



# International Steam Coal Market and the Price Situation in Poland – Part II

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## Abstract

The purpose of the paper was to analyse steam coal prices of Polish producers with reference to the main spot price indices of steam coal from international markets. The research covered the years 2010–2019. Due to the complexity of the discussed issues, the article is divided into two parts. The second part focuses on the analysis of steam coal prices on the European and Polish markets. Analysis of the price indices of the main exporters of steam coal to the European market showed that the prices on international spot markets are closely linked. An investigation into the dependence of prices of the main exporters of steam coal to the European market (Russia, Colombia, the US, and South Africa) on the CIF ARA Mix index confirmed this phenomenon. The calculated coefficient of determination varied between 0.922–0.998. The comparison of the volatility of the average monthly prices of the two Polish steam coal market indices (PSCMI) with the spot indices of CIF ARA Mix and FOB Russia Mix showed that the trends on the international spot market are different from those on the Polish market. This coincidence only occurred when comparing annual average prices, and only when the prices of PSCMI were shifted backwards by one year. This shift backwards is due to the way in which Polish producers have contracts with their customers. Poland is dominated by long-term contracts with prices set once a year. Having shifted the annual averages of both PSCMIs backwards by one year, the differences between the indices decreased to about 1PLN/GJ (previously they had reached 3PLN/GJ). The calculated coefficient of determination for both PSCMIs and CIF ARA Mix for 2010–2018 equalled:  $R^2=0,88$  (PSCMI\_1/Q) and  $R^2=0,89$  (PSCMI\_2/Q).

**Keywords:** steam coal, prices, international coal market, Poland

## 1. Introduction

Within Europe Poland is one of the most important producers and users of steam coal. The production of steam coal in Poland in 2010–2019 totalled 50.0–67.5 Mt/y (ARE, 2010–2020). In the remaining years of the second decade of the 21st century accounted for 83–90% of domestic consumption of this raw material.

The purpose of the paper is to analyse the prices of steam coal of Polish producers in relation to the main spot price indices of steam coal from international markets in 2010–2019. Due to the complexity of the discussed issues, the article is divided into two parts. The first part discusses the European steam coal market, with a particular focus on Poland. The second part focuses on the analysis of steam coal prices on the European and Polish markets.

## 2. Coal prices on the European market

Price indices are commonly used in the international trade of steam coal. They express prices related to coal of standardised quality. For the purposes of this paper, price indices have been taken into account for the following NAR (Net As Received) parameters: a calorific value of 6,000 kcal/kg (25 MJ/kg), a sulphur content of maximum 1% and an ash content of maximum 15%. Prices are quoted in US dollars and refer to fine grades and grain classes of 0–50 mm.

In the markets of importers, the indices values are CIF (i.e.: cost-insurance-freight) or CFR (i.e.: cost&freight) based prices in the port of the importer. In contrast, exporters com-

pete with each other on the basis of prices quoted on a FOB (free-on-board) basis in the port of the exporter.

The analysis was carried out for the following averages calculated by the authors: monthly and annual prices of steam coal from daily spot market quotations (spot market – these are so-called spot transactions with a 15–90 day forward delivery window depending on the coal index). The data used for the calculation came from the following sources: Argus (2010–2019), Platts (2010–2019a,b) and the globalCoal internet platform (globalCoal, 2010–2019). As the presented indices from international markets are the average of the minimum of two indices, and in some periods of time the average of three indices, the name of the indices compared in this article uses the symbol 'Mix'.

Since the aim of the paper is to analyse how Polish steam coal prices depend on the international market, the most important price indices for the North–Eastern European market were taken into account (Figure 1). In the case of the importers' market, this was the index for the terminals of Amsterdam–Rotterdam–Antwerp (the so-called ARA terminals) i.e. CIF ARA Mix. For exporters, coal prices taken into account were from Russia (FOB Russia Mix) in the Baltic terminals, from Colombia (FOB Columbia Mix) in the terminals of the Caribbean Sea, from South Africa (FOB SA Mix) in the terminal of Richards Bay and, in the case of the United States, in the port of Chesapeake Bay on the Atlantic Ocean (FOB USA Mix).

The beginning of 2011 marked the beginning of a gradual decline in prices on international steam coal markets (see

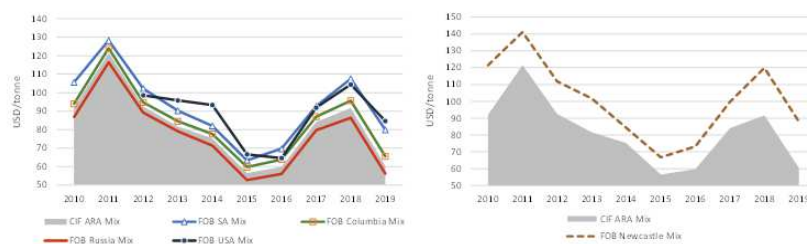


Fig. 1. Average annual steam coal indices: major exporters to the European market (a); main global coal benchmarks (b). Source: Own study based on (Argus, 2010–2019; Platts, 2010–2019a,b; globalCoal, 2010–2019)

Rys. 1. Średnie roczne indeksy węgla energetycznego: głównych eksporterów na rynek europejski (a); głównych światowych benchmarków węglowych (b)

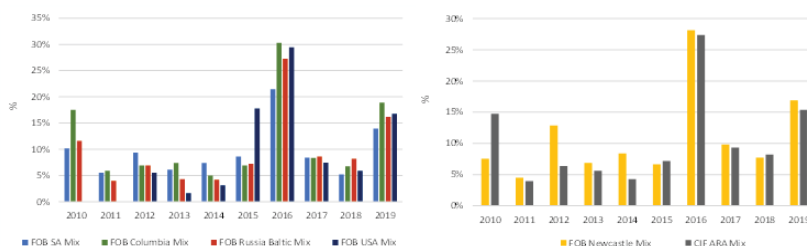


Fig. 2. Variability of average monthly steam coal indices: major exporters to the European market (a); major global coal benchmarks (b). Source: Own study

Rys. 2. Zmienność średnich miesięcznych indeksów węgla energetycznego: głównych eksporterów na rynek europejski (a); głównych światowych benchmarków węglowych (b)

Figure 1a,b) which lasted until 2015. The prices of the main steam coal suppliers to the European market decreased by 36–40%, dropping to USD 53–67 per tonne. Although prices were in a downward trend, the volatility of average monthly prices during the year was relatively small, at several per cent (see Figure 2a). In the case of the main benchmark for steam coal imported to Europe, i.e. the CIF ARA Mix index, the decrease was 39%, falling to USD 57 per tonne, and the volatility of average monthly prices ranged between 4% and 7% (see Figure 2b). Comparing it with the values of the index for the Asian market (FOB Newcastle Mix being the main benchmark for coal exported from Australia), it can be seen that they change in similar trends (see Figure 1b, 2b).

The main reason behind those falls was the oversupply of coal on international markets. The growing production of the main global exporters of steam coal (Australia, Indonesia, Russia, Colombia) was accompanied by weaker demand from both industrialised and developing countries. In the US, due to the so-called 'shale revolution', the production of oil and gas from unconventional sources increased significantly, as a result of which part of domestic coal was replaced by gas in the power industry, and the excess of steam coal was directed to export.

In 2016, this trend changed mainly by the situation in the Chinese market. China had introduced a number of measures aimed at reducing overcapacity in its coal sector and improving the efficiency and profitability of other mines. As a result of those measures, domestic coal production fell significantly and prices rose sharply. As a result, demand for imported coal increased, and China once again became the world's largest importer of steam coal. Events on the Chinese market had repercussions on global coal markets, contributing to price increases which further reduced global demand for coal, especially in the power sector. Other energy carriers, such as

natural gas and renewable energy, became the main beneficiaries.

Compared to 2015, the prices of the main exporters of steam coal to the European market increased by 7–10% (see Figure 1a), and considering the whole 2016, the volatility of average monthly prices was 21–30% (see Figure 2a). The CIF ARA Mix index increased by 6% (y/y) to USD 60 and reached 27% volatility of average monthly prices.

Over the next three years, as a result of a fall in demand, mainly from China, and large stocks accumulated not only at users but also at port terminals, prices followed a downward trend. For example, at the terminals of the European ports of Amsterdam–Rotterdam–Antwerp, coal stocks remained at 5–7 Mt. In 2019, the fall in prices of the main exporters to the European market was 19–31% (see Figure 1a) and CIF ARA Mix prices decreased by 34% (see Figure 1b).

The formation of market prices for steam coal is influenced by several factors which include basic factors, ad hoc factors and exchange rates (Lorenz, 2006; Lorenz and Grudziński, 2009; Lorenz, 2014).

Among the basic factors, the key role is played by the level of demand for steam coal and trends in its developments, as well as the costs of coal extraction. The quantity of coal reserves, their geographical distribution and the costs of transporting this raw material also play an important role. In 2012, for instance, as a result of competition from cheaper 'shale' gas, American coal producers lost a significant part of their domestic market and started looking for opportunities to place their raw material on the international market. This was made possible namely by cooperation with railway operators who aligned their freight rates with the API2 index (the API2 index corresponds to the price under CIF ARA conditions). As a result, US coal prices followed trends in maritime trade. Another important fundamental factor is cost and price com-

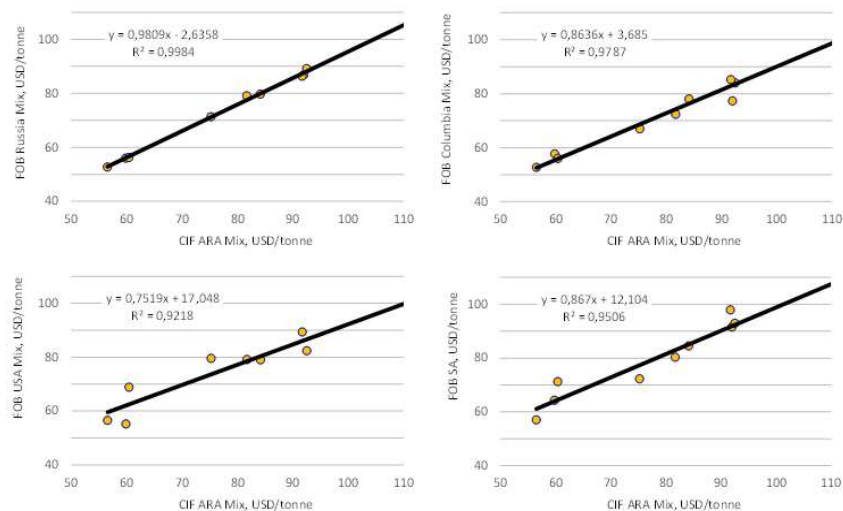


Fig. 3. Correlations of average annual CIF ARA Mix prices with the prices of the main steam coal exporters to the European market: FOB Russia Mix, FOB Columbia Mix, FOB USA Mix and FOB SA Mix. Source: Own calculations

Rys. 3. Korelacje średnich rocznych cen węgla energetycznego CIF ARA Mix z cenami głównych eksporterów węgla energetycznego na rynek europejski: FOB Russia Mix, FOB Columbia Mix, FOB USA Mix oraz FOB SA Mix

Tab. 1. Specification of PSCMIs. Source: TGE, 2020

Tab. 1. Specyfikacja polskich indeksów węglowych

Index	Fine coal grades	Calorific value [MJ/kg]	Sulphur content [%]
PSCMI 1	20-23/1	$20 \leq Q_{d} < 24$	$S_{t} < 1$
PSCMI 2	23-26/08	$23 \leq Q_{d} < 27$	$S_{t} < 0,8$

petitiveness of other energy carriers and the environmental conditions regarding coal extraction and its use.

As far as ad hoc factors are concerned, weather, among other things, is crucial, affecting the energy demand of end users, the conditions of opencast mining operations, and transport. In 2010–2011 and 2017–2018, for instance, heavy rainfall flooding mines and production and transport infrastructure particularly affected Colombia, contributing to the decline in coal extraction and exports from that country. In Russia, coal wagons often freeze during the winter months, which results in temporary difficulties in accessing them. Among other ad hoc factors, random events and transport constraints also play an important role. Random events are also referred to as force majeure and include natural disasters, catastrophes, pandemics or long-term strikes. As far as transport constraints are concerned, they include both land and inland waterway transport, as well as maritime transport, etc.

The last factor is the value of national currencies of coal exporters and importers referred to the US dollar.

The next step of the analysis was to correlate the indices of the main four exporters of steam coal to the European market (Russia, Colombia, the US and South Africa) with the CIF ARA Mix index (Figure 3).

The analyses carried out show how much energy coal prices on the international coal market are interconnected. Sometimes price relatives in different parts of the world and at different times are disrupted by local factors (such as strikes, weather anomalies, logistical problems), but in the long term these relatives are quite stable. The study of the relationship between the main four exporters of steam coal to the European market (Russia, Colombia, USA and South Africa) with the CIF ARA Mix index gives a very high result. The  $R^2$  coef-

ficient ranging from 0.922 to 0.998 confirms these statements. The determination factor for coal from Russia ( $R^2 = 0.998$ ) is particularly notable. Russian coal sellers shape their prices in such a way that they are competitive when compared to prices in ARA terminals (on average their prices are lower by about 5%). This allows Russian coal suppliers to maintain their competitive advantage over non-European suppliers (Colombia, South Africa, USA).

### 3. Prices of steam coal on the Polish market

The next step of the analysis was to answer the question regarding the impact of the situation on the international market on steam coal prices in Poland in the context of large coal imports.

In Poland, two official coal indexes are published for steam coal: PSCMI 1 and PSCMI 2 (PSCMI – Polish Steam Coal Market Index). They are published by the Polish Power Exchange (TGE, 2020) and calculated by ARP Katowice. The Mineral and Energy Economy Research Institute of the Polish Academy of Sciences also took part in the development of the methodology of this index. Both indices are based on the selling prices of fine steam coals with specific quality parameters and calculated ex-post. The oldest published values of these indices refer to January 2011. The PSCMI 1 reflects the pricing of fine steam coals sold to electric utilities and industrial plants whereas the PSCMI 2 reflects the pricing of fine steam coals sold to industrial and district heating plants. The specification of Polish coal indices is presented in Table 1.

Figure 4 compares prices of Polish steam coal market indices (index for power plants and CHP plants: PSCMI\_1/Q and for industrial and district heating plants: PSCMI\_2/Q) with prices of steam coal: CIF ARA Mix and FOB Russia Mix. The



Fig. 4. Comparison of average monthly CIF ARA Mix, FOB Russia Mix prices with PSCMIs. Source: Own study based on data from TGE 2020, NBP 2020, Argus (2010–2019), Platts (2010–2019a,b), globalCoal (2010–2019)

Rys. 4. Porównanie średnich miesięcznych cen CIF ARA Mix, FOB Russia Mix z polskimi indeksami węglowymi PSCMI

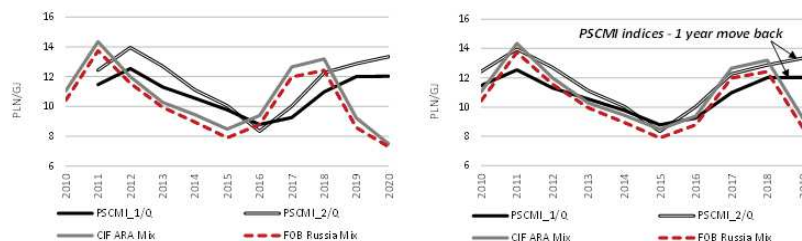


Fig. 5. Comparison of annual averages of PSCMIs with average annual coal prices of CIF ARA Mix, FOB Russia Mix, a) actual quotations, b) PSCMI quotations with year N-1. Source: Own study based on (TGE, 2020; NBP, 2020; Argus, 2010–2019; Platts, 2010–2019a,b; globalCoal, 2010–2019)

Rys. 5. Porównanie średnich rocznych polskich indeksów węglowych PSCMI z średnimi rocznymi cenami węgla CIF ARA Mix, FOB Russia Mix, a) notowania rzeczywiste, b) notowania PSCMI przesunięte o rok wstecz N-1

prices presented in the chart are monthly averages expressed in PLN/GJ. As the prices of the CIF ARA Mix and FOB Russia Mix indices are expressed in US dollars, they are converted into PLN using the exchange rate from (NBP, 2020).

The comparison of the volatility of PSCMI\_1/Q and PSCMI\_2/Q monthly prices with the spot indices CIF ARA Mix and FOB Russia Mix shows that the trends from the international spot market are different from the Polish market, mainly in the recent period. A very strong price competition can be observed between these markets. Domestic coal buyers, seeing the discrepancies between the national and international markets, may in the long term switch to spot purchases at the cost of breaking national contracts. Imports to Poland are priced at prices correlated to the market linked to the CIF ARA index, and this means that the Polish market will eventually be forced to react with lower prices or a drop in production.

The situation appears different when comparing prices of PSCMIs and spot prices of CIF ARA Mix and FOB Russia Mix calculated as annual averages (Figure 5). PSCMIs varied annually from 9 to 13 PLN/GJ for PSCMI\_1/Q and from 8 to 14 PLN/GJ for PSCMI\_2/Q, while CIF ARA Mix and FOB Russia Mix varied from 8 to 14 PLN/GJ.

The graph presented in Figure 5a shows a relatively high convergence of Polish coal prices with international market prices. It can be concluded that prices (annual average) on the Polish domestic market follow the global market represented by CIF ARA Mix and FOB Russia Mix prices with a one-year delay. The visible annual delay is due to the way in which contracts are concluded between coal producers and its recipients. In addition, the Polish market is definitely dominated by contracts in which the price is set on an annual basis. After shifting the quotations of the PSCMI\_1/Q and PSCMI\_2/Q backwards

by one year compared to CIF ARA Mix and FOB Russia Mix (Figure 5b), a very high convergence of prices is visible.

This is confirmed by the results in Table 2 showing price differences between PSCMIs and CIF ARA Mix indices with year N and year N-1. The convergence concerns not only trends in evolution but also the price levels. Greater differences are observed in 2019, but it should be mentioned that only six months of 2020 were used for this calculation. This may lead to the conclusion that after six months of 2020, the prices on the Polish domestic market have not yet reacted to the price situation on the international market in 2020.

In the next step of the research, a correlation was made between PSCMIs prices and CIF ARA Mix prices. Due to the fact that the Polish market is definitely dominated by contracts (the price is determined on an annual basis), the average annual prices of PSCMI\_1/Q and PSCMI\_2/Q delayed by one year were taken into account for correlation, and the results are presented in Figure 6. Due to the very high correlation of the FOB Russia Mix index with the CIF ARA Mix index (see Figure 3), the results of the correlation of PSCMIs with the FOB Russia Mix index were not included because of the similar results obtained.

The correlation between the prices of PSCMIs and CIF ARA prices for 2010–2018 is very high: for PSCMI\_1/Q the  $R^2=0,882$  (Figure 6a), and for PSCMI\_2/Q the  $R^2=0,893$  (Figure 6b). After 2018, trends on the domestic market have been diverse from those on the international market (see Figure 5a,b). As data for the first half of 2020 show, this trend may continue in 2020 as well. However, in the event that high coal imports to Poland continue, a reaction of the domestic market to the price level of imported coal should be expected.

As mentioned earlier, PSCMIs reflect the actual prices of domestic coal sold to Polish buyers. The analysis performed



Tab. 2. Comparison of price differences between PSCMIs and CIF ARA Mix indices with year N and year N-1 of Polish indices, in PLN/GJ.

Source: Own calculations

Tab. 2. Porównanie różnic cen między indeksami PSCMI i CIF ARA Mix bez przesunięcia i z rocznym przesunięciem wstecz indeksów polskich, w zł/GJ

Year	PSCMI 1- CIF ARA Mix		PSCMI 2- CIF ARA Mix	
	Year N	Year N-1	Year N	Year N-1
2010		0,42		1,38
2011	-2,88	-1,81	-1,92	-0,40
2012	0,54	-0,69	1,95	0,71
2013	1,03	0,27	2,43	0,83
2014	1,10	0,33	1,66	0,60
2015	1,30	0,31	1,57	-0,14
2016	-0,60	-0,13	-1,05	0,64
2017	-3,39	-1,67	-2,62	-0,39
2018	-2,21	-1,18	-0,93	-0,32
2019	2,78	2,80	3,64	4,11

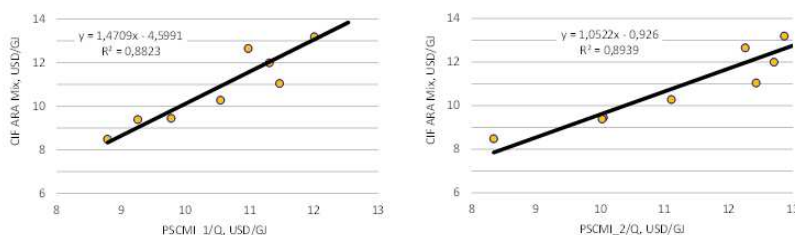


Fig. 6. Correlation of CIF ARA Mix prices with PSCMI\_1/Q (a) and PSCMI\_2/Q (b). Source: Own calculations

Rys. 6. Korelacja cen indeksów CIF ARA Mix z polskimi indeksami węglowymi PSCMI\_1/Q (a) oraz PSCMI\_2/Q (b)

showed a large correlation between PSCMIs and CIF ARA Mix and FOB Russia Mix. A study by Grudziński (2009) showed that CIF ARA coal prices are correlated with oil prices (WTI and Brent), so it can be concluded that the prices of PSCMIs are also correlated with oil prices and other energy carriers. The analyses by Nyga-Łukaszewska et al. (2020) confirmed this conclusion giving evidence of the correlation between PSCMIs and the natural gas market.

#### 4. Summary

As the analyses from the first part of this article showed, within Europe, Poland is one of the most important producers and users of steam coal. For many years, Poland's domestic production was the primary supplier of coal to its domestic market. However, with the decreasing number of mines, which resulted in lower extraction, imports of steam coal have grown in importance.

The main consumer of steam coal in Poland is the sector of electric utilities. With the growing share of imported coal in Poland, the question has arisen as to whether the price situation on the international market affects the prices of coal offered to Polish consumers.

The analysis carried out focused in particular on the quotations of the CIF ARA Mix index being the benchmark for steam coal imported into Europe. The price level of this index is influenced by many macroeconomic factors and the level of prices of competitive fuels. Investigating the relationship between the main four exporters of steam coal to the European market (Russia, Colombia, USA and South Africa) and the CIF ARA Mix index gave a very high result: the  $R^2$  coefficient ranged from 0.922 to 0.998.

The comparison of the volatility of PSCMI\_1/Q and PSCMI\_2/Q monthly prices with the spot indices CIF ARA Mix and FOB Russia Mix has shown that the trends on the international spot market are different from the Polish market. However, the transition to average annual prices has shown

the convergence of price trends in Poland and on the international market. It has been found that in the case of PSCMIs there is a one-year delay in relation to world prices (result of contracts with price set on an annual basis). After moving the annual averages of PSCMIs backwards by one year, the differences between them and the CIF ARA Mix index for 2010–2018 decreased to about 1 PLN/GJ (previously they reached 3 PLN/GJ). The calculated coefficient of determination for both PSCMIs with CIF ARA Mix index is high: for the years 2010–2018 the coefficient was  $R^2=0,882$  and  $R^2=0,893$  respectively.

Due to incomplete data for 2020 (only data for the first half of the year were available), the year 2019 saw trends on the domestic market diverge from the international market. If high coal imports to Poland continue, it can be expected that the domestic market will react to the price level of imported coal.

It is to be expected that when seeing the discrepancy between the national and international market, the domestic buyers will respond, for instance, by increasing the proportion of steam coal purchased from the international spot market at the expense of national contracts. As the prices of coal imported to Poland are assessed at prices correlated with the market linked to the CIF ARA index, it can be expected that the Polish market will eventually be forced to react, for example, by lowering price levels or decreasing domestic production.

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### *Międzynarodowy rynek węgla energetycznego a sytuacja cenowa w Polsce – część II*

*Celem artykułu była analiza cen węgla energetycznego polskich producentów w odniesieniu do głównych indeksów cen spot węgla energetycznego z rynków międzynarodowych. Badaniami objęto lata 2010–2019. Ze względu na złożoność poruszanej problematyki, artykuł został podzielony na dwie części. W części drugiej skupiono się na analizie cen węgla energetycznego na rynku europejskim i polskim. Analizując indeksy cenowe głównych eksporterów węgla energetycznego na rynek europejski zauważono, że ceny na międzynarodowych rynkach spot są ze sobą bardzo ściśle powiązane. Potwierdziło to badanie zależności pomiędzy cenami głównych eksporterów węgla energetycznego na rynek europejski (Rosja, Kolumbia, USA i RPA) a indeksem CIF ARA Mix. Obliczony współczynnik determinacji zmienił się w granicach 0,922–0,998. Porównanie przebiegu zmienności średnich cen miesięcznych dwóch polskich indeksów węglowych (PSCMI) z indeksami spot CIF ARA Mix oraz FOB Russia Mix pokazało, że tendencje z międzynarodowego rynku spot są odmienne od panujących na rynku polskim. Zbieżność ta wystąpiła dopiero przy porównaniu cen średnich rocznych i to dopiero w sytuacji, gdy ceny polskich indeksów węglowych przesunięto o rok do tyłu. Przesunięcie to wynika ze sposobu zawierania kontraktów polskich producentów z odbiorcami. W Polsce dominują kontrakty długoterminowe, w których ceny ustalane są raz w roku. Po cofnięciu średnich rocznych obu indeksów PSCMI o rok wstecz różnice między indeksami zmalały do około 1 PLN/GJ (wcześniej sięgały 3 PLN/GJ). Wyliczony współczynnik determinacji dla obu PSCMI i indeksu CIF ARA Mix dla lat 2010–2018 wyniósł:  $R^2=0,88$  (PSCMI\_1/Q) oraz  $R^2=0,89$  (PSCMI\_2/Q).*

**Słowa kluczowe:** węgiel energetyczny, ceny, międzynarodowy rynek węgla, Polska