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ORIGINAL PAPER

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PRO-INFLATIONARY SIGNIFICANCE OF ENERGY COMMODITY AND ELECTRICITY PRICES

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ABSTRACT

Aim: The main aim of this article is to evaluate the influence of electricity prices on the overall economic price level. **Methods:** The research methodology was carefully designed to encompass various analytical tools, including the graphical representation of data, basic statistical analyses, the computation of the Pearson correlation coefficient with consideration of time lags, and the application of the Granger causality test. **Results:** The outcomes of the study revealed a significant inefficiency within the market mechanism. Contrary to expectations, the anticipated correlation between electricity prices and inflation (PPI and CPI) indices was found to be statistically insignificant. However, among the examined relationships, a strong and noteworthy connection emerged between coal prices and the PPI inflation index, particularly with a distinct two-month lag in this correlation. **Conclusions:** Drawing conclusions from the analysis, it became evident that while energy commodity prices, such as coal, do not directly translate into electricity prices and subsequently influence inflation, coal prices do emerge as a significant predictor of inflation. This observation suggests a gap in the intermediate stage of the production cycle, shedding light on a pronounced market inefficiency. The significance of these findings extends beyond the narrow scope of the energy sector. They provide a broader perspective on pricing relationships in the economy, highlighting the limited impact of the market price of electricity on shaping the overall price level. This nuanced understanding constitutes a noteworthy and valuable contribution to the field of economic research, emphasizing the multifaceted dynamics that underlie pricing mechanisms in a complex economic system.

Key words: energy, electricity, coal, CPI, PPI
JEL codes: E300, E310, E710

INTRODUCTION

The issue of price formation in the economy

The issue of how energy commodity and electricity prices affect overall prices in the economy has become increasingly significant since the beginning of the 2020s, particularly in the field of economic research [Ezeaku et al. 2021]. This situation has been influenced by a variety of factors – including not only recent global events, but also a wide range of decisions made at all levels of public administration in the previous decades [Schlacke et al. 2022].

The matter of price formation in the economy should not be exclusively linked to fluctuations in electricity prices and energy commodities [De Gregorio 2012]. However, due to their widespread use in the modern economy, it would be reasonable to assume that increases in the prices of these production factors can have a significant impact on the final prices

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of products and services in the economy. It is worth noting, however, that beyond the prices of energy in a broad sense, numerous factors stemming from both internal and external conditions of a given economy can significantly influence prices in the economy [Nagy et. al. 2018].

Researchers indicate that one of the key factors influencing the level of inflation is the functioning of the classical market equilibrium model [Raghutla 2020], where the coexistence of demand and supply in a particular market contributes to determining the so-called "equilibrium price and quantity". Any changes in demand and supply, especially phenomena related to shortages and surpluses, can significantly impact the final determination of the price [Loxton et al. 2020].

Presently, it is generally acknowledged in the majority of countries worldwide that government authorities should intervene in the free market to some extent [Majone 2019]. This sentiment is echoed in Poland, where the constitution (Article 20) establishes the economic system in the country as the so-called "social market economy" [Constitution of the Republic of Poland 1997]. This gives public administration authorities the highest mandate for economic intervention. However, state intervention, particularly in terms of setting minimum and maximum prices or altering tax rates on specific products and services, can have implications for shaping prices in the economy [Seremak-Bulge et al. 2006]. When implementing minimum prices, the state often aims to protect producers, while maximum prices are introduced to safeguard consumers. Similarly, the regulation of tax rates on products and services, including excise taxes, can also significantly impact overall price levels in the economy [Ferrara et al. 2021].

In Poland, fixed electricity prices for households and some businesses are a relatively common phenomenon [Gabryś 2020]. However, this is not the norm globally, as exemplified by recent fluctuations in electricity prices in Texas [Brown et al. 2022], which led to a sharp increase in costs for consumers.

State intervention in the free market, often expressed in strategic sectors of the economy, is not the sole determinant of prices. Scientific discourse also highlights entrepreneurial initiative as a significant factor contributing to inflation [Weber and Wasner 2023]. Given their nature, companies primarily seek to maximize profits or enhance their value for shareholders from a financial standpoint [Widarti and Pramajaya 2018]. These fundamental objectives of companies make them inclined to increase the prices of their offered products and services as long as it results in tangible benefits for the company. Consequently, businesses meticulously utilize any opportunities arising from the conditions of a given market, thereby contributing to the final price level in that market or on a broader scale within the entire economy [Loxton et al. 2020]. Cognitive factors, specifically psychological aspects, are also considered pivotal in the context of price formation in the economy. History has witnessed numerous instances where individuals, influenced by external factors often causing panic, made seemingly irrational decisions by purchasing specific products in large quantities, thereby significantly increasing demand and subsequently, prices. In recent years, events such as the COVID-19 pandemic and the armed conflict in Ukraine have contributed to such behaviors [Caldara et al. 2022]. Amid widespread panic, prices of essential products such as sugar, masks, and disinfectants during the pandemic, or fuels, coal, and gas during the conflict in Ukraine, experienced substantial fluctuations, often witnessing significant price hikes in a very short period. This, particularly in the case of energy commodities, could imply a chain reaction on inflation throughout the entire economy [Guenette et al. 2022].

The issue of energy in the economy

The energy sector in Poland, as well as in many other countries worldwide, is perceived as strategic. Consequently, public administration authorities intervene in this branch of the economy in a particular manner [Szkutnik and Sobota 2010]. State intervention in the national energy sector can take direct forms such as implementing maximum prices, regulating tax rates, imposing energy consumption restrictions, price rigidities, etc. [Sikorska 2021]. It can also be indirect through the implementation of national and European policies concerning the future directions of the sector's development [EU Directives EU/2019/944; EU/2019/943].

As of 2023, the Polish energy market is partially liberalized, thanks to the simultaneous operation of a rigid, "frozen" electricity price for households and

certain businesses [Gabryś 2020]. The rates are determined based on consumption thresholds. Meanwhile, liquid prices, which are expressed through market principles, are facilitated by the Towarowa Giełda Energii – TGE [Grudziński et al. 2023].

Furthermore, the energy market includes not just electricity, but also energy commodities like coal, gas, oil, and gasoline. The prices of these commodities are determined by the free market and are also traded on global exchanges. They are often vulnerable to speculative activities [Conrad 2023]. The state, at most, intervenes to safeguard consumers, not through price policies but by implementing subsidies. This was observed in 2022 when subsidies were introduced for coal, leading to increased demand and subsequent price growth [Prokopowicz 2023].

The market for liquid fuels in Poland is also characterized by state intervention, albeit indirectly through the monopoly of state-owned capital companies, in which the state holds a majority stake [Leszkiewicz-Kędzior 2014]. As a result, political decisions may have an impact on the final retail and wholesale prices of liquid fuels and subsequently influence the overall inflation rate in the economy.

Energy prices can also be influenced by policies and development strategies in the energy sector. Strategic documents such as 'Polska Polityka Energetyczna do 2040' or the EU's 'Fit for 55' package could potentially impact future changes in energy prices. Both strategic documents outline a comprehensive energy transformation plan, which includes the diversification of energy generation, investments in nuclear energy, modernization of transmission networks, and efforts to reduce pollution and greenhouse gas emissions [Zarębski and Katarzyński 2023]. This transformation will require significant investment, and the financing needs may be partially reflected in energy prices in the future.

The specific characteristics of electricity in Poland

Electricity plays a fundamental role in the lives of every individual. Nowadays, conducting regular daily life and economic activities without it seems practically impossible. Therefore, it seems rational to assume that its prices can significantly impact the level of inflation in the economy [Adi et al. 2022].

It is worth noting that electricity can be generated in many ways, ranging from less to more environmentally friendly methods. However, in the case of Poland, the vast majority of energy is produced using hard coal and lignite [PSE 2023], constituting over 75% of the energy structure (Fig. 1).

In light of the presented structure (Fig. 1), it can be observed that electricity prices in Poland should be relatively strongly correlated with the market price of coal. This, in turn, may have implications for the final prices of products and services due to the widespread use of electricity in the economy.

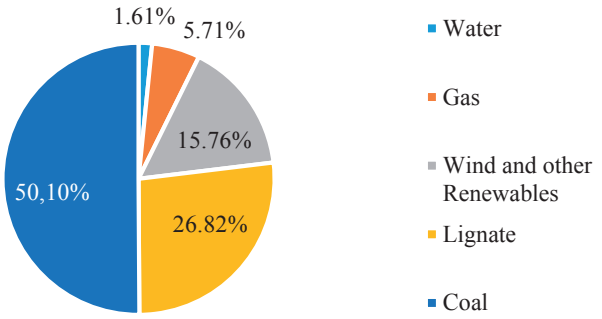

Fig. 1. Structure of electricity generation in Poland in 2022
Source: own study based on the report of Report of PSE for 2022 [2023].

The main goal of this study is to verify the impact of electricity prices on the overall price level in the economy. Achieving this objective is based on exploring the interrelationships between global coal prices, the market price of electricity in Poland, and the inflation levels measured by the PPI (Producer Price Index) and CPI (Consumer Price Index). This has led to the formulation of the following research questions:

1. How do changes in energy commodity prices affect the inflation level in Poland?
2. How does the change in electricity prices contribute to changes in the inflation level in Poland?

Due to the significance of coal for Poland's energy sector and the widespread use of electricity in the economy, a hypothesis has been adopted assuming a connection between coal prices, electricity prices, and the level of inflation in the economy.

MATERIALS AND METHODS

The research conducted in this study is based on a literature review regarding the pro-inflationary impact of energy, an examination of key documents and policies related to energy development, and a statistical analysis of a dataset spanning from 2021 to 2023. The dataset includes:

- monthly PPI and CPI indicators;
- the average monthly energy prices according to the TGE in PLN;
- stock market prices of Rotterdam Coal in USD.

The analyzed time series is relatively brief, yet it effectively captures significant relationships. Of particular interest is its coverage of a period marked by heightened inflation, and understanding potential reasons for this upsurge is crucial. It serves as a foundation for shaping the state's macroeconomic policy. Additionally, the primary statistical analyses are built upon return rate series, mitigating the influence of trends in the data on research outcomes and minimizing the occurrence of spurious correlations.

The statistical analysis of the dataset was rooted in:

- graphical representation of changes in PPI, CPI, electricity, and coal prices on a month-to-month basis, both as single-base indices with a January 2021 base and in the form of month-to-month illustrations;
- determining basic statistics for the time series increments of the analyzed data, including: mean, median, standard deviation, coefficient of variation, minimum, and maximum;
- determining the values of Pearson's correlation coefficient without time delays and with time delays of t+1 and t+2:

$$r = \frac{\frac{1}{(n-i)\sum_{t=1}^{n}(x_t - \bar{x}\,(y_{t+i} - \bar{y})}}{S_x \cdot S_y}$$

$$i = 0, 1, 2$$

where:
$\bar{x}, \bar{y}$ – mean values of increments for variables X and Y,
S_x, S_y – standard deviations of increments for variables X and Y.

The Pearson correlation coefficient enables the assessment of the strength and direction of the linear relationship between two variables. When examining the relationship between energy prices and the level of inflation, we can use the Pearson correlation coefficient to determine if there is a correlated trend between these variables.

- determining the significance level of the t-Student test for the correlation coefficient (without time delays) and the significance level of the Granger test for relationships with time delays of t+1 and t+2.

The Granger significance test was based on two-equation models:

$$x_t = a_1 + \Sigma_i a_{1.i} x_{t-i} + \Sigma_i b_{1.i} y_{t-i},\ i = 1, 2;$$

$$y_t = a_2 + \Sigma_i a_{2.i} x_{t-i} + \Sigma_i b_{2.i} y_{t-i},\ i = 1, 2.$$

The focus was on the second equation. The Granger causality test provides a statistical tool to determine whether past values of a variable (e.g., energy prices) can predict future values of another variable (e.g., inflation levels). By investigating the causal relationship between energy prices and inflation, researchers can discern the direction of influence between these economic indicators. Therefore, the Granger test allows assessing whether it is possible to eliminate variable X in the equation describing the development of variable Y [Kusideł 2000].

The selected methods, due to their properties, could be utilized in scientific research on the interdependen-

cies of various variables. Both the Pearson correlation coefficient and the Granger causality test provide empirical evidence that can support or refute theoretical assumptions about the relationship between energy prices and inflation. This enhances the robustness of research findings and contributes to a deeper understanding of the economic mechanisms at play.

RESULTS

The years 2021–2023, in the wake of two consecutive global crises – the pandemic followed by the war – were relatively unstable, not only economically, but also socially. Uncertainty also affected global energy markets, often leading to drastic changes in prices within short periods. From significant decreases in the initial stages of the pandemic to sharp several hundred percent increases in energy commodity prices and electricity itself in the months following the outbreak of the Russo-Ukrainian War [Kępka and Pająk 2022].

Similarly shaped is the graphical representation of changes in energy prices, coal prices, and inflation levels presented in (Figs 2 and 3). In Fig. 2, the development of coal prices, energy prices, and inflation is depicted as a single-base index with a base of January 2021 = 100, while in Fig. 3, it is illustrated as a chain index, representing the month-to-month ratio to the previous month.

The presented charts (Fig. 2) reveal highly dynamic changes in the selected values during the analyzed period. It is noteworthy that in the cumulative increment chart from January 2021 (Fig. 2), the prices of electricity (TGeBase_Wavg) and coal, depicted on the left side, exhibited a significant surge, reaching a peak in September/October 2022, at a level five times higher compared to January 2021. In the latter part of the examined period, there is a rapid decline in coal and energy prices. The most recent prices are twice as high as at the beginning of the period.

In the chart on the right side (Fig. 2), the values of CPI and PPI inflation are presented, characterized by a dynamic increase compared to January 2021. They reached a peak in February 2023 for PPI and April 2023 for CPI. Therefore, despite the decline in coal and energy prices, inflation did not decrease, but its growth rate slowed down. The period from which the slowdown in inflation is observed suggests a delayed dependence on changes in coal and electricity prices. At the end of the examined period, inflation indices are about a third higher than in January 2021, indicating that the price increase is not as significant as the increase in coal and electricity prices.

Fig. 3 shows month-to-month fluctuations. Interestingly, electricity and coal prices exhibit significantly larger fluctuations than PPI and CPI inflation, as can be seen on the chart axes. The variations in energy

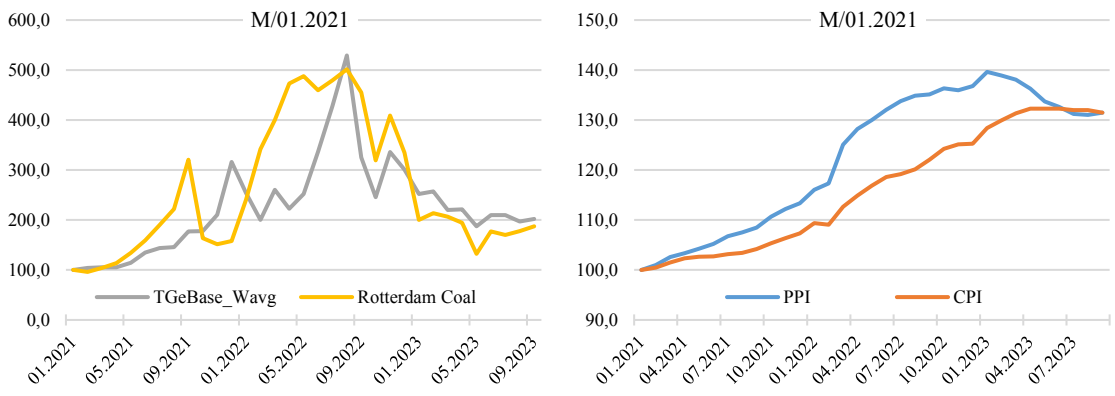

Fig. 2. Fluctuations in electricity, coal and inflation prices in Poland compared to January 2021 = 100 (2021–2023)
Source: own study based on the publicly available data (Statistics Poland and Stock data).

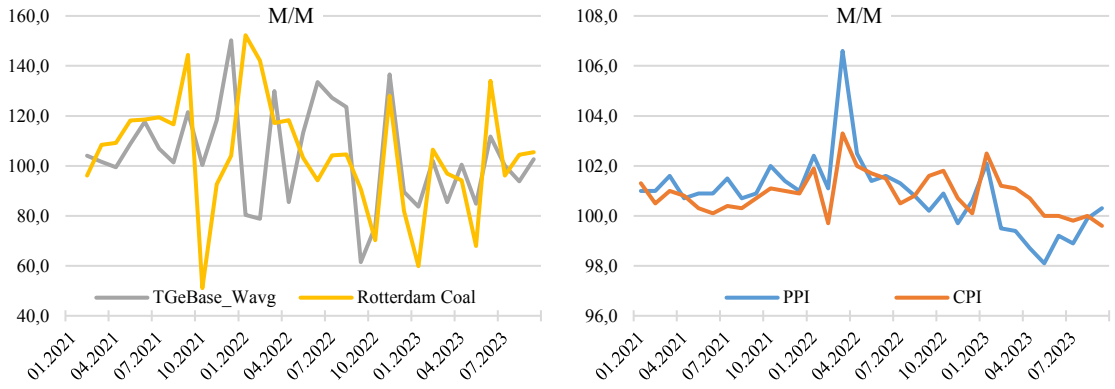

Fig. 3. Monthly fluctuations in electricity, coal and inflation prices in Poland (2021–2023)
Source: own study based on the publicly available data (Statistics Poland and Stock data).

prices are strong and relatively frequent, with monthly fluctuations reaching extreme magnitudes of up to ±50%. In contrast, inflation only experienced one strong fluctuation in March 2022 (6.6% for PPI and 3.3% for CPI on a monthly scale), and since then, the price increases have lost momentum. It is crucial to note, as depicted in Figure 3, that fluctuations in energy prices do not seem to directly affect inflation levels within the same time period. For example, the sharpest rise in inflation can be observed around March and April 2022, whereas energy prices, particularly electricity prices, recorded a significant decrease on a monthly basis. On the other hand, it seems that coal prices may indeed impact inflation levels, especially when examining the timeline since the beginning of 2023. Starting from January 2023, most observations of coal prices show negative fluctuations, which is also the case for CPI inflation. As for PPI levels since the beginning of 2023, there is a noticeable regular decline in month-to-month fluctuations.

For the data presented in Fig. 3, basic statistics were also determined (as shown in Table 1).

The values of the presented statistics confirm the dynamic nature of the changes occurring in the analyzed period. It is worth noting that electricity and coal prices experienced the strongest average increase (4–5%) with a very high variability measured by the standard deviation (19–22 p.p.) from month to month. On the other hand, the mean and standard deviation values for inflation were significantly lower, indicat-

Table 1. Basic statistics of selected variables (2021–2023)

M/M	Rotterdam Coal	TGeBade_Wavg (Electricity)	PPI	CPI
Mean	4,71%	4,08%	0,87%	0,86%
SD	22,69 p.p.	19,53 p.p.	1,47 p.p.	0,83 p.p.
V	4,82	4,78	1,69	0,97
Range	101,21 p.p.	88,77 p.p.	8,50 p.p.	3,70 p.p
Median	4,55%	1,81%	0,90%	0,75%
Min	–48,94%	–38,52%	–1,90%	–0,40%
Max	52,27%	50,25%	6,60%	3,30%

Source: own study based on the publicly available data (Statistics Poland and Stock data).

ing relatively more stable and less dynamic changes in these variables during the analyzed period. The minimum and maximum values also exhibit a significant discrepancy between inflation and energy. Coal prices showed the highest peaks of fluctuations, changing from nearly –50% at the minimum point to over 50% at the maximum. This should not be particularly surprising given the market nature of this raw material and its susceptibility to speculative investor behavior. Strong fluctuations in coal prices, in connection with the conditions of the Polish energy sector, could translate into reactions in the form of equally significant fluctuations in electricity prices, subsequently affecting PPI but in the form of less dynamic fluctuations. These, in turn, led to a slow, relatively stable increase in CPI, averaging no more than 1% month-to-month. The extreme values of monthly changes in PPI and CPI indicators range from –1.90% to 6.60% and from –0.40% to 3.30%, respectively.

The assumed relationship presented above, which can be described as a sequence:

coal ➡ electricity ➡ PPI ➡ CPI,

and alternative sequences:

coal ➡ PPI ➡ CPI,
electricity ➡ CPI,

was subjected to statistical analysis expressed by determining the Pearson correlation coefficient and the significance level of the Granger test with lags of t+1 and t+2, as shown in the table below (Table 2). In addition, lags of t+3 and t+4 were also analyzed, but their results are not shown in (Table 2) due to decreasing values in both the Granger causality test and Pearson correlation coefficient.

In the Granger causality test, most of the assumed relationships do not appear prominently. As seen in Table 2, no clear correlation was found between coal prices and electricity prices in Poland, both in the

Table 2. Correlation coefficients and significance levels of selected variables $X \rightarrow Y$

Rotterdam Coal (*X*)	***X*→*Y***	**TGeBase_Wavg (*Y*)**		**Rotterdam Coal (*X*)**	***X*→*Y***	**PPI (*Y*)**	
		correlation coefficient	*p*-value			correlation coefficient	*p*-value
	M/M	0.234	0.197		*M/M*	0.134	0.466
	M/Mt+1	–0.161	0.407		*M/Mt*+1	0.360	0.067
	M/Mt+2	–0.009	0.695		*M/Mt*+2	0.568	0.004
TGeBase_ Wavg (*X*)	***X*→*Y***	**PPI (*Y*)**		**TGeBase_ Wavg (*X*)**	***X*→*Y***	**CPI (*Y*)**	
		correlation coefficient	*p*-value			correlation coefficient	*p*-value
	M/M	0.204	0.262		*M/M*	–0.028	0.880
	M/Mt+1	0.107	0.950		*M/Mt*+1	–0.055	0.799
	M/Mt+2	0.100	0.990		*M/Mt*+2	0.041	0.924
PPI (*X*)	***X*→*Y***	**CPI (*Y*)**					
		correlation coefficient	*p*-value				
	M/M	0.686	0.000				
	M/Mt+1	0.402	0.059				
	M/Mt+2	0.473	0.061				

Source: own study based on the publicly available data (Statistics Poland and Stock data).

contemporaneous period and with time lags. Such a situation may be considered atypical, considering the degree of dependence of the Polish energy sector on coal as a raw material. Similarly, there is no significant relationship between electricity prices and the level of PPI and CPI inflation, indicating a lack of the often suggested influence of electricity prices on inflation. However, it is worth noting that households and a large portion of businesses in Poland use electricity at fixed prices, which undoubtedly contributes to the absence of a visible correlation between inflation and market electricity prices. Additionally, not surprisingly, a high degree of dependence was observed between PPI inflation and CPI inflation, confirmed by low values in the Granger causality test.

On the other hand, what may be perceived as surprising is the observation of a relatively strong association between market fluctuations in coal prices and changes in PPI inflation in the period t+2. Such a relationship suggests that when there are changes in coal prices in the market, inflation reacts accordingly with a two-month delay. Subsequently, due to the statistical connection between PPI and CPI, changes in coal prices also affect the prices of consumer goods and services. This indicates a ripple effect throughout the economy, where changes in coal prices, which are a crucial input across multiple industries, ultimately impact the general cost of living for consumers [Guan et al. 2023]. These findings illuminate the intricate interplay among commodity markets, inflation trends, and consumer price indices, emphasizing the inherent complexity of economic systems and the interconnectedness among diverse sectors within them.

DISCUSSION

The results presented in connection with the research conducted lead to a natural discussion regarding the actual impact of energy prices on the economy. These studies indicate that no specific relationship was observed between market prices of coal and electricity prices in Poland, which may be surprising given the characteristics of the country's electricity generation system. Moreover, it was not found that the market price of electricity significantly influences the country's inflation rate. The lack of a visible correlation does not necessarily mean a real lack of impact of these prices on inflation levels [Liu et al. 2013], due to the dual nature of the market, where a significant portion of electricity consumers depends on the decisions of state authorities regarding prevailing electricity prices. In such a situation, price changes for consumers typically occur at the beginning of the new calendar year, leading to immediate changes in the economy [Liu et al. 2013]. On the other hand, the remaining portion of consumers with various agreements where the electricity price is linked to market quotations constitutes too small a portion to visibly affect changes in inflation at the macroeconomic level [Keles and Yilmaz 2020]. Consequently, for businesses operating with flexible electricity prices, it is in their interest to distribute the impact of electricity price fluctuations over time on the services and products offered [Dussaux and Monjon 2023] to maintain competitiveness compared to competitors operating with fixed electricity prices.

The studies conducted also revealed strong dependencies along the Rotterdam Coal – PPI – CPI line, with the exception of electricity prices. In this context, the findings of the study confirmed the assumptions of many researchers that energy commodity prices have a significant impact on overall prices in the economy [Przekota 2022]. However, it is worth discussing the observed delayed relationship between changes in the market price of coal and the level of PPI inflation, as well as the fact that inflation has been maintained at a relatively high level despite a gradual decline in coal prices since the beginning of 2023. According to Kilian [2008], the phenomenon of maintaining high inflation resulting from a rapid increase in energy prices is relatively normal, especially in highly energy-intensive industries. The high price level may be sustained for reasons beyond energy factors, such as the desire for profit maximization within enterprises, which may be emboldened by the opportunities presented by high inflation to explain the excessive surge in the prices of goods and services [Kilian 2008].

It is worth noting that in the conditions of the 21st-century economy, enterprises should not be significantly dependent on coal, with the exception of a few industries. However, there is a clear correlation between

these variables. This phenomenon can be partially explained by psychological aspects [Ezeaku et al. 2021]. Society, being informed from all sides about potential dangers, threats, and energy resource shortages, tends to make seemingly irrational decisions [Prentice et al. 2022], dramatically increasing demand for, among other things, energy resources. This, in turn, leads to actual shortages in the market while simultaneously driving up prices. Observing these rapid changes in energy resource markets, companies also prepare themselves by increasing their expenditures, which subsequently affects the shaping of prices, both in the case of PPI and CPI inflation [Bardazzi et al. 2015].

CONCLUSIONS

In general, the conducted research has yielded valuable conclusions regarding the pro-inflationary implications of energy prices. Therefore, the initially stated research objective has been achieved, ruling out a direct translation of electricity prices in the market into the prevailing prices in the economy. Nevertheless, the provided results have allowed for the formulation of even more general and specific conclusions. The correlation between PPI and CPI inflation, as indicated by high correlation coefficient values and Granger causality test results, is not surprising. This relationship arises from the interaction between producers and consumers, as well as the objectives of economic activity, such as maintaining profitability. However, the clear link between PPI and CPI could be the basis for further research into the factors that directly influence PPI, which in turn indirectly affects changes in CPI. Examining the factors that directly impact PPI, as suggested by its correlation with CPI, can provide valuable insights into the drivers of producer prices. This understanding not only sheds light on the dynamics of producer-consumer relationships, but also equips policymakers and businesses with crucial information to anticipate and address fluctuations in consumer prices. Therefore, it emphasizes the significance of incorporating both PPI and CPI in economic analyses and policymaking endeavors.

Fluctuations in coal prices, both month-to-month and with delays, do not appear to significantly impact electricity market prices in Poland. This can be attributed to the low correlation coefficient and Granger's causality values. This situation may be related to EU policies on CO_2 emission rights prices, which are determined by market forces. A significant increase in these prices could have a greater impact on electricity prices in a coal-dominant generation system compared to changes in coal prices alone. The relationship between coal and electricity prices should be further examined in terms of the effects of the CO_2 emission rights market.

Fluctuations in market electricity prices, both month-to-month and with delays, do not seem to have a significant impact on inflation levels in Poland. This is due to the very low values obtained for the correlation coefficient and Granger's causality. The absence of a direct relationship between electricity prices and inflation may be attributed to government regulations that impose maximum prices on electricity for most consumers. This regulatory intervention creates a barrier to market forces influencing electricity prices and, consequently, limits the transmission of electricity prices to broader economic indicators such as inflation. Further investigation into the effects of government intervention on electricity pricing dynamics and its implications for inflationary trends is warranted to better understand the observed phenomenon.

A relatively strong correlation has been identified between fluctuations in coal prices and the PPI inflation level in the economy. This correlation is especially noticeable with a two-month delay, as revealed by the results of the correlation coefficient and Granger causality test. There could be several reasons for this dependence, including the behavior of businesses based on stock market data and aspects of crowd psychology, particularly during times of turbulence. However, further research should focus on determining why coal stock market prices have a significant impact on prices in the economy. It is necessary to investigate how business behavior, market reactions to stock market data, and psychological factors may influence this relationship. Analyzing these factors can contribute to a better understanding of economic mechanisms and help develop appropriate policy and business strategies.

REFERENCES

Adi, T.W., Prabowo, E., Prasadjaningsih, O. (2022). Influence of electricity consumption of industrial and business, electricity price, inflation and interest rate on GDP and investments in Indonesia. International Journal of Energy Economics and Policy, 12(3), 331–340. https://doi.org/10.32479/ijeep.13022

Bardazzi, R., Oropallo, F., Pazienza, M.G. (2015). Do manufacturing firms react to energy prices? Evidence from Italy. Energy Economics, 49, 168–181. https://doi.org/10.1016/j.eneco.2015.01.014

Brown, D.P., Tsai, C.H., Zarnikau, J. (2022). Do gentailers charge higher residential electricity prices in the Texas retail electricity market?. The Electricity Journal, 35(4), 107109. https://doi.org/10.1016/j.tej.2022.107109

Caldara, D., Conlisk, S., Iacoviello, M., Penn, M. (2022). The effect of the war in Ukraine on global activity and inflation. FEDS Notes. Washington: Board of Governors of the Federal Reserve System, May 27. https://doi.org/10.17016/2380-7172.3141

Conrad, C. (2023). Speculation in Food and Commodities A Research Report A Critical Discussion of the Econometric Research Method and an Alternative Analysis. International Journal of Economics and Finance, 15(6), 14–26. https://doi.org/10.5539/ijef.v15n6p14

De Gregorio, J. (2012). Commodity prices, monetary policy, and inflation. IMF Economic Review, 60(4), 600–633. https://doi.org/10.1057/imfer.2012.15

Directive (EU) 2019/943 of the European Parliament and of the Council. Retrieved from https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32019R0943 [accessed: 25.03.2024].

Directive (EU) 2019/944 of the European Parliament and of the Council. Retrieved from https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32019L0944 [accessed: 25.03.2024].

Dussaux, D., Monjon, S. (2023). Selling under other skies when energy prices skyrocket: How do the companies adapt their export strategy when energy prices rise? Energy Policy, 183, 113777. https://doi.org/10.1016/j.enpol.2023.113777

Ezeaku, H.C., Asongu, S.A., Nnanna, J. (2021). Volatility of international commodity prices in times of COVID-19: Effects of oil supply and global demand shocks. The extractive industries and society, 8(1), 257–270. https://doi.org/10.1016/j.exis.2020.12.013

Ferrara, L., Metelli, L., Natoli, F., Siena, D. (2021). Questioning the puzzle: fiscal policy, real exchange rate and inflation. Journal of International Economics, 133, 103524. https://doi.org/10.1016/j.jinteco.2021.103524

Gabryś, H. (2020). Elektroenergetyka w Polsce 2020 (Power industry in Poland 2020). Energetyka, 8, 365-373.

Grudziński, Z., Stala-Szlugaj, K., Ozga-Blaschke, U. (2023). Ceny energii elektrycznej na rynku krajowym. Zeszyty Naukowe Instytutu Gospodarki Surowcami Mineralnymi i Energią PAN, 111, 81-94.

Guan, Y., Yan, J., Shan, Y., Zhou, Y., Hang, Y., Li, R., Liu, Y., Liu, B., Nie, Q., Bruckner, B., Feng, K., Hubacek, K. (2023) Burden of the global energy price crisis on households. Nature Energy, 8(3), 304–316. https://doi.org/10.1038/s41560-023-01209-8

Guenette, J.D., Kenworthy, P.G., Wheeler, C.M. (2022). Implications of the War in Ukraine for the Global Economy. Policy Notes, World Bank. https://doi.org/10.1596/37372

Keles, D., Yilmaz, H.Ü. (2020). Decarbonisation through coal phase-out in Germany and Europe – Impact on emissions, electricity prices and power production. Energy Policy, 141, 111472. https://doi.org/10.1016/j.enpol.2020.111472

Kępka, A., Pająk, N. (2022). Wpływ wojny w Ukrainie na wysokość inflacji w Polsce (The impact of the war in Ukraine on the level of inflation in Poland). Studia Ekonomiczne, Prawne i Administracyjne, 1(4), 59–72. https://doi.org/10.24136/sepia.2022.020

Kilian, L. (2008). The economic effects of energy price shocks. Journal of Economic Literature, 46(4), 871–909. https://doi.org/10.1257/jel.46.4.871

Konstytucja Rzeczypospolitej Polskiej z dnia 2 kwietnia 1997 roku (Constitution of the Republic of Poland of April 2, 1997). Dz.U. z 1997 r. Nr 78, poz. 483 z późn. zm. Retrieved from https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19970780483/U/D19970483Lj.pdf [accessed: 25.03.2024].

Kusideł, E. (2000). Modele wektorowo-autoregresyjne VAR. Metodologia i zastosowania (VAR vector-autoregressive models. Methodology and applications). Absolwent, Olsztyn.

Leszkiewicz-Kędzior, K. (2014). Asymetryczne dostosowania cenowe na rynku paliw w Polsce (Asymmetric price adjustments on the fuel market in Poland). Wydawnictwo Uniwersytetu Łódzkiego, Łódź. http://dx.doi.org/10.18778/7969-422-8

Liu, M.H., Margaritis, D., Zhang, Y. (2013). Market-driven coal prices and state-administered electricity prices in China. Energy Economics, 40, 167–175. https://doi.org/10.1016/j.eneco.2013.05.021

Loxton, M., Truskett, R., Scarf, B., Sindone, L., Baldry, G., Zhao, Y. (2020). Consumer behaviour during crises: Preliminary research on how coronavirus has manifested consumer panic buying, herd mentality, changing discretionary spending and the role of the media in influencing behaviour. Journal of Risk and Financial Management, 13(8), 166. https://doi.org/10.3390/jrfm13080166

Majone, G. (2019). The rise of the regulatory state in Europe. [In:] W.C. Mueller, V. Wright (eds), The State in Western Europe. Retreat or Redefinition? Routledge, London, 77–101.

Nagy, E.É., Tengely, V. (2018). The external and domestic drivers of inflation: the case study of Hungary. BIS Paper, 100, 149–172.

Prentice, C., Quach, S., Thaichon, P. (2022). Antecedents and consequences of panic buying: The case of COVID-19. International Journal of Consumer Studies, 46(1), 132–146. https://doi.org/10.1111/ijcs.12649

Prokopowicz, D. (2023) Gospodarcze skutki wojny w Ukrainie (Economic consequences of the war in Ukraine). [In:] E. Cieślak, J. Maj, K. Pająk, D. Prokopowicz, A. Radomyski, P. Soroka, P. Śledź (eds), Wybrane aspekty rosyjskiej agresji na Ukrainę w obszarze politycznym, militarnym i gospodarczym (Selected aspects of Russian aggression against Ukraine in the political, military and economic areas). Dom Wydawniczy Elipsa, Warszawa, 284–332.

Przekota, G. (2022). Do high fuel prices pose an obstacle to economic growth? A study for Poland. Energies, 18, 6606. https://doi.org/10.3390/en15186606

Raghutla, C. (2020). The effect of trade openness on economic growth: Some empirical evidence from emerging market economies. Journal of Public Affairs, 20(3), e2081. https://doi.org/10.1002/pa.2081

Report of PSE for 2022 (2023). Zestawienie danych ilościowych dotyczących funkcjonowania KSE w 2022 roku (Summary of quantitative data on the operation of the National Power System in 2022). Polskie Sieci Elektroenergetyczne S.A. Retrieved from https://www.pse.pl/dane-systemowe/funkcjonowanie-kse/raporty-roczne-z-funkcjonowania-kse-za-rok/raporty-za-rok-2022 [accessed: 20.11.2022].

Schlacke, S., Wentzien, H., Thierjung, E. M., Köster, M. (2022). Implementing the EU Climate Law via the 'Fit for 55'package. Oxford Open Energy, 1, oiab002. https://doi.org/10.1093/ooenergy/oiab002

Seremak-Bulge, J., Rembeza, J., Łopaciuk, W., Judziński, B., Jerzak, M., Krzemiński, M., Borek, M. (2006). Ewolucja rynku zbożowego i jej wpływ na proces transmisji cen (Evolution of the grain market and its impact on the price transmission process). Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej – Państwowy Instytut Badawczy, Warszawa.

Sikorska, E. (2021). Jak nie stabilizować cen energii elektrycznej – nieudana ingerencja państwa (How not to stabilize electricity prices – failed state intervention). Kontrola Państwowa, 66.6/I 401, 52–65. https://doi.org/10.53122/ISSN.0452-5027/2021.1.51

Statistics Poland (2023). Retrieved from https://stat.gov.pl [accessed: 22.11.2023]

Stock data (2023). Retrieved from https://stooq.pl/ [accessed: 22.11.2023]

Szkutnik, J., Sobota, R. (2010). Zagadnienie bezpieczeństwa Energetycznego w Polsce w perspektywie do 2030 roku (The issue of energy security in Poland in the perspective of 2030). Rynek Energii, (1), 57–62.

Weber, I.M., Wasner, E. (2023). Sellers' inflation, profits and conflict: why can large firms hike prices in an emergency? Review of Keynesian Economics, 11(2), 183–213. https://doi.org/10.4337/roke.2023.02.05

Widarti, S., Pramajaya, J. (2018). The effect of profit management on company performance. International Journal of Academic Research in Economics and Management Sciences, 7(4), 44–63.

Zarębski, P., Katarzyński, D. (2023). Small Modular Reactors (SMRs) as a Solution for Renewable Energy Gaps: Spatial Analysis for Polish Strategy. Energies, 16(18), 6491. https://doi.org/10.3390/en16186491

Katarzyński D., Przekota G. (2024). Pro-inflationary significance of energy commodity and eletricity price. Acta Sci. Pol. Oeconomia 23 (2), 29–40, DOI: 10.22630/ASPE.2024.23.2.7

PROINFLACYJNE ZNACZENIE CEN SUROWCÓW ENERGETYCZNYCH I ENERGII ELEKTRYCZNEJ

STRESZCZENIE

Cel: Głównym celem tego artykułu było ocenienie wpływu cen energii elektrycznej na ogólny poziom cen w gospodarce. **Metody:** Metodologia badawcza została starannie zaprojektowana, aby obejmować różnorodne narzędzia analityczne. Obejmowała ona graficzną reprezentację danych, podstawowe analizy statystyczne, obliczenia współczynnika korelacji Pearsona z uwzględnieniem opóźnień czasowych oraz zastosowanie testu przyczynowości Grangera. **Wyniki:** Wyniki badania ujawniły znaczące niedoskonałości w mechanizmie rynkowym w kontekście przełożenia cen energii na poziom cen w gospodarce. Wbrew oczekiwaniom przewidywana korelacja między cenami energii elektrycznej a wskaźnikami inflacji (PPI i CPI) okazała się statystycznie nieistotna. Niemniej jednak, w ramach zbadanych zależności, pojawiło się silne i istotne powiązanie między cenami węgla a indeksem inflacji PPI, zwłaszcza z wyraźnym opóźnieniem dwóch miesięcy. **Wnioski:** Wyciągając wnioski z analizy, stało się jasne, że chociaż ceny surowców energetycznych, jak węgiel, nie przekładają się w pełni na ceny energii elektrycznej, a następnie wpływają na inflację, ceny węgla stają się istotnym predyktorem inflacji. Ta obserwacja wskazuje na niedoskonałości w pośrednim etapie cyklu produkcji, co uwydatnia zauważalne niedoskonałości funkcjonowania rynku. Znaczenie tych wyników wykracza poza wąski obszar sektora energetycznego. Zapewniają one szerszą perspektywę na relacje cenowe w gospodarce, podkreślając ograniczony wpływ rynkowej ceny energii elektrycznej na kształtowanie ogólnego poziomu cen. Ta wiedza stanowi istotny i cenny wkład w obszarze badań ekonomicznych, podkreślając wielowarstwowe dynamiki, które leżą u podstaw mechanizmów ustalania cen w złożonym systemie gospodarczym.

Słowa kluczowe: energia, elektryczność, węgiel, CPI, PPI