enders and Granger 1998; Enders and Siklos 2001) to investigate the asymmetric relationship between energy commodity prices and disaggregated inflation variables, which are studied in many research papers (Mork 1989; Mork et al. 1994; Leszkiewicz-Kędzior and Welfe 2014; Geise and Piłatowska 2015; Herrera et al. 2015). However, as we found no long-run relationship using the Engle-Granger method, we assumed a more simplified linear relationship between variables.

Variables *lnIR*, *lnOP*, *lnCP*, and *lnGP* are non-stationary, or their stationarity is questionable. Therefore, we classify them as I(1), as they become stationary after being transformed into first differences. The remaining variables, based on the test results, can be considered I(0). Even

Table 2. ADF and KPSS unit root tests

Tabela 2. Testy pierwiastka jednostkowego ADF i KPSS

Variable	Augmented Dickey-Fuller		Kwiatkowski–Phillips–Schmidt–Shin	
	Levels	1st Diff.	Levels	1st Diff.
lnFCPI	–4.43***	–5.36***	0.39	0.11
lnECPI	–3.70***	–4.88***	0.35	0.11
lnTCPI	–4.48***	–8.25***	0.20	0.07
lnCCPI	–4.07***	–4.48***	0.51	0.48
lnOG	–5.73***	–8.61***	0.09	0.03
lnREER	–4.12***	–7.07***	0.15	0.04
lnIR	–2.56	–7.43***	1.65	0.11
lnOP	–2.25	–6.99***	1.19	0.08
lnCP	–2.57*	–5.53***	1.77	0.05
lnGP	–2.82*	–3.82***	0.79	0.05

Source: own elaboration.

***, ** and * denote significance at 1%, 5% and 10% respectively.

Critical values for KPSS test are 0.734, 0.462 and 0.349 for significance at 1%, 5% and 10% respectively. We also applied the Zivot-Andrews unit root test to check for structural breaks in the variables. In most cases, the results align with those from the ADF and KPSS tests, confirming that it is safely to use first differences.

though the model described by Equation (2) includes most variables in their levels, the results of the ADF and KPSS tests indicate that using such variables could lead to spurious regression due to existing unit roots among some of them. However, all variables are stationary after being transformed into the first differences – the logarithmic rates of growth.

We investigated several problems with residual components after we ran the models. We investigated the PACF functions and added necessary lagged values of growth rates of each disaggregated *CPI* variable. We also added several dummy variables to ensure the residuals follow a normal distribution. Therefore, the final models (for each disaggregated *CPI* variable) used in the study are described as follows:

$$\begin{aligned} \Delta lnFCPI_t &= \beta_0 + \beta_1 \Delta lnFCPI_{t-1} + \beta_2 \Delta lnFCPI_{t-4} + \\ &+ \beta_3 \Delta lnOG_t + \beta_4 lnREER_t + \beta_5 \Delta lnIR_t + \beta_6 \Delta lnECP_t^j + \varepsilon_t \end{aligned} \tag{3}$$

where most of the variables and parameters are similar to those used in Equation (2);

$$\begin{aligned} \Delta lnECPI_t &= \beta_0 + \beta_1 \Delta lnECPI_{t-1} + \beta_2 \Delta lnECPI_{t-4} + \beta_3 \Delta lnOG_t + \beta_4 lnREER_t + \\ &+ \beta_5 \Delta lnIR_t + \beta_6 \Delta lnECP_t^j + \beta_7 dummy_{1,t} + \beta_8 dummy_{2,t} + \varepsilon_t \end{aligned} \tag{4}$$

where most of the variables and parameters are similar to those used in Equation (2);

- $dummy_1$ – represents the Q1 2020, which is the first quarter of the presence of COVID-19 in Europe, particularly in Poland,
- $dummy_2$ – represents the Q4 2022, which is the beginning of first heating season after Russia's aggression against Ukraine and the resulting trade restrictions.

$$\Delta lnTCPI_t = \beta_0 + \beta_1 \Delta lnTCPI_{t-1} + \beta_2 \Delta lnTCPI_{t-4} + \beta_3 \Delta lnOG_t + \beta_4 lnREER_t + \\ + \beta_5 \Delta lnIR_t + \beta_6 \Delta lnECP_t^j + \beta_7 dummy_{3,t} + \beta_8 dummy_{4,t} + \varepsilon_t \tag{5}$$

where most of the variables and parameters are similar to those used in Equation (2);

- $dummy_3$ – represents the Q2 2021, which is the first quarter of increased demand for services and travel after the lifting of most restrictions after third wave of COVID-19 in Poland;
- $dummy_4$ – represents the Q2 2023, where it is difficult to pinpoint a single main factor behind the change in TCPI during this period;

$$\Delta lnCCPI_t = \beta_0 + \beta_1 \Delta lnCCPI_{t-1} + \beta_2 \Delta lnCCPI_{t-3} + \beta_3 \Delta lnOG_t + \\ + \beta_4 lnREER_t + \beta_5 \Delta lnIR_t + \beta_6 \Delta lnECP_t^j + \varepsilon_t \tag{6}$$

where most of the variables and parameters are similar to those used in Equation (2).

Multiple regression models were built using simple OLS to conduct the analysis. The significance of individual parameters was verified using the Student's t-test. The R^2 coefficient was used to assess the model's goodness of fit with the data. The properties of the residuals were verified using several statistical tests. To check the compliance of the residuals with the normal distribution, we used Doornik Hansen, Shapiro-Wilk, and Jarque-Bera tests. White and Breusch-Pagan tests were used to check the homogeneity of the variance. Ljung-Box test was used to check for the autocorrelation between the residuals. Additionally, we investigated for any ARCH effect in the residuals.

The choice of research methods and the verified data sources used to conduct the analysis allowed the validity and reliability criteria to be met. Thus, the research carried out can be replicated.

3. Results and discussion

This section presents the study's results in chronological order. First, we present the results of the models we ran and the results of the tests performed. Second, we discuss the consistency of our model results with other studies on inflation, especially from the *CEE* region.

Table 3 contains the results of diagnostics tests of the residuals, specifically the p-values for tests performed. Results of the White test for most of the models indicate that the variance is homogeneous. However, for several models, the p-value is too low to meet even a 1% level of significance. Therefore, we also use the Breusch-Pagan test, which is more relevant if the number of observations is relatively low. Results of the Breusch-Pagan test indicate that the residual component of all models is characterized by homogeneity of variance at each of the conventional levels of significance. There is no ARCH effect for models where the dependent variables are *FCPI*, *ECPI*, and *CCPI*. However, for models with *TCPI* as a dependent variable, ARCH-LM test results reject the null hypothesis. The presence of ARCH effects can lead to

Table 3. Diagnostic tests results

Tabela 3. Wyniki testów diagnostycznych

Model	Diagnostic tests estimates (p-value)						
	White	Breusch-Pagan	ARCH -LM	Doornik -Hansen	Shapiro -Wilk	Jarque-Bera	Ljung-Box
(1)	0.36	0.36	0.99	0.49	0.49	0.60	0.61
(2)	0.58	0.49	0.99	0.49	0.68	0.53	0.43
(3)	0.60	0.23	0.98	0.45	0.71	0.56	0.59
(4)	0.91	0.77	0.97	0.55	0.78	0.70	0.38
(5)	0.37	0.81	0.81	0.54	0.82	0.59	0.06
(6)	0.34	0.78	0.86	0.48	0.64	0.55	0.04
(7)	0.32	0.31	0.77	0.16	0.15	0.13	0.10
(8)	0.13	0.37	0.79	0.12	0.31	0.10	0.04
(9)	0.00	0.02	0.00	0.03	0.16	0.02	0.30
(10)	0.00	0.10	0.00	0.14	0.37	0.29	0.54
(11)	0.01	0.08	0.00	0.38	0.55	0.42	0.36
(12)	0.01	0.01	0.00	0.04	0.23	0.03	0.43
(13)	0.01	0.21	0.47	0.93	0.35	0.76	0.92
(14)	0.01	0.09	0.45	0.88	0.63	0.96	0.75
(15)	0.00	0.41	0.48	0.92	0.49	0.75	0.86
(16)	0.04	0.14	0.49	0.86	0.34	0.87	0.82

Source: own elaboration.

inefficient OLS estimation while still being unbiased (Engle 1982; Hamilton 1994; Greene 2012). Doornik-Hansen, Shapiro-Wilk, and Jarque-Bera indicate compliance of the residual component with the normal distribution – mostly – at all conventional levels of significance. Some of the results are below 0.10, even below 0.05, although they are higher than 0.01. Therefore, assuming the significance level of 1%, it was concluded that the residual component of each model was consistent with a normal distribution. According to Ljung-Box test results for each model, there is a symptom of autocorrelation of the residual components. However, assuming level of significance at 1%, we cannot reject the null hypothesis, which states that the residual component does not have an auto correlation of order 5.

Based on the above-described results of the model analysis, it should be concluded that at the significance level of 1%, the residual components meet most of the desired statistical properties. This proves the good specification of the model and its high power in explaining the dynamics of Poland's disaggregated inflation in the adopted time period. This should allow for a correct inference regarding the results of the estimation of structural parameters for individual variables and their interpretation.

Tables 4. and 5. reports results obtained from the models of all considered energy commodity growth of prices. The results of the estimated models indicate that it was possible to explain a high degree of variance in the observed phenomenon, which is confirmed by the relatively high values of the R^2 coefficient for each model

In every model, the first lag of each disaggregated *CPI* variable growth rate can be related positively to the current growth rate of the disaggregated *CPI* variable. Specifically, a 1% increase in the lagged growth rate of *FCPI*, *ECPI*, and *CCPI* is associated with a 0.406–0.791% (depending on which model) increase in the growth rate of the disaggregated *CPI* variable in the current period. However, for models with a growth rate of *TCPI* as a dependent variable, the first lag turned out to be statistically insignificant. The third lag of the *CCPI* growth rate can be related negatively – a 1% increase in the third lag of the *CCPI* growth rate is associated with a 0.129–0.179% decrease in the growth rate of *CCPI* in the current period. Fourth, lagged growth rates of *FCPI*, *ECPI*, and *TCPI* are also related negatively to current growth rates. The relationship is significant, and a 1% increase in the fourth lagged growth rate of *FCPI*, *ECPI*, and *TCPI* is associated with a 0.303–0.331%, 0.280–0.330%, and 0.184–0.216% decrease in current growth rates of *FCPI*, *ECPI*, and *TCPI* respectively.

The growth rate of the output gap turned out to be statistically insignificant in half of the models we built. However, the relationship is positive, and the results are statistically significant. A 1% increase in the growth rate of the output gap can be related to a 0.031–0.038% increase in the growth rate of *FCPI* or a 0.012–0.014% increase in the growth rate of *CCPI*. The positive relationship between the output gap and inflation could be attributed to the fact that an increase in the output gap reflects an increase in economic activities. This could lead to a significant increase in the demand for goods and services that may outweigh the supply on the market. A higher output gap could lead to demand-pull inflation (Machlup 1960).

The real effective exchange rate exerts a negative impact and, in half of the models, a significant impact on disaggregated inflation. An increase of 1% in real effective exchange

Table 4. Models estimation results

Tabela 4. Wyniki estymacji modeli

Variable	*FCPI*				*ECPI*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
const.	0.328*** (0.115)	0.318*** (0.115)	0.327*** (0.116)	0.314*** (0.115)	0.019 (0.071)	0.012 (0.070)	0.028 (0.069)	0.019 (0.069)
$\Delta lnFCPI_{t-1}$	0.458*** (0.087)	0.441*** (0.087)	0.446*** (0.089)	0.406*** (0.092)				
$\Delta lnFCPI_{t-4}$	–0.330*** (0.087)	–0.310*** (0.088)	–0.331*** (0.087)	–0.303*** (0.088)				
$\Delta lnECPI_{t-1}$					0.668*** (0.063)	0.650*** (0.063)	0.643*** (0.062)	0.624*** (0.064)
$\Delta lnECPI_{t-4}$					–0.330*** (0.068)	–0.298*** (0.069)	–0.301*** (0.067)	–0.280*** (0.069)
$\Delta lnOG$	0.038** (0.016)	0.034** (0.015)	0.035** (0.016)	0.031* (0.016)	0.004 (0.010)	0.003 (0.010)	0.008 (0.010)	0.004 (0.010)
$lnREER$	–0.071*** (0.025)	–0.069*** (0.025)	–0.071*** (0.025)	–0.068*** (0.025)	–0.004 (0.015)	–0.003 (0.015)	–0.006 (0.015)	–0.004 (0.015)
$\Delta lnIR$	0.006* (0.004)	0.006* (0.004)	0.008** (0.004)	0.008** (0.004)	0.012*** (0.002)	0.010*** (0.002)	0.009*** (0.002)	0.010*** (0.002)
$\Delta lnOP$	0.010 (0.009)			0.002 (0.011)	–0.001 (0.006)			–0.007 (0.007)
$\Delta lnCP$		0.012 (0.009)		0.017 (0.011)		0.010* (0.005)		0.010 (0.007)
$\Delta lnGP$			–0.004 (0.007)	–0.010 (0.008)			0.010** (0.005)	0.007 (0.005)
$dummy_1$					0.047*** (0.008)	0.047*** (0.008)	0.050*** (0.008)	0.048*** (0.008)
$dummy_2$					–0.034*** (0.009)	–0.033*** (0.009)	–0.027*** (0.010)	–0.028*** (0.010)
R^2	0.49	0.49	0.48	0.51	0.75	0.76	0.76	0.77

Source: own elaboration.
***, ** and * denote significance at 1, 5 and 10% respectively.

rates can be related to a decrease in the *FCPI* growth rate by 0.068–0.071% and a decrease in the *CCPI* growth rate by 0.018–0.019. The real effective exchange rate is a stimulus responsible for inflation, especially among countries that are heavily dependent on oil imports (Sek et al. 2015). Additionally, the real effective exchange rate is not only a measure of marginal costs but is closely related to the internal demand pressure. As the real effective exchange rate rises above the trend, the domestic price level falls below the price level of trading partners, which will cause demand pressure and should bring the domestic price level in line with foreign prices (Celasun et al. 2004).

Table 5. Models estimation results – continued

Tabela 5. Wyniki estymacji modeli – ciąg dalszy

Variable	TCPI				CCPI			
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
const.	0.333 (0.247)	0.316 (0.272)	0.352 (0.291)	0.352 (0.251)	0.089** (0.039)	0.086** (0.039)	0.088** (0.040)	0.084** (0.040)
$\Delta lnTCPI_{t-1}$	0.066 (0.074)	–0.013 (0.085)	0.020 (0.096)	0.028 (0.084)				
$\Delta lnTCPI_{t-4}$	–0.206** (0.085)	–0.209** (0.094)	–0.184* (0.100)	–0.216** (0.086)				
$\Delta lnCCPI_{t-1}$					0.791*** (0.085)	0.741*** (0.085)	0.779*** (0.086)	0.741*** (0.085)
$\Delta lnCCPI_{t-3}$					–0.175** (0.084)	–0.129 (0.087)	–0.179** (0.085)	–0.134 (0.089)
$\Delta lnOG$	0.024 (0.035)	–0.027 (0.039)	–0.028 (0.009)	0.005 (0.038)	0.014*** (0.005)	0.012** (0.005)	0.013** (0.005)	0.012** (0.005)
$lnREER$	–0.073 (0.053)	–0.069 (0.059)	-0.076 (0.063)	–0.077 (0.054)	–0.019** (0.009)	–0.019** (0.008)	–0.019** (0.009)	–0.018** (0.009)
$\Delta lnIR$	0.019** (0.008)	0.024*** (0.008)	0.028*** (0.009)	0.017* (0.008)	0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.001)
$\Delta lnOP$	0.110*** (0.020)			0.100*** (0.023)	0.004 (0.003)			0.001 (0.004)
$\Delta lnCP$		0.071** (0.022)		0.017 (0.024)		0.005* (0.003)		0.006 (0.004)
$\Delta lnGP$			0.019 (0.019)	0.009 (0.018)			0.000 (0.002)	-0.002 (0.003)
$dummy_3$	0.120*** (0.031)	0.129*** (0.034)	0.134*** (0.036)	0.116*** (0.032)				
$dummy_4$	–0.132*** (0.029)	–0.100*** (0.035)	–0.132*** (0.035)	–0.120*** (0.032)				
R_2	0.60	0.52	0.46	0.61	0.66	0.67	0.65	0.67

Source: own elaboration.
***, ** and * denote significance at 1%, 5% and 10% respectively.

The interest rate has a significant positive relationship with disaggregated inflation. A 1% increase in ΔIR is associated with a 0.004–0.028% increase in disaggregated inflation. The significant positive linkage between the interest rate and disaggregated *CPI* shows the importance of the interest rate as a monetary policy instrument for controlling inflation. These findings are consistent with other studies about the linkage between interest rates and inflation (see e.g., Kollmann 2021).

A 1% increase in the oil price growth led to a 0.100–0.110% increase in *TCPI* growth rate, but it is good to remember that these results come from models where the presence of the ARCH effect is spotted. The relationship is statistically significant. However, for other disaggregated *CPI* variables, the relationship is statistically insignificant but mostly positive. Even if the relationship turned out to be significant and negative, it would only be a spurious linkage. There is no reason why Poland, as a so-called small open economy, would have an opposite relationship between global oil prices and inflation. These outcomes are consistent with other studies, where oil prices significantly affect inflation due to the transport sector (Álvarez et al. 2011; Misztal 2011; Ibrahim Anyars and Adabor 2023).

Global prices of coal turned out to be positive and statistically significant in half of the models conducted. A 1% increase in the coal price growth can be related to an increase in the *FCPI* growth rate by 0.012–0.017%, but this relationship is insignificant. The same impact can be related to an increase in the *ECPI* growth rate by 0.10%, an increase in the *TCPI* growth rate by 0.017–0.071%, and an increase in the *CCPI* growth rate by 0.005–0.006%. Suppose the relationship between coal prices and food inflation was significant. In that case, it might mainly be due to coal usage in various stages of the growing, storage, transportation, and distribution of agricultural products. Higher coal prices may lead to higher agricultural prices (Du et al. 2022). Coal is an important factor for domestic inflation in Poland due to (1) the structure of the energy supply system and (2) its importance for household heating. In 2021, approximately 33% of households in Poland were using solid fuel as a heating source, and approximately 52% were using a heating network (Kapica et al. 2023). However, in 2021, the share of coal-type fuels in energy production within the heating network was 69.5% (URE 2022). Electricity production in Poland also relies mainly on coal – in 2023, coal accounted for 60.5% of production (Forum Energii 2024). In the case of a significant relationship between coal prices and *TCPI*, we believe that this is due to a large correlation between coal and oil prices. It is also notable when we look at the results of model (12), where only oil prices turn out to be statistically significant. Therefore, we can assume that oil prices are crucial for inflation in the transport sector. In the case of *CCPI*, we believe that this relationship is due to the relatively small volatility of coal prices.

Only models with *ECPI* growth rate as a dependent variable turned out to be significantly related to natural gas price growth. Particularly, a 1% increase can be related to a 0.010% increase in the *ECPI* growth rate. In other models, there is no statistically significant relationship. It is good to note that in the model (8), where all energy commodity variables are present, the significance of natural gas prices drops really low and becomes insignificant. The reason why this relationship is insignificant is due to a relatively low (compared to coal) usage of natural gas in production and household heating. In fact, when the global price of natural gas increased, the Polish government temporarily cut taxes to lower inflation pressure (Grodzicki et al. 2023). Another explanation is the problem of an excessive number of variables, which made significant relationships observed in models with commodity prices added separately insignificant.

Models also have several dummy variables. As we have argued, their presence results only from the need to achieve the normal distribution of residuals.

4. Concluding remarks

The conducted study achieved the research objective, which was to estimate the impact of energy commodity prices, particularly oil, coal, and natural gas, on disaggregated inflation in Poland and to answer the following research question: What role do energy commodity prices play in shaping disaggregated inflation in Poland? The study covered the period from Q1 2000 to Q3 2023 (except for data on core CPI, which starts from Q1 2001). The application of econometric models allowed for a detailed analysis of the relationship between energy prices and various inflation indicators, considering sectoral price changes. The study focused on inflation in the areas of food, housing, transportation, and core inflation.

The research showed that energy commodity prices have a significant impact on three out of four considered inflation categories, with the nature of this interaction varying depending on the sector. Coal and natural gas prices had a significant effect on inflation in the housing sector (*ECPI*), while oil prices had the most significant impact on inflation in the transportation sector (*TCPI*). None of the considered variables affected the inflation of food, at least not in the short run. This type of differentiation highlights the importance of a disaggregated analysis of inflation.

Macroeconomic control variables, such as the output gap, exchange rate, and interest rate, also played a key role in the model. The results suggest that a positive output gap increases inflationary pressure, and exchange rates, especially the real effective exchange rate (*REER*), can suppress price increases, particularly in import-dependent sectors such as transportation. Interest rates also had a clear impact on inflation, emphasizing their role as a monetary policy tool.

The study took into account the impact of global crises, such as the COVID-19 pandemic and the war in Ukraine, which affected energy commodity prices. The analysis showed that these crises had a significant impact on inflation in sectors most sensitive to energy price changes, such as housing and transportation. In particular, the introduction of dummy variables for crisis periods allowed for precise capture of these effects.

The findings offer a solid understanding of the dynamics between energy commodity prices and disaggregated inflation in Poland, providing valuable insights for policymakers in their efforts to manage inflationary pressures effectively. This is particularly important as studying the behavior of energy commodities and the direct and indirect impacts of energy prices is crucial from the perspective of consumers, other mineral commodities, and the economy as a whole (Sharma and Escobari 2018).

Like any scientific article, this one is not without limitations. The presented research provides only short-run analysis and does not take into account asymmetry in the inflation response under the influence of energy commodity prices. The lack of information about the causality and impulse responses of inflation, which can show the formation of inflation in response to impulses from the energy commodity market, is also not considered here. A multi-equation approach, perhaps a VECM model or a VECM threshold, which will give the opportunity to investigate both the long-run relationship and asymmetry in the inflation response, could be useful. Also, it is a good idea to extend the models presented in this paper by adding money supply variables or the FAO food price index. In the context presented, further research is recommended. Also, the growing importance of renewable energy sources may alter the structure of the relationship between energy prices and inflation, which requires further research. Moreover, some non-financial factors, such as legal regulations and climate policy, were not included in the analysis.

The perspective for future research should include a more detailed analysis of the impact of the energy transition on inflation, especially in the context of renewable energy sources (Coenen et al. 2024). It is also important to examine the effects of regulatory changes, such as climate policy, on energy costs and inflation in different sectors of the economy. Comparative studies between Poland and other Central and Eastern European countries could provide valuable insights into regional differences in the relationship between energy prices and inflation.

The publication was co-financed/financed from the subsidy granted to the Krakow University of Economics – Project nr 084/EED/2024/POT.

The Authors have no conflicts of interest to declare.

References

Abosedra et al. 2015 – Abosedra, S., Shahbaz, M. and Sbia, R. 2015. The Links between Energy Consumption, Financial Development, and Economic Growth in Lebanon: Evidence from Cointegration with Unknown Structural Breaks. *Journal of Energy* 2015, pp. 1–15, DOI: 10.1155/2015/965825.

Álvarez et al. 2011 – Álvarez, L.J., Hurtado, S., Sánchez, I. and Thomas, C. 2011. The Impact of Oil Price Changes on Spanish and Euro Area Consumer Price Inflation. *Economic Modelling* 28, pp. 422–431, DOI: 10.1016/j.econmod.2010.08.006.

Anwar et al. 2017 – Anwar, M.M., Khan, G.Y. and Khan, S.J.I. 2017. Effect of Increase in Oil Proce on Inflation in Pakistan. *International Review of Humanities and Scientific Research* 2, pp. 224–259.

Bass, A. 2019. Do Oil Shocks Matter for Inflation Rate in Russia: An Empirical Study of Imported Inflation Hypothesis. *International Journal of Energy Economics and Policy* 9(2), pp. 288–294, DOI: 10.32479/ijeep.7359.

Bednář et al. 2022 – Bednář, O., Čečrdlová, A., Kadeřábková, B. and Řežábek, P. 2022. Energy Prices Impact on Inflationary Spiral. *Energies* 15(9), DOI: 10.3390/en15093443.

Bernanke, B. and Blanchard, O. 2023. What caused the US pandemic-era inflation? *Peterson Institute for International Economics Working Paper* 23(4), DOI: 10.2139/ssrn.4505856.

Bórawski et al. 2023 – Bórawski, P., Bełdycka-Bórawska, A. and Holden, L. 2023. Changes in the Polish Coal Sector Economic Situation with the Background of the European Union Energy Security and Eco-Efficiency Policy. *Energies* 16(2), DOI: 10.3390/en16020726.

Bórawski et al. 2019 – Bórawski, P., Bełdycka-Bórawska, A., Szymańska, E.J., Jankowski, K.J., Dubis, B. and Dunn, J.W. 2019. Development of renewable energy sources market and biofuels in The European Union. *Journal of Cleaner Production* 228, pp. 467–484, DOI: 10.1016/j.jclepro.2019.04.242.

Brown, S.P.A. and Yttcel, M.K. 2008. What Drives Natural Gas Prices? *The Energy Journal* 29, pp. 45–60, DOI: 10.5547/ISSN0195-6574-EJ-Vol29-No2-3.

Castro et al. 2017 – Castro, C., Jiménez-Rodríguez, R., Poncela, P. and Senra, E. 2017. A new look at oil price pass-through into inflation: evidence from disaggregated European data. *Economia Politica* 34, pp. 55–82, DOI: 10.1007/s40888-016-0048-9.

Cebotari, L. and Paierele, A. 2024. Economic Effects of rising Energy Prices. *Proceedings of the International Conference on Business Excellence* 18, pp. 295–302, DOI: 10.2478/picbe-2024-0025.

Celasun et al. 2004 – Celasun, O., Gelos, R.G. and Prati, A. 2004. Obstacles to Disinflation: What is the Role of Fiscal Expectations? *Economic Policy* 19, pp. 442–481, DOI: 10.1111/j.1468-0327.2004.00129.x.

Cheikh et al. 2023 – Cheikh, N.B., Zaied, Y.B. and Mattoussi, W. 2023. Oil price shocks in the age of surging inflation. *Energy Economics* 128, DOI: 10.1016/j.eneco.2023.107128.

Chen, D. and Yang, R. 2024. The Effects of Energy Commodities on CPI: An Analysis of Energy Commodities as a Factor of US Inflation. *Journal of Student Research* 13(2), DOI: 10.47611/jsrhs.v13i2.6753.

Coenen et al. 2024 – Coenen, G., Lozej, M. and Priftis, R. 2024. Macroeconomic effects of carbon transition policies: An assessment based on the ECB's New Area-Wide Model with a disaggregated energy sector. *European Economic Review* 167, DOI: 10.1016/j.euroecorev.2024.104798.

Du et al. 2022 – Du, W., Wu, Y., Zhang, Y., Gao, Y., 2022. The Impact Effect of Coal Price Fluctuations on China's Agricultural Product Price. *Sustainability* 14, DOI: 10.3390/su14158971.

Elder, J. and Serletis, A. 2010. Oil Price Uncertainty. *Journal of Money, Credit Banking* 42, pp. 1137–1159, DOI: 10.1111/j.1538-4616.2010.00323.x

Enders, W. and Granger, C.W.J. 1998. Unit-Root Tests and Asymmetric Adjustment With an Example Using the Term Structure of Interest Rates. *Journal of Business & Economic Statistics* 16, pp. 304–311, DOI: 10.1080/07350015.1998.10524769.

Enders, W. and Siklos, P.L. 2001. Cointegration and Threshold Adjustment. *Journal of Business & Economic Statistics* 19, pp. 166–176, DOI: 10.1198/073500101316970395.

Engle, R.F. 1982. Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica* 50, DOI: 10.2307/1912773.

Engle, R.F. and Granger, C.W.J. 1987. Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica* 55, DOI: 10.2307/1913236.

Forum Energii 2024. Transformacja energetyczna w Polsce. Forum Energii.

Fuller, W.A. 1976. *Introduction to statistical time series*. Wiley series in probability and mathematical statistics. New York, London, Toronto: John Wiley & Sons.

Geise, A. and Piłatowska, M. 2015. Oil Prices, Production and Inflation in the Selected EU Countries: Threshold Cointegration Approach. *Dynamic Econometric Models* 14, pp. 71–91, DOI: 10.12775/DEM.2014.004.

Giovanni et al. 2023 – Giovanni, J.D., Kalemli-Özcan, Şebnem, Silva, A. and Yildirim, M. 2023. Pandemic-Era Inflation Drivers and Global Spillovers. *National Bureau of Economic Research*, DOI: 10.3386/w31887.

Girdzijauskas et al. 2022 – Girdzijauskas, S., Streimikiene, D., Griesiene, I., Mikalauskiene, A. and Kyriakopoulos, G.L. 2022. New Approach to Inflation Phenomena to Ensure Sustainable Economic Growth. *Sustainability* 14, DOI: 10.3390/su14010518.

Greene, W. 2012. Econometric analysis, 7. ed., international ed., [veränd. Nachdr.]. ed, Pearson series in economics. Pearson, Boston, Mass. Munich.

Grodzicki et al. 2023 – Grodzicki, M.J., Możdżeń, M. and Surmacz, T. 2023. Poland: Policies dealing with the inflation crisis. *Wirtschaft und Gesellschaft* 48(4), pp. 519–544. DOI: 10.59288/wug484.170.

Hamilton, J.D. 1994. *Time series analysis*. Princeton University Press: Princeton, N.J.

Hansen, B. 2016. *A Study in the Theory of Inflation*. London: Routledge. DOI: 10.4324/9781315621487.

Hein, E. 2024. Inflation is always and everywhere… a conflict phenomenon: post-Keynesian inflation theory and energy price driven conflict inflation, distribution, demand and employment. *European Journal of Economics and Economic Policies: Intervention* 21, pp. 202–231, DOI: 10.4337/ejeep.2024.0135.

Herrera et al. 2015 – Herrera, A.M., Lagalo, L.G. and Wada, T. 2015. Asymmetries in the response of economic activity to oil price increases and decreases? *Journal of International Money and Finance* 50, pp. 108–133, DOI: 10.1016/j.jimonfin.2014.09.004.

Husaini, D.H. and Lean, H.H. 2021. Asymmetric impact of oil price and exchange rate on disaggregation price inflation. *Resources Policy* 73, DOI: 10.1016/j.resourpol.2021.102175.

Ibrahim Anyars, S. and Adabor, O. 2023. The impact of oil price changes on inflation and disaggregated inflation: Insights from Ghana. *Research in Globalization* 6, DOI: 10.1016/j.resglo.2023.100125.

Ibrahim, M.H. and Said, R. 2012. Disaggregated consumer prices and oil price pass-through: evidence from Malaysia. *China Agricultural Economic Review* 4, pp. 514–529, DOI: 10.1108/17561371211284858.

Kapica et al. 2023 – Kapica, K., Koziel, A., Matysiak, J., Twaróg, D., Plutecki, P., Machowska, K., Drudzińska-Dracz, D., Mikołajuk, H., Nowotarska, J., Stosio, M., Juchno, A., Kacprowska, J., Galewski, K., Moskal, I., Dzwolak, J. and Dembicz, E. 2023. *Energy consumption in households in 2021*. Warszawa, Rzeszów: Statistics Poland. [Online] https://stat.gov.pl/en/topics/environment-energy/energy/energy-consumption-in-households-in-2021,11,2.html [Accessed: 2025-03-20].

Karasek et al. 2023 – Karasek, A., Fura, B. and Zajączkowska, M. 2023. Assessment of Energy Efficiency in the European Union Countries in 2013 and 2020. *Sustainability* 15, DOI: 10.3390/su15043414.

Katarzyński, D. and Przekota, G. 2024. Pro-inflationary significance of energy commodity and electricity prices. *Acta Scientiarum Polonorum. Oeconomia* 23, pp. 29–40, DOI: 10.22630/ASPE.2024.23.2.7.

Kollmann, R. 2021. Effects of Covid-19 on Euro area GDP and inflation: demand vs. supply disturbances. *International Economics and Economic Policy* 18, pp. 475–492, DOI: 10.1007/s10368-021-00516-3.

Kuzemko et al. 2022 – Kuzemko, C., Blondeel, M., Dupont, C. and Brisbois, M.C. 2022. Russia's war on Ukraine, European energy policy responses & implications for sustainable transformations. *Energy Research & Social Science* 93, DOI: 10.1016/j.erss.2022.102842.

Kwiatkowski et al. 1992 – Kwiatkowski, D., Phillips, P.C.B., Schmidt, P. and Shin, Y. 1992. Testing the null hypothesis of stationarity against the alternative of a unit root. *Journal of Econometrics* 54, pp. 159–178, DOI: 10.1016/0304-4076(92)90104-Y.

Leszkiewicz-Kędzior, K. and Welfe, A. 2014. Asymmetric Price Adjustments in the Fuel Market. *Central European Journal of Economic Modelling and Econometrics* 6, pp. 105–127.

Lucidi et al. 2024 – Lucidi, F.S., Pisa, M.M. and Tancioni, M. 2024. The effects of temperature shocks on energy prices and inflation in the Euro Area. *European Economic Review* 166, DOI: 10.1016/J.EUROECOREV.2024.104771.

Machlup, F. 1960. Another View of Cost-Push and Demand-Pull Inflation. *The Review of Economics and Statistics* 42, pp. 125–139, DOI: 10.2307/1926532.

Markowski, Ł. and Kotliński, K. 2023. Renewables, Energy Mix and Inflation in the European Union Countries. *Energies* 16(23), DOI: 10.3390/en16237808.

Misztal, P. 2011. Oddziaływanie światowych cen ropy naftowej na procesy inflacyjne w Polsce w okresie 1990–2010. *Studia i Prace Kolegium Zarządzania i Finansów* 112, pp. 20–35.

Mohammadi, H. 2011. Long-run relations and short-run dynamics among coal, natural gas and oil prices. *Applied Economics* 43, pp. 129–137, DOI: 10.1080/00036840802446606.

Mork, K.A. 1989. Oil and the Macroeconomy When Prices Go Up and Down: An Extension of Hamilton's Results. *Journal of Political Economy* 97, pp. 740–744, DOI: 10.1086/261625.

Mork et al. 1994 – Mork, K.A., Olsen, Y. and Mysen, H.T. 1994. Macroeconomic Responses to Oil Price Increases and Decreases in Seven OECD Countries. *The Energy Journal* 15, pp. 19–35, DOI: 10.5547/ISSN0195-6574-EJ-Vol15-No4-2.

Munteanu, P. and David, G. 2023. The Energy Crisis and Its Real Impact on the Inflation Rate. *Proceedings of the International Conference on Business Excellence* 17(1), pp. 48–61, DOI: 10.2478/picbe-2023-0007.

Neufeld, D. 2022. Inflation: How are rising food and energy prices affecting the economy? [Online] https://www.weforum.org/stories/2022/09/inflation-rising-food-energy-prices-economy/ [Accessed: 2025-03-20].

Oberndorfer, U., 2009. Energy prices, volatility, and the stock market: Evidence from the Eurozone. *Energy Policy* 37, pp. 5787–5795, DOI: 10.1016/j.enpol.2009.08.043.

Odhiambo, N.M. 2021. Energy consumption and economic growth in Botswana: empirical evidence from disaggregated data. *International Review of Applied Economics* 35, pp. 3–24, DOI: 10.1080/02692171.2020.1792851.

Olasehinde-Williams et al. 2024 – Olasehinde-Williams, G., Olanipekun, I. and Usman, O. 2024. Does geopolitics trigger energy inflation in the European economic area? Evidence from a panel time-varying regression. *International Journal of Energy Sector Management* 18(5), pp. 941–955, DOI: 10.1108/IJESM-05-2023-0027.

Palac, P. and Tomala, J. 2024. Aggregated Inflation in Poland: Examining Impact of the Energy Commodity Global Prices. *Studies of the Industrial Geography Commission of the Polish Geographical Society* 38(4), pp. 7–23, DOI: 10.24917/20801653.384.1.

Pallotti et al. 2024 – Pallotti, F., Paz-Pardo, G., Slacalek, J., Tristani, O. and Violante, G.L. 2024. Who bears the costs of inflation? Euro area households and the 2021–2023 shock. *Journal of Monetary Economics* 148, DOI: 10.1016/j.jmoneco.2024.103671.

Pesaran, M.H. and Shin, Y. 1999. An Autoregressive Distributed-Lag Modelling Approach to Cointegration Analysis. [In:] Strom, S. (Ed.), *Econometrics and Economic Theory in the 20th Century*. Cambridge University Press, Cambridge, pp. 371–413, DOI: 10.1017/CCOL521633230.011.

Pesaran et al. 2001 – Pesaran, M.H., Shin, Y. and Smith, R.J. 2001. Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics* 16, pp. 289–326, DOI: 10.1002/jae.616.

Przekota, G. and Szczepańska-Przekota, A. 2022. Pro-Inflationary Impact of the Oil Market – A Study for Poland. *Energies* 15(9), DOI: 10.3390/en15093045.

Qiao et al. 2023 – Qiao, H., Qin, P., Liu, Y. and Yang, Y. 2023. International energy trade and inflation dynamics: The role of invoicing currency use during the low carbon transition. *Energy Economics* 128, DOI: 10.1016/j.eneco.2023.107178.

Romaniello, D. and Stirati, A. 2024. Cost-Push and Conflict Inflation: A Discussion of the Italian Case. *Review of Political Economy* 36, pp. 1351–1380, DOI: 10.1080/09538259.2024.2373738.

Razzaqi et al. 2022 – Razzaqi, S., Bilquees, F. and Sherbaz, S. 2022. Dynamic Relationship Between Energy and Economic Growth: Evidence from D8 Countries. *The Pakistan Development Review* 50(4), part II, pp. 437–458, DOI: 10.30541/v50i4IIpp.437-458.

Sek et al. 2015 – Sek, S.K., Teo, X.Q. and Wong, Y.N. 2015. A Comparative Study on the Effects of Oil Price Changes on Inflation. *Procedia Economics and Finance* 26, pp. 630–636, DOI: 10.1016/S2212-5671(15)00800-X.

Shapiro, A.H. 2024. Decomposing Supply- and Demand-Driven Inflation. *Journal of Money, Credit Banking*, DOI: 10.1111/jmcb.13209.

Sharma, S. and Escobari, D. 2018. Identifying price bubble periods in the energy sector. *Energy Economics* 69, pp. 418–429, DOI: 10.1016/j.eneco.2017.12.007.

Shitile, T.S. and Usman, N. 2020. Disaggregated inflation and asymmetric oil price pass-through in Nigeria. *International Journal of Energy Economics and Policy* 10(1), pp. 255–264, DOI: 10.32479/ijeep.8343.

Siksnelyte-Butkiene, I. 2021. Impact of the COVID-19 Pandemic to the Sustainability of the Energy Sector. *Sustainability* 13, DOI: 10.3390/su132312973.

Siksnelyte-Butkiene, I. 2022. Combating Energy Poverty in the Face of the COVID-19 Pandemic and the Global Economic Uncertainty. *Energies* 15(10), DOI: 10.3390/en15103649.

Turan, T. and Özer, H.A. 2022. The impact of oil price shocks on inflation: Do asymmetries matter? *Acta Oeconomica* 72(3), pp. 271–288, DOI: 10.1556/032.2022.00022.

Umar et al. 2022 – Umar, M., Riaz, Y. and Yousaf, I. 2022. Impact of Russian-Ukraine war on clean energy, conventional energy, and metal markets: Evidence from event study approach. *Resources Policy* 79, DOI: 10.1016/j.resourpol.2022.102966.

URE 2022. *Energetyka cieplna w liczbach*. Urząd Regulacji Energetyki, Warszawa.

Vestin, D. 2006. Price-level versus inflation targeting. *Journal of Monetary Economics* 53, pp. 1361–1376, DOI: 10.1016/j.jmoneco.2005.07.015.

Wildauer et al. 2023 – Wildauer, R., Kohler, K., Aboobaker, A. and Guschanski, A. 2023. Energy price shocks, conflict inflation, and income distribution in a three-sector model. *Energy Economics* 127, DOI: 10.1016/j.eneco.2023.106982.

Zakeri et al. 2022 – Zakeri, B., Paulavets, K., Barreto-Gomez, L., Echeverri, L.G., Pachauri, S., Boza-Kiss, B., Zimm, C., Rogelj, J., Creutzig, F., Ürge-Vorsatz, D., Victor, D.G., Bazilian, M.D., Fritz, S., Gielen, D., McCollum, D.L., Srivastava, L., Hunt, J.D. and Pouya, S. 2022. Pandemic, War, and Global Energy Transitions. *Energies* 15(17), DOI: 10.3390/en15176114.

Piotr Palac, Justyna Tomala

Wpływ globalnych cen surowców energetycznych na zdezagregowany wskaźnik inflacji w Polsce

Streszczenie

Celem artykułu jest oszacowanie wpływu cen surowców energetycznych, w szczególności ropy naftowej, węgla i gazu ziemnego, na zdezagregowany wskaźnik inflacji w Polsce. Część empiryczna została oparta na modelach regresji wielorakiej skonstruowanych przy użyciu prostych metod OLS, zapewniających analizę krótkookresową. Badanie koncentrowało się na inflacji w obszarach żywności, mieszkań, transportu i inflacji bazowej. Badanie wykazało, że ceny surowców energetycznych mają znaczący wpływ na trzy z czterech rozpatrywanych kategorii inflacji, przy czym charakter tej interakcji różni się w zależności od sektora. Ceny węgla i gazu ziemnego miały znaczący wpływ na inflację w sektorze mieszkaniowym (ECPI), podczas gdy ceny ropy naftowej wywarły największy wpływ na inflację w sektorze transportu (TCPI). Żadna ze zmiennych nie wpłynęła na inflację w obszarze żywności. Ten rodzaj zróżnicowania podkreśla znaczenie zdezagregowanej analizy inflacji. Makroekonomiczne zmienne kontrolne, takie jak luka produktowa, kurs walutowy i stopy procentowe, również odegrały kluczową rolę w modelu. Dodatnia luka produktowa zwiększa presję inflacyjną, a kursy walutowe, w szczególności realny efektywny kurs walutowy (REER), mogą tłumić wzrost cen, zwłaszcza w sektorach zależnych od importu, takich jak transport. Stopy procentowe również miały wyraźny wpływ na inflację, podkreślając ich rolę jako narzędzia polityki pieniężnej. Badanie przyczynia się do rozwoju wiedzy na temat wpływu cen surowców energetycznych, w szczególności ropy naftowej, węgla i gazu ziemnego, na zdezagregowany wskaźnik inflacji w Polsce.

Słowa kluczowe: zdezagregowany wskaźnik inflacji, sektor energetyczny, ceny surowców energetycznych, Polska