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## Coal mining in Central-East Europe in perspective of industrial risk

**JEL Classification:** P23; P28; G31; L72

**Keywords:** *post-transition economies; economic and industrial risk; coal mining*

### Abstract

**Research background:** Due to increasing economic and sector risk coal mining in Europe is treated as a declining industry. In post-transition economies such approach is a threat for energy security and local and regional economic development. Nowadays, coal mining survival in Central-East Europe is additionally threatened by accumulative global risk factors, especially by price differentiation and shale gas revolution in United States of America. Revealed circumstances require deepen research and diagnosis in the area of risk and corporate management in mining enterprises in Central-East Europe.

**Purpose of the article:** The main aim of the article is to assess industrial risk in coal mining in Central-East Europe. The research is divided into three parts. In the first one the situation of coal mining in Central-East Europe is characterized. It is the basis for selection of the countries for the detailed analysis. In the second part the industrial risk factors are assessed and described. Finally, in the third part their influence on financial results in the examined mining enterprises is evaluated. In the summary the international comparison is made and general assumptions for risk and corporate management are formulated.

**Methods:** In the article a risk checklist is used to identify the economic and industrial risk factors. To determine their influence on financial results on the first stage of research Pearson's coefficients are used. Than regression functions are developed. The data are collected on the basis of public statistics and financial statements of the examined mining enterprises.

**Findings & Value added:** On the basis of research results it may be stated that there are only a few countries in Europe in which mining enterprises still operate as separate econom-

ic units and all of them have experienced serious financial troubles in the last years. Risk intensification contributed mostly to revenues reduction and negative financial results.

## **Introduction**

Hard coal mining in Europe is treated as an industry of a declining character. This sector has been struggling with numerous problems for many years, and the most important of them was and still is the inability of permanent improvement of financial effectiveness and providing the price advantage for this resource. In Great Britain, France or Germany coal mining underwent deep restructuring and, in its result, most mines were liquidated or mining enterprises were incorporated into the structures of fuel or power concerns. Nevertheless, hard coal still is one of the key energy resource in Europe. It is excavated in, among others, Poland, Germany, Czech Republic, Romania or Ukraine. Despite the increasing decarbinization and promotion of renewable energy sources, changes in energy balance of EU countries take place relatively slowly, and a complete exclusion of hard coal as an energy resource is an undertaking of a long-term horizon, what constitutes a chance for survival for mining enterprises functioning in Europe. Mining enterprises excavating additionally or mainly coking coal also may rely on the existing sales markets in a form of European and Asian steel manufacturers. However, both hard coal market, and coking coal market these days are the recipients' markets, specific for high quality and low price demands. It is especially difficult to meet the latter condition due to a decreasing demand and price fluctuations of resources on the global market.

The situation of state-owned mining enterprises is additionally complicated due to restricting the regulations by European Union concerning aid for hard coal mining and limiting the possibilities of public aid for the sector only to financing liquidation processes of unprofitable hard coal mines. The circumstances above intensify the sources of specific, industrial and sector risk. In such conditions the current maintenance of positive financial results, and in a long-term perspective, the stabilization or value growth of mining enterprises, being the indication of their development potential is a very difficult management challenge.

Taking the circumstances above into account, the main objective of this paper is to assess the influence of industrial risk on financial results of European mining enterprises. In order to achieve such objective, in the first part of the paper literature review is presented related to risk in a company. Next, the situation of the hard coal mining in Europe was referred to and the selection of enterprises was conducted for further research. In the me-

thodical part the selection was made concerning risk sources and methods of assessment of the influence of these sources on financial results of the examined enterprises. The last part of the paper included the conclusions from research carried out and the practical implications for the examined enterprises and the industry.

## **Literature review**

### *The essence of risk and its identification and assessment in a company*

In the subject literature risk is defined as a possibility of failure, and especially as a possibility of occurrence of events independent from the acting subject, which the subject cannot predict and cannot fully prevent and which — by decreasing the results of the usefulness and/or by increasing expenditures — partially or fully remove the feature of effectiveness, profitability or economics from the action (Kaczmarek, 2006, p. 11). Therefore, it is a state of reality, in which there is a possibility of occurrence of an undesired event, which is a harmful deviation (deviation from the expected result) (Vaughen & Vaughen, 1999, pp. 3–4). In practice the occurrence of particular risk sources negatively influences the level of financial result and it means that it will be lower than the expected or planned.

Taking into consideration the harmful consequences of risk occurrence, it is necessary to implement risk management in a company which consists of risk identification and assessment as well as risk prevention and control. In this paper the focus is on the first two stages of this process, describing them in details below and then using them in the conducted research.

Risk identification consists in highlighting risk sources, and therefore, in determining all events that may cause the deviation of the result from the expected goal of the enterprise operations. A tangible result of this stage is risk checklist, which contains the accepted classification of risk together with highlighting risk sources occurring in the highlighted areas. It is a stage of risk management which requires an exceptionally careful approach, because the results of it strongly influence further stages of this process. Failing to take the significant sources of risk into consideration will result in a lack of proper actions in the area of risk and as a consequence, in ignoring possible threats. Thus, in risk identification, anticipatory abilities and experiences of people designing the risk checklist become very important.

Risk assessment is an another — after its identification — stage of risk management in a company. It requires estimating risk level. The basis for

conducting it is the identification of risk sources, which highlights the sources subjected to the assessment, making it possible to select the proper parameters for the assessment. Risk assessment is an extremely difficult and complicated stage, due to referring to future events and the multifaceted nature of risk in the enterprise operations. It can be performed by utilizing both quantitative and qualitative methods.

Among the general quantitative methods one can count probabilistic, statistical and econometric methods. The first of the aforementioned methods are based on the theory of probability. When using them the probability of occurrence of the particular risk sources in the future is calculated (Sienkiewicz, 2010, pp. 21–52). The company, with information about threats and losses (opportunities and profits) at its disposal is able to additionally determine the scale of the effects of the occurrence of risk. The use of the theory of probability requires, however, the knowledge about the past or predicted frequency of events as well as the information about the results of these events. In the first case the utilized information is subject to a not always true assumption about the repeatability of the past, while in the second case it is burdened with the inability to predict the future precisely. Risk assessment will therefore always be accompanied by a forecast error.

In statistical methods risk assessment is mostly carried out in the context of the volatility of a given phenomenon. The higher the volatility in time the higher the risk. The common measures of volatility are used for the measurement. Methods those, similarly as the probabilistic ones, are accompanied by a forecast error coming from basing the measurements on historical or predicted data (Witkowski, 2009, pp. 36–37).

In the econometric methods certain econometric functions are used for risk assessment. Among the most commonly used there are the functions allowing conducting sensitivity analysis, discriminant analysis, as well as multiple regression functions. Sensitivity analysis determines the strength of the reaction of the output variable to the changes of the value of the input variable (compare Kiziukiewicz, 2003, pp. 378–380; Żwirbla, 2007, p. 249; Gabrusewicz, 2006, p. 243; Sojak, 2003, pp. 296–297). This reaction identifies the intensity of risk in the operations of the enterprise. The more intense it is, the higher risk accompanies it (more Saltelli *et al.*, 2008; Saltelli *et al.* (Ed.), 2000; Saisana *et al.*, 2005, pp. 307–323). Discriminant analysis on the other hand makes it possible to classify the enterprises in terms of the level of risk that accompanies their operations (more Hołda, 2001). Functions used while conducting it most often contain the most important indicators of the assessment of the financial condition of the company. Discriminant analysis is utilized mainly in assessing bankruptcy risk of the enterprise. Based on its results, the examined subjects are divided into

threatened by bankruptcy and not threatened by it. Functions of multiple regressions are an expansion of discriminant analysis, enabling assessing the risk of bankruptcy in a more precise manner by presenting a degree of bankruptcy risk.

### *Hard coal mining industry in Europe*

In relation to the fact that research on risk was placed in mining industry, it is justified to present the conditions of the functioning in this sector in the closest economic environment. And so, Europe and Eurasia have coal deposits on the level of 8% and 26% of global deposits, what corresponds to the sufficiency on the level of 80 and 174 years. Because of the availability and significant sufficiency of coal it is a resource present in energy balances for many European countries. It is a dominant source of energy in Poland, Bulgaria, Czech Republic, Kazakhstan and Ukraine. As an energy resource it is also significant in: Austria, Denmark, Finland, Greece, the Netherlands, Ireland, Germany, Portugal, Russia, Romania, Turkey, Ukraine, Hungary and Great Britain<sup>1</sup>.

Despite the significant extent of utilization of hard coal in Europe and Eurasia, both mining production and consumption of this raw resource has been systematically decreasing since the early 1990s. A slight increase of production and consumption in comparison to previous periods occurs only in years 2010–2014 both in Europe and Eurasia. The main reason for this increase is a growing demand for electricity and lower than expected rate of development of renewable sources of energy (Marques & Fuinhas, 2012, pp. 109–118; Hong *et al.*, 2015, pp. 451–459; Ferguson, 2006, pp. 50–54). A drop of prices of coal caused by its oversupply in the United States and Australia, located in the form of export in European countries is also of great significance for the increase of the utilization of this resource in power industry.

The prospective energy security is guaranteed for the main coal consumers in Europe and Eurasia by the significant deposits of this resource and their sufficiency. It is worth noting, however, that in a relatively short period, as not exceeding 30 years, the deposits will run out in Romania, Czech Republic and the United Kingdom. In Poland the sufficiency of the coal deposits also covers a relatively short time perspective, amounting only 38 years. The greatest potential also characterizes Germany, Kazakhstan and Ukraine, corresponding to sufficiency exceeding 200 years.

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<sup>1</sup> Detailed information about the type of coal (hard, brown, coking) mined and utilized in particular countries of Europe and Eurasia were presented in the chapter devoted to the selection of enterprises for empirical research.

Among the European countries the sufficiency of hard coal deposits exceeding one hundred years characterizes Spain and Turkey.

Despite the utilization and rather significant sufficiency of hard coal as an energy resource, in Europe the use of coal in the economy is significantly limited by the restrictions concerning the emission of carbon dioxide and compounds of sulfur and nitrogen into the atmosphere and by the promotion of renewable sources of energy, leading to decarbonization and focus on the realization of proecological priorities in power industry (compare Haftendorn *et al.*, 2012, pp. 274–283; Kasman & Duman, 2015, pp. 97–103; Gawel *et al.*, 2014, pp. 175–182; Lund, 2007, pp. 799–806; Flues *et al.*, 2014, pp. 91–99). The guidelines in this area take the form of documents generally applicable in the countries of the European Union. The utilization of coal in Europe is not helped by the aforementioned *Council Decision on State aid to facilitate the closure of uncompetitive coal mines* (2010/787/UE). Until the year 2010 the EU hard coal mining industry has been systematically subsidized as a part of the *Council Regulation (EC) No. 1407/2002 of 23 July 2002 on State aid to the coal industry* (see Frondel *et al.*, 2007, pp. 3807–3814). According to this *Regulation* maintaining the domestic energy security justified providing public aid to unprofitable hard coal mines (compare Olkuski, 2011, pp. 42–45). The financial support for the mining industry covered a wide range of subjects, including: aid for the closure of unprofitable mines, operational aid, investment aid and aid for inherited extraordinary costs related to the restructuring of the sector. The aforementioned categories of aid for hard coal mining industry have been restricted by the aforementioned *Decision*, according to which public aid may currently only cover the costs of liquidating mines (Jonek-Kowalska, 2015, pp. 69–87).

### **Risk sources and assessment methodology of their influence on financial result**

In every company financial result is shaped by sales revenues and production costs. These are the most important parts of the final results of company's activity, therefore, in this paper the focus is on these two variables that indicate operating result, which is the subject of key analysis. It was additionally assumed that in the last few years the revenues in mining enterprises have been mainly affected by the resource price undergoing considerable fluctuations and showing a decreasing tendency recently. Sales volume shaped by the demand for hard or coking coal in the domestic and Europe-

an economy has also significance for mining enterprises (Kowalska-Styczeń & Sznajd–Weron, 2006; Caputa, 2015, pp. 1–157).

In turn, in terms of costs the main determinant of financial result is the employment level and accompanying share of wages costs in the structure of total costs. In hard coal mining industry — due to traditionalism and labor intensity — wages costs are the most important total costs element and in a major part they have a character of fixed costs because of the necessity of maintaining mine's infrastructure even in the conditions of a reduced excavation level (Michalak, 2016, pp. 317–329; Michalak, 2013, pp. 380–384). Additionally, taking into account the cost intensity of mining production, in the part of cost analysis of financial result the cost index was used being a relationship of production costs to sales revenues and it reflects the level of resource thriftiness and usage in a company (Bąk, 2007, pp. 93–108; Sierpińska & Bąk, 2013, pp. 141–155).

Finally, risk checklist incorporated 6 factors in the examined mining enterprises:

- price of steam coal for enterprises mining coal for power industry or price of coking coal for enterprises producing coal for steel manufacturers,
- consumption of steam hard coal in the country for enterprises mining coal for power industry or consumption of coking coal in the country for enterprises producing coal for steel manufacturers,
- consumption of steam hard coal in Europe for enterprises mining coal for power industry or consumption of coking coal in Europe for enterprises producing coal for steel manufacturers,
- employment level in the examined mining enterprises,
- share of wages costs in total costs,
- cost index (Nawrocki & Jonek-Kowalska, 2016, pp. 50–67).

In order to determine the influence of these factors on financial result, in the first stage Pearson correlation coefficient was used and in the second stage multiple regression functions were used. Furthermore, taking the market tendencies described into account, the following research hypotheses were used:

*H1. The most important risk source in the revenues part in mining enterprises currently are changes of hard coal prices on global market.*

*H2. The most important risk source in the cost part in mining enterprises is a high share of wages costs in the total cost structure.*

## **Selection of research sample**

When choosing the companies for examining the relationships of value — risk, four key criteria were referred to that were supposed to provide comparability for the results obtained and make it possible to formulate the conclusions of a general character from research. These are the criteria:

- geographical — guaranteeing similar socio-economic and geological-mining conditions,
- organizational — enabling distinguishing mining activity and its results,
- technical — allowing grouping the enterprises in terms of excavation method used,
- utilitarian — making it possible to gather data necessary for research on value and risk.

Finally, after analyzing the whole mining industry in Europe, 4 enterprises were distinguished that comply with all four above mentioned conditions. These enterprises are: LW Bogdanka SA, Jastrzębska Spółka Węglowa SA, Coal Energy SA and New World Resources Plc. All the aforementioned subjects are listed on Warsaw Stock Exchange (Rydzewska, 2016, pp. 49–62). In the analysis of case studies within the frames of the enterprises the data from financial statements were used as well as statistical data concerning the economy of Poland, Czech and Ukraine. The research encompassed the years 2011–2014.

## **Research results**

In table 1 correlation coefficients are presented for operating result and risk sources distinguished in the examined mining enterprises.

According to the results obtained, the variable significantly related to the operating result is cost index in all the enterprises, furthermore, the strength of this relationship is increasing in the enterprises excavating coking coal mainly (NWR Plc and JSW SA), where the financial situation has considerably deteriorated in the analyzed period. These are the enterprises performing on the global market, highly exposed to fluctuations of coking coal prices, what is also reflected by high and statistically significant relationships of prices with operating result.

Price is also significantly related to financial result in Ukrainian enterprise Coal Energy. In LW Bogdanka weaker and lower number of relationships of distinguished risk factors with operating result are observed, what to a great extent stems from a permanent local sales market of this enter-

prise, guaranteeing sales security and resistance to price changes on global market.

In table 2 and 3 the results of multiple regression functions for the examined mining enterprises are presented. These functions are well adjusted for the enterprises mining coking coal. Accordingly, for the Czech enterprise NWR, being in the worst situation, financial result is most affected by cost index, employment level and hard coal price. In JSW the main determinants of operating result are hard coal prices and domestic production of steel.

In case of less adjusted multiple regression functions in the enterprises excavating steam coal, the most important risk factors also include hard coal price. In LW Bogdanka the determinants of operating result, also significant, are the following: cost index, employment and domestic coal production, what results from the local range of production. In Coal Energy important are: cost index, European hard coal production and share of wages in total costs.

## Conclusions

According to the above, the most important risk source is hard coal price in the world for the examined enterprises, what allows confirming the first research hypothesis, according to which: *H1. The most important risk source in the revenues part in mining enterprises currently are changes of hard coal prices on global market.* In turn, the second research hypothesis stating that *H2. The most important risk source in the cost part in mining enterprises is a high share of wages costs in the total cost structure* cannot be positively verified as from the analysis conducted it results that it is cost index. That is confirmed by the significance of cost intensity of mining production for operating results of enterprises functioning in this industry.

From the research conducted also the necessity arises related to introducing cost reduction and flexibility in all the examined mining enterprises. It is the only method of resistance to changing and decreasing hard coal prices in the world, independent from the examined enterprises, but strongly affecting their operating result. For this reason, in further research one should focus on cost and risk management methods in mining industry, allowing these companies to survive in changing conditions of the economic environment.

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## Annex

**Table 1.** Pearson correlation coefficients for operating results and risk sources distinguished for the examined mining enterprises

Specification	Mining enterprises			
	LW Bogdanka	Coal Energy	JSW	NWR
coal price (steam/coking)	-0,3542	0,5378*	0,9013*	0,7566*
domestic production (coal/steel)	-0,3094	0,0331	0,3687	0,1421
European production (coal/steel)	0,0889	0,0411	0,3005	0,3715
employment	0,3012	0,3135	-0,3231	0,6307*
share of wages	-0,1762	0,2278	0,0904	-0,0483
cost index	-0,4547*	-0,6725*	-0,8559*	-0,8769*

\*p<0,05

**Table 2.** Multiple regression functions for LW Bogdanka and Coal Energy

Specification	LW Bogdanka			Coal Energy		
<b>R</b>	0,6739			0,8733		
<b>R<sup>2</sup></b>	0,4542			0,7627		
<b>R<sup>2</sup> adjusted</b>	0,2359			0,5847		
<b>F</b>	F(6,15)=2,0802			F(6,8)=4,2858		
<b>p</b>	p<0,1171			p<0,313		
Variables	Parameters			Parameters		
	b*	b	p	b*	b	p
coal price (steam/coking)	0,2789	602,58	0,6931	-0,4685	-15 741	0,6640
domestic production (coal/steel)	-0,2881	-7,17	0,2184	0,0622	20,20	0,7856
European production (coal/steel)	0,0527	0,38	0,8526	-1,4464	-167,70	0,1039
employment	0,6779	43,34	0,3337	0,4013	247,91	0,5447
share of wages	0,0816	55 619	0,7663	-0,7921	-15 002 146	0,3655
cost index	-0,5922	-481 249	0,0429	-1,6754	-7 325 965	0,1209

**Table 3.** Multiple regression functions for JSW and NWR

Specification	JSW	NWR
<b>R</b>	0,9314	0,9434
<b>R<sup>2</sup></b>	0,8677	0,8900
<b>R<sup>2</sup> adjusted</b>	0,7542	0,7958
<b>F</b>	F(6,7)=7,6489	F(6,7)=9,4433
<b>p</b>	p<0,0084	p<0,0045

**Table 3.** Continued

Variables	Parameters			Parameters		
	b*	b	p	b*	b	p
coal price (steam/coking)	0,8433	18 133	0,2215	-0,2647	-372,27	0,6131
domestic production (coal/steel)	0,2035	477,82	0,2675	0,1819	63,55	0,3808
European production (coal/steel)	0,0156	3,63	0,9240	-0,0582	-0,8871	0,7712
employment	-0,0314	-9,63	0,8570	0,7151	17,19	0,1556
share of wages	-0,0856	-2 378 085	0,6029	0,1851	134 038	0,4023
cost index	-0,0297	-76 146	0,9634	-0,7345	-12 699	0,0208