

# Market risk in the hard coal mining industry in Poland

## in the context of the mining production planning

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### Abstract

The hard coal mining industry is of strategic importance in Poland, due to the dominant share of hard coal in the energy balance and a significant role in the industrialization of the country, particularly in Upper Silesia. In recent years, the industry has experienced a deep crisis threatening its further existence, therefore the main aim of this article is to analyze and assess the market risk associated with the mining production in Poland in 2011-2016. Statistical measurements of volatility and the Pearson correlation coefficient were used in the research. The research results indicate that the level of production is not adjusted to the changing market demand and the high level of risk characterized by high price volatility and sale volume.

**Key words:** *mining production; market risk; hard coal mining industry in Poland; hard coal prices; market demand planning*

### 1 Introduction

For many years Poland has been among the top ten hard coal producers in the world. In Europe, it is currently the largest producer of this raw material. Therefore, the hard coal mining industry – mainly located in the Upper Silesian and Lublin Coal Basins – is a sector of strategic importance for the economy and the country's energy security (the share of hard coal in the Poland's energy balance is about 60%) (*Dubiński et al.*<sup>1</sup>). Nevertheless, for several years, Polish mining enterprises have been experiencing a serious crisis showing a drastically decreasing efficiency of mining production, rising debt and loss of financial liquidity (*Bqk*<sup>2</sup>, *Michalak et al.*<sup>3</sup>). Among the main external causes of deterioration in the hard coal mining industry, the European Union's anti-coal policy promoting and subsidizing renewable energy sources and suppressing state aid to the mining sector should undoubtedly be pointed out

(*Bluszcz<sup>4</sup>, Bluszcz et al.<sup>5</sup>*). The situation is also exacerbated by the volatility of prices of non-renewable raw materials on the world market and the increasing interdependence of internal markets on global changes (*Sierpińska et al.<sup>6</sup>*). In turn, the internal causes of the crisis are rising production unit costs, over-employment and the pressure of trade unions to maintain mining privileges, as well as the high and increasing level of remuneration independent of production and financial performance. The underinvestment in mining enterprises and the low innovativeness of this sector constitute another significant problem (*Turek<sup>7</sup>; Brodny et al.<sup>8</sup>; Kmieciak et al.<sup>9</sup>*).

The aforementioned circumstances caused the loss of price competitiveness of Polish hard coal, manifested by the influx of cheaper hard coal to Europe and Poland from Russia, Kazakhstan and the United States (*Olkuski<sup>10</sup>*). As a result, the Polish hard coal mining industry has undergone a profound repair restructuring (*Jonek-Kowalska<sup>11</sup>; Bijańska et al.<sup>12</sup>*). Some of the unprofitable mines were decommissioned and the remaining part of 2017 was consolidated with the energy sector. Despite these changes, the existing mines still need special financial and managerial attention, so that they can remain effective enterprises and guarantee jobs in the region as well as ensure the energy security in Poland. Therefore, in this article it was decided to draw attention to the market aspects of hard coal mines, which ultimately determine their further existence and should be considered as priorities in relation to social or energy objectives.

Bearing in mind the above, the main aim of this article is to analyze and assess the market risk associated with the mining production in Poland in 2011-2016, carried out in the context of key economic and production parameters, including production volume, sale volume and market prices (*Kowalska-Styczeń et al.<sup>13</sup>*). To achieve this objective, further part of the article presents the applied research methodology, research results and their interpretation in the context of planning the mining production in Poland in micro- and macro-perspective.

## 2 Experimental

The research methodology includes two key areas covered by this article, namely the market analysis and the risk assessment. The market analysis is based on key parameters defining the mining production, including production volume, sale volume and market prices. For the latter, two price indexes representing the Polish commodity market were used: (1) PSCMI 1 (Polish Steam Coal Market Index 1) – reflecting the supply prices for the professional power industry in Poland, and (2) PSCMI 2 (Polish Steam Coal Market Index 2) – reflecting the

supply prices for the heating sector in Poland. The monthly data used in the market analysis, covering the years 2011-2016, was obtained from the Industrial Development Agency (Agencja Rozwoju Przemysłu S.A.).

In the risk assessment – the second research area – measures of variability of economic phenomena were used, i.e. the standard deviation (Eq. 1) and the coefficient of variation (Eq. 2) to assess the intensity of observed changes while assuming that the higher the variability of a given parameter, the higher the risk associated with its prediction and the lower the predictability of future operating conditions, and therefore greater difficulty in adjusting the production volumes and the costs to market conditions:

$$s = \sqrt{\frac{\sum_{i=1}^n (x - \bar{x})^2}{n - 1}} \quad (1)$$

where:

$\bar{x}$  – the arithmetic mean,

$x$  – another variable in the sample,

$n$  – the number of observations in the sample.

$$v = \frac{s}{\bar{x}} \times 100\% \quad (2)$$

where:

$\bar{x}$  – the arithmetic mean,

$s$  – the standard deviation.

In the course of the assessment, basic correlations between the variables were also identified using the Pearson correlation coefficient (Eq. 3) attempting to answer the following research problems: (1) Is the level of total mining production and sale correlated and what do the dependencies or their lack evidence? and (2) Is the level of sale and production correlated with the level of hard coal market prices expressed by the PSCM 1 and PSCM 2 indexes?

$$r_{xy} = \frac{cov(x, y)}{s_x \times s_y} \quad (3)$$

where:

$cov(x, y)$  – the covariance of  $x$  and  $y$  variables,

$s_x, s_y$  – standard deviations of variables  $x$  and  $y$ .

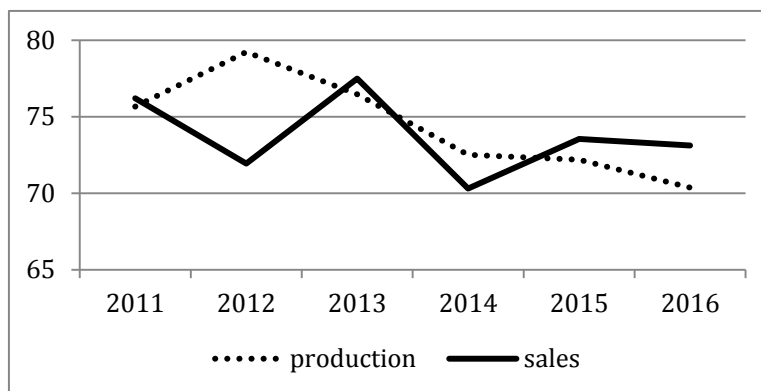
### 3 Results and discussions

The results are presented taking into account the sequence of analyses carried out and they concern the assessment of the variability of studied parameters and the analysis of their interdependencies, respectively. As already mentioned, the level of market volatility is reflected in the level of volatility of the demand volume and market prices. In addition, the volatility of production volume was calculated to compare it to the volatility of sale. The average value, the standard deviation and the coefficient of variation for the above-mentioned parameters are shown in Table 1, and the production and sale volume in the analyzed period are compared in Fig. 1.

*Table 1* – Arithmetic mean, standard deviation and coefficient of variation for sale and prices of hard coal in Poland in 2011-2016 [for monthly data]

Specification	Production [in PLN per ton]	Sale [in tons]	PSCMI 1 [in PLN per ton]	PSCMI 2 [in PLN per ton]
$\bar{x}$	6,200,561	6,147,616	237	277
$s_x$	434,973	604,212	28.05	47.21
$v$	7.01%	9.83%	11.80%	16.99%

Source: own study based on data from the Industrial Development Agency



*Fig. 1* – Production and sale of steam coal in Poland in 2011-2016 [in mln tons]

Source: own study based on data from the Industrial Development Agency

According to the data presented in Fig. 1 and in Table 1, the highest volatility in the analyzed period is characterized by hard coal prices, while in the case of coal prices for the heating sector (PSCMI 2) the value of the coefficient of variation is the highest. Therefore, this is a parameter indicating the highest market risk area. The sale volume is characterized by an average volatility, but it is important to note the cyclical nature of the observed changes and their significant amplitude of fluctuations, reaching 8 mln tons. Periodic reduction in the sales of domestic mining enterprises results largely from the non-price competitiveness of Polish

producers and as a consequence causes covering the domestic demand (which is at a fairly stable level) for hard coal with cheaper and often better quality imported raw material (Russia, Kazakhstan and the Czech Republic). The hard coal sale is rising only during times when prices on the world market are rising and it allows Polish enterprises, at least in part, to regain a competitive advantage on the domestic market.

It is also worth noting that the production of hard coal is characterized by lower volatility than the sale and a steady downward trend, which, with the above-described changes in sale, in 2015, lead to a surplus of sale over production, which was covered by excess inventory from 2013-2014. Nevertheless, since the beginning of 2017, there has been a shortage of hard coal for sale and extracted in the Polish mining enterprises, which indicates a growing mismatch between production and market demand, ex post expressed in the sale made. This is also confirmed by the correlation coefficient between production and sale of 0.6035, which indicates the average interdependence of the analyzed variables.

On the other hand, when analyzing hard coal prices in terms of production and sale, it can be concluded that there is a positive and statistically significant correlation relationship (significance level of  $p < 0.05$ ) with an average strength between the mining production and market prices. This is mainly due to the downward trend of both studied parameters. Whereby mining enterprises do not make effective attempts to adjust the production costs to diminishing prices – to be competitive – but they limit the extraction without recognizing or accepting the reasons for declining sale, attributable not so much to the decreasing demand, but to too high production costs negatively affecting the final proposed selling price. This is also confirmed by the lack of a linear relationship between the level of sale and market prices (Table 2).

*Table 2 – Pearson correlation coefficients for production, sale and hard coal prices in 2011-2016*

Specification	Production	Sale
PSCMI 1	0.5950	0.0838
PSCMI 2	0.5409	0.0700

(significance factor of  $p < 0.05$ )

Source: own study based on data from the Industrial Development Agency

## 4 Conclusions

Referring to the main objective of the article, it has to be stated that in the last six years an increased price risk related to the volatility of the PSCMI 1 and PSCMI 2 indexes and their systematic downward trend has been observed in the Polish hard coal mining industry

(Nawrocki *et al.*<sup>14</sup>). Due to the inability to effectively reduce unit costs to make it possible to regain competitiveness, the Polish mining enterprises have limited the production despite the relatively stable demand from the power and heating sectors. This means that they were not able to properly plan the mining production both in terms of cost and volume. Undoubtedly, this was hindered by the increased price risk, but the influx of cheaper coal from imports, meeting the supply gaps, proves that this was not an impossible task.

It is worth mentioning that apart from inefficient planning in macro-perspective, the Polish mining enterprises are also not very efficient in planning in micro-perspective as they do not calculate the profitability of extraction prior to commissioning other deposits and excavations, which in turn negatively affects the level of costs and the final efficiency of extraction. To sum up, the necessary condition for maintaining and improving the competitiveness of existing hard coal mines is to implement and use production planning tailored to the estimated market demand and the expected level of competitiveness.

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