

KRYSTIAN PERA¹

Investment attractiveness of natural resources companies and commodity contracts – a comparative analysis for the first half of 2019 and 2020 motivated by the SARS-Cov-2 pandemic

Introduction

The Polish economy and the entire global economy have experienced a period of strong economic turbulence caused by the ongoing SARS-Cov-2 pandemic in 2020. Investors are recording significant losses, and one should anticipate a decline in the gross domestic product in most (if not all) countries. The current economic situation provides the basis to seek the answer to the question whether all sectors of the economy are equally strongly affected by the wave of the crisis or are there sectors that show at least partial resilience to the economic downturn.

This paper presents selected elements of the investment characteristics of the raw material sector exhibited by two indirect forms of commodity investment. Namely, the analysis

✉ Corresponding Author: Krystian Pera; e-mail: krystian.pera@ue.katowice.pl

¹ University of Economics, Katowice, Poland; ORCID iD: 0000-0003-2924-0713;
e-mail: krystian.pera@ue.katowice.pl



covered share prices of selected companies of the Polish commodity exchange and commodity contracts linked with the analyzed natural resources companies.

The paper intends to answer an aggregate research question: Is the raw material sector resilient (and if so, to what extent) towards negative changes in the domestic and global economy? In terms of a time horizon, the research covers the first half of 2019 (as an example of the time of economic growth) and comparatively the first half of 2020 (as an example of the time of the economic crisis).

1. Methodological assumptions, research goals

The management of natural resources has many faces and, at the same time, various ways of benefiting from natural resources. This paper analyses two indirect forms of benefiting from investments in deposit resources. The study adopted the perspective of a hypothetical investor who is looking for sources of income in investments in natural resources in an indirect form of shares of natural resources companies or commodity contracts.

The investment strategy perspective of the analyzed hypothetical investor was divided into two parts based on two criteria. The first division concerns the subject of the investment. It was assumed that the first way was to invest in the purchase of shares of natural resources companies listed on the Warsaw Stock Exchange: Jastrzębska Spółka Węglowa SA (JSW) and Lubelski Węgiel Bogdanka SA (LWB) (coal companies), Kombinat Górniczo-Hutniczy Polska Miedź SA (KGHM) (a copper company) and Polskie Górnictwo Naftowe i Gazownictwo (PGNiG) (extraction of hydrocarbons). Two other large companies (PKN Orlen and LOTOS) belong to the raw materials sector on the Warsaw Stock Exchange (as the fuel sector). However, as their structure of operations is slightly different from that of PGNiG, it was assumed that only PGNiG would represent the hydrocarbon production company. In the paper, PKN Orlen and LOTOS were partially included in the analysis by comparing selected rates of return of these companies and the rate of return on crude oil contracts.

The other method of indirect investment in the analyzed natural resources is the purchase (long position) or the issue (short position) of futures contracts for the following raw materials: hard coal, copper and Brent crude oil. Methodologically, it has been assumed that the investor buys or issues a contract at the price equal to the price of the commodity on the contract issue date and executes the contract after six months at the current price of the commodity on the day the contract is performed.

The other criterion for the division of investments, which is also a comparative criterion, is the time period of the investment. It was assumed in the first option that the investment lasted for the first 6 months of the calendar year of 2019, and in the second option – for the first half of 2020. This enables an assessment to what extent the analyzed forms of commodity investments are effective in the period of economic growth (2019) and in the

period of economic crisis (2020). Obviously, this is a short time perspective, which limits the power of inference. However, such a time period was adopted due to the time of writing this paper. The paper was written after the end of the first 6 months of the economic crisis of 2020. As the Polish and the world economy have been in a crisis situation for six months, two six-month periods were adopted for the symmetry of comparisons and analysis.

In this context, it was assumed that on the stock market, the investor bought the shares of the listed companies during the first trading session in 2019 and sold these shares at the last session in June 2019. For the sake of comparison, the investor carried out the same transactions in the corresponding period of 2020. The arithmetic rates of return, which are a relative measure of the profitability of the analyzed investments, the level of investment risk expressed by the standard deviation of monthly rates of return, and the relationship with the market of large listed companies were worked out by calculating the Pearson linear correlation coefficients of the rates of return of the analyzed companies to the WIG20 stock exchange index. Further, it was assumed that the investor does not create a compound portfolio of the analyzed shares, but instead invests the available capital alternatively in each analyzed single asset. The analysis of these investments enables the comparison of the effectiveness of companies in the raw materials sector over time, and thus enables the assessment of the degree of their response to crisis phenomena.

The other form of indirect investments in commodities (contracts) was analyzed in terms of the possible rates of return, so that it was possible to compare them with the rates of return on shares and thus answer the research questions posed.

The subject of the research results directly from the research objective set, which is to answer two basic questions:

1. Does the raw material sector show characteristics of efficiency resilience to crisis conditions and how do the rates of return achieved by this sector compare to the stock market of large companies?
2. Which of the analyzed forms of indirect investment (stocks or contracts) is characterized by higher efficiency in the period of economic boom and crisis?

The issues discussed in this paper were the subject of prior research by both Polish and foreign authors. The prior studies share a certain common characteristics as they analyzed so-called commodity funds, not commodity stocks or a portfolio of commodity stocks. In this way, the approach to the issues in question in this paper is somewhat distinct. A similar approach is used in research, for example, on the effectiveness of investing in socially responsible companies (Buła 2019b).

Generally, the authors of the publications treat indirect investments in raw materials as so-called alternative investments, which is hard to agree with. The category of alternative-ness relates to the subject of investment and, in this terms, each form of investment is alternative to the other. If we tried anyhow to separate commodity investments from the classical financial market, they are of a slightly different nature, but – in the view of the author – they are also typical.

The economic crisis of the first decade of the 20th century also triggered the interest of researchers. The effectiveness of commodity funds on the Polish market is described, for example, by (Moskal and Zawadzka 2017) or (Krawiec 2012). As far as overseas research is concerned, it is worth noting studies by (Jensen and Mercer 2011) or an analysis of the effectiveness of a very long-term investment, from 1877 to 2016 by (Levine et al. 2018). An equally long time horizon of research on the rate of return on investment in commodities is presented by (Court and Fizaine 2017). In these studies, the authors use energy, not financial, measures of return.

The commodities analyzed in this paper are of strategic nature. They are strategic in terms of their high economic utility. Strategic goods have always been the subject of financial speculation. The effectiveness of arbitration on strategic commodities is presented, e.g. by (Hain et al. 2018). Finally, the analysis of the issues in question may be carried out to verify the hypothesis of information efficiency of strategic commodities. Such studies are presented by (Jawadi et al. 2017) for the period of 1997–2016.

Commodity investments are also assessed from the point of view of the fundamental analysis of natural resources companies. An interesting comparison for the years 2014 to 2018 for Polish and foreign hard coal companies is presented by (Sierpińska-Sawicz et al. 2020). A similar long-term analysis of Polish coal companies, considering restructuring processes, is provided by (Sobczyk et al. 2020). A different point of view taking the problem of modelling influence of macro- and microeconomic determinants of capital expenditures in coal mining industry into account is presented e.g. by (Franik 2012).

The analysis presented in this paper is an attempt to supplement the mentioned studies with the Polish market conditions.

All data on share prices and commodities come from websites. The share prices come from the official website of the Warsaw Stock Exchange (pl), and the commodity prices from the website: <https://markets.businessinsider.com/commodities>.

2. Financial efficiency of investments in shares of natural resources companies in the first half of 2019

2.1. Rates of return analysis

The comparative analysis of companies against the market was presented in a synthetic manner. This was achieved by comparing the arithmetic monthly rates of return, the analysis of investment risk understood as the standard deviation of monthly rates of return and for positive rates of return in the form of the coefficient of variation, and the analysis of dependence expressed by the level of Pearson's linear correlation coefficients for individual companies and the WIG 20 index.

Table 1. Quotations of the analyzed companies together with monthly and semi-annual arithmetic rates of return for the first half of 2019

Tabela 1. Notowania analizowanych spółek wraz z miesięcznymi i półrocznymi arytmetycznymi stopami zwrotu za pierwsze półrocze 2019 roku

Company	Purchase price P_0	Months of 2019							Half-year
			31.01.	28.02.	31.03.	30.04.	31.05.	30.06.	
JSW	67.26	P_t	68.30	57.60	61.00	58.05	50.2	47.20	
		r	1.55%	-15.67%	5.90%	-4.84%	-13.52%	-5.98%	-29.82%
LWB	51.30	P_t	56.20	51.50	47.55	40.50	35.40	35.60	
		r	9.55%	-8.36%	-7.67%	-14.83%	-12.59%	0.56%	-30.60%
KGHM	88.88	P_t	94.16	101.30	107.00	102.85	95.00	103.50	
		r	5.94%	7.58%	5.63%	-3.88%	-7.63%	8.95%	16.45%
PGNiG	6.91	P_t	7.63	6.92	6.25	5.8	5.6	5.31	
		r	10.42%	-9.31%	-9.68%	-7.20%	-3.45%	-5.18%	-23.15%

Source: own computation.

The arithmetic rates of return were calculated as:

$$r = \frac{P_1}{P_0} - 1$$

where P_1 is the company's exchange rate at the end of each subsequent month, and P_0 is the company's exchange rate at the end of the previous month. In this sense, the rate of return for January is calculated relative to the last December stock exchange quotation, which is contractually treated as the purchase price of each company.

The arithmetic rates of return for the holding period (first half of 2019) outside of KGHM are negative. Naturally, the same values carry certain information about the efficiency of stock exchange commodity companies, whereas the power of inference is enhanced by the answer to the next question: how did the prices of these shares behave compared to stock market indices? For this purpose, a comparison of the obtained partial results with the rates of return of the WIG20 stock index as an example of large capitalization companies was adopted. A comparative analysis with the WIG20 index allows us to answer the question of the relative effectiveness of the analyzed companies compared to the Polish stock exchange market of large companies.

However, the relativity is significant when a 1% increase in the company's share prices compared to 1% of the overall market growth has a different weight in relation to, e.g. a 1% increase in the company's share prices with a simultaneous 1% decrease in the market.

Therefore, it is not about the absolute efficiency of income or loss, but about relative efficiency in the form of rates of return, which enables a direct comparison of different stocks and different forms of investment. The WIG-mining index is also present on the Polish stock exchange and is made up of all mining companies analyzed in this paper and, additionally, the Australian Praire Mining Limited company. However, the share of the latter company in the index is only 0.185%, therefore the impact of its quotations on the index level is minimal (the structure of WIG – mining is very asymmetrical, as KGHM creates this index in 90.781%). This dominant position in the index is a derivative of a very high market capitalization compared to other companies).

Thus, it was assumed that the analysis of JSW, LWB and KGHM is synonymous to the analysis of the WIG-mining index, but provides a broader spectrum of information than just the analysis of the index itself. On the other hand, PGNiG is included in the WIG-fuels sector index, accounting for 24.88% of its value. The WIG20 index was adopted as a benchmark due to the fact that the subject of the analysis are companies with large capitalization and three out of four analyzed companies are included in the WIG20 (except for LWB).

Table 2. WIG20 index levels for the first 6 months of 2019

Tabela 2. Poziomy indeksu WIG20 w I półroczu 2019 roku

	Price 31.12.2018	First half of 2019							
			31.01.	28.02.	31.03.	30.04.	31.05.	30.06.	01.–06.
WIG20	2277	P_t	2 380	2 332	2 312	2 334	2 239	2 327	
		r	4.52%	-2.39%	-0.47%	0.95%	-4.07%	3.97%	2.24%

Source: own computation.

The Polish stock exchange market of large companies achieved a return rate of 2.24% for the entire first half of 2019, which is a much better result than the rates of return for JSW, LWB and PGNiG, and much weaker than KGHM. The commodity sector performed even worse compared to the entire stock exchange market, as the broadest stock exchange index, WIG, achieved a rate of return of 4.33% in the first half of 2019.

If prices and rates of return were to be treated as synthetic measures of effectiveness, and the first half of 2019 as an example of the period of economic growth, it is legitimate to conclude that the raw materials sector in the period of relative development is not effective (in terms of profitability) compared to the market of large companies. Furthermore, it is not effective in comparison to the entire stock market. Naturally, the conventionality of such inference is quite high, as only one six-month period was analyzed, but the actual investment in natural resources companies was not profitable at that time.

2.2. Risk analysis

The other criterion for comparative assessment is the risk analysis of investments in shares of natural resources companies. It is true that most of these companies did not achieve a positive rate of return. Therefore, the risk analysis itself is possible, but it does not carry significant information because for negative rates of return, even the lowest risk level increases the degree of ineffectiveness. However, since this paper is a comparative analysis over time (comparison with 2020), appropriate standard deviations of monthly rates of return were calculated. The author is aware of the existence of a wide range of risk measures, ranging from standard deviation to measures related to the fractal market theory, cf. (Buła 2019a). For the purposes of this paper, the classical standard deviation of the rates of return seems to be entirely sufficient.

Table 3. Standard deviations of monthly rates of return of raw materials companies and the WIG20 index for the first half of 2019

Tabela 3. Odchylenia standardowe miesięcznych stóp zwrotu spółek surowcowych oraz indeksu WIG20 za I półrocze 2019 roku

Company/index	Standard deviation of monthly rate of return
JSW	7.62%
LWB	8.30%
KGHM	6.22%
PGNiG	6.83%
WIG20	3.13%

Source: own computation.

As it can be seen from the data presented in the table, the risk of natural resources companies in the first 6 months of 2019 was at least twice as high as the risk of the WIG20 index, which, taking into account the negative rates of return of companies (except for KGHM), increases the negative assessment of the profitability of this sector on the stock market.

The volatility coefficient was calculated for KGHM and the WIG20 index as they achieved a positive rate of return in the analyzed period. This enables the answer to the question: how much risk is attributable to a unit of a positive rate of return? The coefficient of variation is the ratio of the level of standard deviation to the level of returns achieved. The logic behind the coefficient of variation clearly indicates that it is meaningful in an interpretive way only in terms of positive rates of return. In the analyzed area and period, the coefficient of variation is meaningful for KGHM (V_{KGHM}) and for the WIG20 index (V_{WIG20}). The values are as follows: $V_{\text{KGHM}} = 0.36$, $V_{\text{WIG20}} = 1.40$. This means that for one percentage point

of KGHM's rate of return, acceptance of 0.36 percentage points of the standard deviation was required. For the WIG20 index, the same ratio is at a much higher level and amounts to 1.40 percentage points. In this regard, KGHM was more effective than the WIG20 index and less risky at the same time.

2.3. Correlation analysis

It was assumed that the Pearson's linear correlation coefficient is a measure of the relationship between the analyzed rates of return. The levels of this ratio were calculated between the monthly rates of return of individual companies and the monthly rates of return of the WIG20 index, respectively. The direction and strength of the relationship are presented in the Table 4.

Table 4. Linear correlation coefficients between the rates of return of companies and the WIG20 index

Tabela 4. Współczynniki korelacji liniowej pomiędzy stopami zwrotu spółek i indeksu WIG20

Correlation	
WIG20 – JSW	0.57
WIG20 – LWB	0.77
WIG20 – KGHM	0.53
WIG20 – PGNiG	0.55

Source: own computation.

All correlation coefficients are positive, which means that the rates of return of all the analyzed companies followed the changes in the rates of return of the WIG20 index. However, their levels are around 0.5 (except for LWB) which indicates a moderate strength of correlation.

To sum up, it should be clearly stated that in the first half of 2019, investments in natural resources companies were financially unprofitable. The only exception is KGHM, which achieved a positive rate of return, similar to the WIG20 index.

3. Financial efficiency of investments in shares of natural resources companies in the first half of 2020

3.1. Rates of return analysis

In line with the research methodology adopted at the outset, it was assumed that the first half of 2020, due to the global Covid-19 pandemic, is a period of economic crisis. Although the future course of the domestic and world economy is largely unknown at the time of writing this paper, the last half of 2020 may be considered a time of a strong economic downturn. This part of the paper attempts to answer the question: how did indirect investments in commodities (as in 2019, i.e. shares and commodity contracts) reflect the global crisis, and whether investing in commodities is a good form of capital allocation in times of strong economic turbulence.

For this purpose, and to maintain full comparability of the results, the said investments were analyzed in the same way as for 2019, assuming a six-month time horizon (in this case, the first 6 months of 2020). The prices of the analyzed shares and the rates of return are presented in the Table 5.

For the crisis-driven first half of 2020, the six-month rates of return of three companies were negative (JSW, LWB, KGHM) and one was positive (PGNiG). The analysis of the structure of monthly rates of return is interesting. Therefore, in the first two months,

Table 5. Quotations of the analyzed companies with monthly and semi-annual arithmetic rates of return for the first half of 2020

Tabela 5. Notowania analizowanych spółek wraz z miesięcznymi i półrocznymi arytmetycznymi stopami zwrotu za pierwsze półrocze 2020 roku

Company	Purchase price P_0	Months of 2020							Half-year
			31.01.	28.02.	31.03.	30.04.	31.05.	30.06.	
JSW	21.38	P_t	18.8	13.53	12.44	13.69	16.54	18.7	
		r	-12.07%	-28.03%	-8.06%	10.05%	20.82%	13.06%	-12.54%
LWB	33.60	P_t	29.8	16.46	17.9	21.1	19.5	22.05	
		r	-11.31%	-44.77%	8.75%	17.88%	-7.58%	13.08%	-34.38%
KGHM	95.58	P_t	91.2	70.54	59.82	76.98	86.28	90.9	
		r	-4.58%	-22.65%	-15.20%	28.69%	12.08%	5.35%	-4.90%
PGNiG	4.33	P_t	3.6	3.17	3.44	3.71	4.2	4.54	
		r	-16.86%	-11.94%	8.52%	7.85%	13.21%	8.10%	4.85%

Source: own computation.

when the information about the pandemic was not widely circulated, the monthly rates of return of all the analyzed companies were already negative. In March 2020, when the stock exchange as a whole recorded a dramatic slump, two of the analyzed companies recorded an increase (LWB and PGNiG). In particular, for LWB it was not resilience to the impending crisis, but some form of rebound to a very large drop in exchange rates by 44.77% in February 2020. Starting from April 2020, the share prices on the Polish stock exchange began to increase significantly, which, however, did not translate into increases in the prices of commodity companies, as shown by the levels of six-month rates of return.

At the same time, the WIG20 index of large companies was at the levels shown in the Table 6.

Table 6. Levels of the WIG 20 index in the first half of 2020

Tabela 6. Poziomy indeksu WIG 20 w I półroczu 2020 roku

	Purchase price 31.12.2020	Months of 2020							
			31.01.	28.02.	31.03.	30.04.	31.05.	30.06.	01.–06.
WIG20	2150	P_t	2 066	1 769	1 513	1 649	1 723	1 759	
		r	-3.91%	-14.38%	-14.47%	8.99%	4.49%	2.09%	-18.19%

Source: own computation.

As it may be seen from the above data, the index of large companies recorded a decrease of 18.19% in the first half of 2020. JSW and KGHM were better in that that the level of decline in their prices was smaller. LWB lost significantly more than all large companies (loss of 34.39%). Compared to the market of WIG 20 index, PGNiG is the best among the analyzed companies, with a positive rate of return of 4.85%. It is worth noting that PGNiG turned out to be much more effective during the economic crisis than during the economic growth, when it recorded a negative rate of return.

3.2. Risk analysis

For the first half of 2020, standard deviations of the monthly rates of return of the analyzed companies were also calculated. The reservation remains that for negative rates any investment risk only increases the losses. However, there are two aspects of the comparison in this case. First, whether the risk of the analyzed companies increased in 2020 and, second, how the change in the companies' risk level compares with the change in the risk level of the entire market of large companies, i.e. the standard deviation of the WIG20 index. The data for 2020 is presented in the Table 7.

Table 7. Standard deviations of monthly rates of return of natural resources companies and the WIG20 index for the first half of 2020

Tabela 7. Odchylenia standardowe miesięcznych stóp zwrotu spółek surowcowych oraz indeksu WIG20 za I półrocze 2020 roku

Company/index	Standard deviation of the monthly rate of return
JSW	16.82%
LWB	21.06%
KGHM	17.13%
PGNiG	11.46%
WIG20	9.01%

Source: own computation.

As expected, the risk of the analyzed companies, expressed as the standard deviation of rates of return during the crisis, is higher than for 2019. A common phenomenon on the stock exchange in times of crisis is a higher volatility of rates, and thus also rates of return. It was no different for the analyzed natural resources companies. All the analyzed companies are characterized by a higher level of risk. The lowest level of standard deviation was recorded by PGNiG in this period, and the highest volatility (similar to 2019) was recorded by LWB. Comparing the calculated levels of the standard deviation of the analyzed companies with the standard deviation of the WIG 20 index, it can be seen that natural resources companies are more vulnerable to economic turbulence than the index.

The conclusion about the effectiveness of these companies during the economic crisis is that they are more risky than the entire market of large companies. On the other hand, the standard deviation is a measure of volatility, not a risk, therefore, in proportion to the level of risk for natural resources companies, the probability of an above-average high and above-average low rate of return increases. Based on those criteria, PGNiG compares favorably, as it was the only company to achieve a positive six-month rate of return with the lowest standard deviation level analyzed.

3.3. Correlation analysis

As for the first half of 2019, the levels of linear correlation coefficients were calculated for the analyzed companies and the WIG20 index. Their levels are presented in the Table 8.

During this period, an increase in correlation with the market can be observed for two out of four analyzed companies. The rates of return for JSW and even more for KGHM were strongly positively correlated with the market of large companies in the first half of 2020.

Table 8. Linear correlation coefficients between the rates of return of companies and the WIG20 index

Tabela 8. Współczynniki korelacji liniowej pomiędzy stopami zwrotu spółek i indeksu WIG20

Correlation	
WIG20 – JSW	0.84
WIG20 – LWB	0.57
WIG20 – KGHM	0.97
WIG20 – PGNiG	0.46

Source: own computation.

The correlation of PGNiG was moderate as compared to 2019, and in 2020, LWB was less correlated with the market than in 2019.

A comparison of the correlation coefficients for the analyzed periods of 2019 and 2020 gives some grounds to conclude that during the economic crisis, the trends in changes in the share prices of natural resources companies follow the market more than in the period of economic growth. This, in turn, again weakens the argument about the resilience of investment in commodity stocks to the economic crisis.

The following part of the paper presents a similar analysis of the profitability of the other of the mentioned forms of indirect investment in raw materials, namely investment in commodity contracts. This enables the achievement of the assumed objective in this paper whether this form of indirect investment in the commodity market shows efficiency resilience to turbulence in the economy.

4. Financial efficiency of investments in hard coal, copper and crude oil contracts in the first half of 2019

Futures contracts, just like the purchase of shares, are an indirect form of investment in the commodity market and, for the same time periods, in terms of the rates of return can be directly compared with each other. The efficiency analysis of the investment in the shares of natural resources companies presented earlier in this paper will be compared in this section to the profitability of purchasing or issuing futures contracts for hard coal, copper and crude oil (Brent). The prices expressed in USD/Mg (copper and hard coal) and USD/bbl for oil are presented below. The prices of these commodities are presented as at the beginning of 2019 and as at June 30, 2019. The semi-annual rates of return for these commodities are also presented (Table 9).

As the analysis of prices and rates of return concerns companies listed on the Polish stock exchange, in order to maintain full comparability of results, the prices of commodities were converted, and thus the rates of return into the Polish currency based on the ave-

Table 9. Prices of commodities in the first half of 2019 in USD and semi-annual rates of return

Tabela 9. Ceny surowców w I półroczu 2019 roku w USD oraz półroczne stopy zwrotu

	Copper		Hard coal		Crude oil (Brent)	
	01.01.2019	30.06.2019	01.01.2019	30.06.2019	01.01.2019	30.06.2019
Price	5 819	5 982	75.4	54.3	54.91	66.55
Arithmetic rate of return	2.80%		-27.98%		21.2%	

Source: own computation.

rage US dollar exchange rate (NBP quotations) for the relevant dates of the analysis period. At the beginning of January 2019, the average US dollar exchange rate was PLN 3.76, and at the end of the first 6 months of 2019, PLN 3.73. The calculated values are presented in the next Table 10.

Table 10. Prices of commodities in the first half of 2019 in PLN and semi-annual rates of return

Tabela 10. Ceny surowców w I półroczu 2019 roku w PLN oraz półroczne stopy zwrotu

	Copper		Hard coal		Crude oil (Brent)	
	01.01.2019	30.06.2019	01.01.2019	30.06.2019	01.01.2019	30.06.2019
Price	21 879	22 313	283.50	202.54	206.46	248.23
Arithmetic rate of return	1.98%		-28.56%		20.23%	

Source: own computation.

The effectiveness of investments in commodities understood this way was highly diversified, but almost independent of the currency price. Investments in hard coal in the analyzed period were strongly unprofitable, copper allowed to achieve a positive, but low rate of return. It is worth noting that the rate of return on copper, at 2.8% for USD prices and 1.98% for PLN prices, made this investment generally unprofitable. If we assume that in this period in Polish conditions the risk-free rate of return was at the level of 1%, the achieved risk premium understood as the difference between the rate of return on copper and the risk-free rate is so low that it does not compensate for the volatility risk of the commodity prices.

The rate of return for crude oil is the most favorable, exceeding 20%. It should also be noted that the rates of return calculated for prices denominated in the Polish currency are at a slightly lower level, due to a slight decline in the dollar exchange rate in the analyzed period. A stronger appreciation of the zloty slightly decreased the rate of return.

4.1. Comparison of the effectiveness of investments in shares of Polish natural resources companies and commodity contracts for the first half of 2019

Assuming the methodological assumptions of this paper that 2019 was treated as an example of domestic and global economic growth, the following is a comparison of the financial profitability of the two analyzed intermediate forms of investment in commodities in the form of shares of natural resources companies and commodity contracts. The comparative criterion is the arithmetic rate of return on shares and contracts (for contracts, the rate for prices expressed in PLN). As the shares of two coal companies (JSW, LWB) were analyzed earlier, a weighted average of the rates of return of these companies was used for this comparison. The weights in this case are the capitalization levels of both companies as at June 30, 2019. JSW's capitalization was around PLN 4.65 billion, and LWB at around PLN 1.25 billion. Thus, the weight for JSW is 0.79 and for LWB is 0.21. Therefore, the rate of return on the two-component portfolio of coal shares for the first half of 2019 was minus 29.99%. The comparison of the rates of return is presented in the Table 11.

Table 11. Comparison of rates of return for the first half of 2019 of shares of natural resources companies and commodity contracts

Tabela 11. Porównanie stóp zwrotu za I półrocze 2019 roku akcji spółek surowcowych oraz kontraktów na surowce

	Copper	Hard coal	Crude oil (Brent)
Shares	9.92%	-29.99%	-30.41%
Contracts	1.98%	-28.56%	20.23%

Source: own computation.

The results of the comparison (except for the investment in hard coal) are very diverse. Comparing the shares of the PGNiG company with the broadly understood crude oil market, it can be seen that the achieved rates of return differ significantly. The shares recorded a loss of over 23%, and the crude oil contracts allowed for a positive rate of return of over 20%. Referring this relation to the two other fuel sector companies mentioned at the beginning of the paper, namely PKN ORLEN and Grupa LOTOS, their semi-annual rates of return for the first half of 2019 were: minus 15.23% and minus 3.60% respectively. Share prices for PKN ORLEN were PLN 106.15 on 2 January 2019, PLN 89.98 on 28 June 2019, and for Grupa LOTOS PLN 87.86 and PLN 84.70, respectively.

There was also loss recorded in these cases, albeit much lower than for PGNiG, especially for Grupa LOTOS. However, the direction of the comparison remains unchanged in favor of crude oil contracts.

Investment in copper in the analyzed period was characterized by a positive rate of return for both shares and contracts, while investment in KGHM shares was much more

profitable. On the other hand, the investment in hard coal gave a strongly negative (and very close to the level for contracts) rate of return, thus being the worst among the analyzed investment options.

To sum up this part of the analysis, quite clear conclusions can be drawn. Indirect commodity investments in the first half of 2019 did not turn out to be financially effective. Among the two analyzed forms of indirect investment in commodities, the investment in commodity contracts turned out to be more profitable (positive rate of return for copper and crude oil, and negative rate for coal). On the other hand, investment in shares of natural resources companies gave negative rates of return for two commodities (coal and crude oil) and a positive rate of return for copper.

Generally, for the period of economic growth (as defined in this paper), the best investment was the purchase of crude oil contracts (semi-annual rate of over 20%), and the worst investment was hard coal (semi-annual rate of almost minus 30%, regardless of whether it is contracts or shares).

5. Financial efficiency of investments in hard coal, copper and crude oil contracts in the first half of 2020

Similarly to 2019, the profitability analysis for contracts for selected commodities for the first half of 2020 was carried out. In line with the adopted methodology, this time period was selected for analysis in order to answer the question: is this form of indirect investment resilient to the economic crisis in the financial market. The prices of the analyzed commodities expressed in US dollars and the semi-annual rates of return are presented in the Table. 12

Table 12. Prices of commodities in the first half of 2020 in USD and semi-annual rates of return

Tabela 12. Ceny surowców w I półroczu 2020 roku w USD oraz półroczne stopy zwrotu

	Copper		Hard coal		Crude oil (Brent)	
	01.01.2020	30.06.2020	01.01.2020	30.06.2020	01.01.2020	30.06.2020
Price	6 165	6 038	45.55	49.85	66.25	41.15
Arithmetic rate of return	-2.06%		9.44%		-37.89%	

Source: own computation.

A comparative analysis should be carried out for the data presented in the table to the analogous values for 2019. The smallest difference is noticeable for the price of copper.

While the semi-annual rate of return was 1.98% in 2019, in the crisis-driven first half of 2020, the corresponding rate is slightly negative. On this basis, it can be concluded that investment in copper is cyclical in that the direction of price changes corresponds to the economic situation with moderate changes in the rates of return.

The conclusions for crude oil are completely different. Crude oil was and is a strategic resource. The strategic role of this commodity is both economic and political. Therefore, significantly greater fluctuations in the prices of this commodity could be expected. The analysis of the data for 2019 and 2020 clearly shows that the volatility of prices is high, and the direction of changes is consistent with the fluctuations in the global economy. In 2019, i.e. in the boom phase, the price of crude oil increased by 20.23% in the first half of the year, to decrease by 37.89% in the economic crisis of the first half of 2020. For a potential investor in the commodity contracts market, this is an indication that if crude oil contracts were to be a way of investment in the commodity market, long positions should be assumed on the contracts (purchase of crude oil contracts) in the period of increases, and in times of economic downturn the short positions (issue of contracts) should be taken.

From the data on hard coal presented in the paper, the results are opposite to the analysis of crude oil prices. In the analyzed period of growth, coal prices decreased by over 28% on a six-month scale, while in the period of the economic downturn, prices increased by over 9%. Clearly, it is difficult to draw far-reaching conclusions on the basis of a comparison of only two six-month periods, but the direction of inference in this case is that hard coal is a good investment commodity for periods of crisis and an unprofitable investment in times of economic prosperity. Perhaps the logic behind such a direction of price changes is that, in periods of economic growth, the world turns to alternative energy sources and under crisis conditions, with a global, though relative scarcity of capital, hard coal becomes a strategic asset again. It is also worth noting that the data presented in the paper on the effectiveness of shares of coal companies, unlike coal contracts, did not show any significant dependence on the state of the global economic situation.

Bringing this part of the analysis closer to Polish conditions, the change in the US dollar exchange rate in the analyzed period of the first half of 2020 was taken into account. It is justified as the Polish currency still shows a strong correlation with changes in the world economy and usually becomes significantly weaker in periods of economic downturn and gains disproportionately less in economic booms. In the analyzed period, the US dollar exchange rate increased from PLN 3.80 at the beginning of January 2020 to PLN 3.98 at the end of the first half of 2020. In this case, the increase is at the level of 4.7%, at the same time, for the same period of 2019, the Polish zloty strengthened by 0.8% (the USD exchange rate fell from 3.76 at the beginning of 2019 to 3.73 at the end of June 2019). It was assumed in the further analysis that the purchase prices of subsequent commodities expressed in dollars were converted into PLN using the exchange rate from the beginning of 2020, and the selling prices were converted using the exchange rate from mid-2020. The Table 13 shows the impact of the weakening of the Polish zloty in 2020, combined with the change in global commodity prices.

Table 13. Commodity prices in the first half of 2020 in PLN and semi-annual rates of return

Tabela 13. Ceny surowców w I półroczu 2020 roku w PLN oraz półroczne stopy zwrotu

	Copper		Hard coal		Crude oil (Brent)	
	01.01.2020	30.06.2020	01.01.2020	30.06.2020	01.01.2020	30.06.2020
Price	23 427	24 031	173.09	198.40	251.75	163.78
Arithmetic rate of return	2.58%		14.62%		-34.95%	

Source: own computation.

Recognition in the Polish currency gives only a slightly changed basis for the conclusion. The strengthening of the dollar was enough for the slightly negative rate of return for copper to become almost slightly positive. For the same reason, the rate of return on hard coal increased sharply, and in turn, the fall in crude oil prices was slightly lower.

5.1. Comparison of the effectiveness of investments in shares of Polish natural resources companies and commodity contracts for the first half of 2020

A comparison of the financial efficiency of investments in shares of natural resources companies and relevant contracts for commodities for 2020 is presented in the Table 14. Methodically, as for 2019, the rate of return on shares in hard coal mining companies was determined as the weighted average (with the capitalization of JSW and LWB) of semi-annual rates of return for these shares.

The comparison of analogous data calculated for 2019 and the data from the table above allows us to conclude that crude oil is the most susceptible commodity to economic fluctuations. In a period of economic growth, it is more profitable to invest in crude oil contracts than in joint-stock companies whose activity is crude oil extraction. On the other hand,

Table 14. Comparison of rates of return on shares of natural resources companies and commodity contracts for the first half of 2020

Tabela 14. Porównanie stóp zwrotu za I półroczu 2020 roku akcji spółek surowcowych oraz kontraktów na surowce

	Copper	Hard coal	Crude oil(Brent)
Shares	-4.90%	-17.16%	4.85%
Contracts	2.58%	14.62%	-34.95%

Source: own computation.

as shown in the table above, it is exactly the opposite during an economic downturn, crude oil contracts are a source of losses, and shares generate positive returns. This effect is additionally strengthened by the fact that among the analyzed companies, all those remaining recorded negative rates of return in the economic crisis of the first half of 2020.

The effectiveness of indirect investment in hard coal is different. The basic conclusion is that hard coal is a risky investment in that that strongly negative rates of return prevail both in the period of economic growth and crisis. The only exception is the profitability of hard coal contracts purchased during the time of economic crisis. Here, a long position on contracts allowed for a semi-annual return of over 14%. Again, it can be noticed that in the period of economic growth, the market turns more towards other, less traditional energy sources, and the time of economic crisis is a period of returning to traditional energy resources. However, the investment in shares of coal companies turned out to be ineffective in both analyzed periods.

Among the analyzed commodities, copper turned out to be the most resilient to economic fluctuations. In times of economic growth, both stocks and contracts yielded a positive rate of return. The copper contracts also generated income during the crisis, while the shares of the copper company suffered a loss. The stability of indirect investments in copper is also observed in the spread of rates of return in the boom and downturn as it is the smallest among all the analyzed commodities.

To generalize the analyses carried out, it should be noted that crude oil quotations are relatively the easiest to predict with a strong recommendation to make contacts in periods of economic growth (due to the expected increase in prices) and to issue contracts in times of crisis (due to the expected drop in oil prices). Hard coal is a non-cyclical commodity for which a positive rate of return is most difficult to obtain. Copper prices are also weakly affected by economic changes, but it is easier than for hard coal to achieve a positive rate of return (especially on a long position in contracts).

Conclusions

The results of the analysis carried out allow for certain conclusions to be drawn and research questions posed in this paper to be answered. The conclusions from the analysis can be aggregated to a few basic conclusions described following the adopted time perspective.

1. Conclusions on the effectiveness of commodity investments for the first half of 2019:
 - ◆ investments in the shares of natural resources companies on the Polish stock exchange market during the period of economic growth (for which the calculations were based on the first half of 2019) generally did not turn out to be an effective investment, neither in terms of the rate of return, nor in terms of a comparison to a broader market expressed by changes in the WIG20 index level,
 - ◆ out of the four analyzed companies, three (JSW, LWB, PGNiG) achieved a strongly negative rate of return, and only KGHM achieved a high, over 16%, semi-

-annual rate of return. This company stands out in this period both in relation to the other analyzed companies and in relation to the WIG20 index, which at the same time increased its value by over 2%,

- ◆ companies that did not achieve a positive rate of return in the analyzed year of 2019 were additionally characterized by a high level of investment risk. For these companies, the investment risk was higher than the standard deviation of the market. Here again KGHM stands out positively with a positive rate of return accompanied by the lowest level of risk,
 - ◆ the degree of correlation between the rates of return of natural resources companies and the market was positive, but at a moderate level, which proves a certain distinctiveness in terms of the strength of the impact of the stock market on these companies,
 - ◆ on the other hand, the analysis of the rates of return of contracts for strategic commodities allows us to conclude that hard coal is not a good form of indirect investment in the period of economic growth. Crude oil contracts turned out to be the most effective. Copper contracts showed a slight but positive rate of return.
2. Conclusions on the effectiveness of commodity investments for the period of pandemic-driven crisis (first half of 2020):
- ◆ in the second sub-period under study, the effectiveness of indirect investments consisting in the purchase of shares of natural resources companies is also not favorable. Again, three out of four analyzed companies recorded losses. The difference here is that PGNiG showed a positive rate of return at that time. The level of losses on the shares of JSW and LBW is significant, and KGHM, which recorded increases in 2019, recorded a loss of less than 5% in this sub-period, which, however, with an over 18% decline in the WIG20 index, should be considered a very good result,
 - ◆ three of the surveyed natural resources companies did not show effectiveness in the conditions of economic crisis. Such resilience was demonstrated by PGNiG. If we were to consider natural resources companies with a positive rate of return in the analysis, the suggestion would be that in the period of economic growth it is best to invest in KGHM, and in the period of economic crisis – in PGNiG (among the analyzed natural resources companies),
 - ◆ similarly to 2019, the risk of natural resources companies was higher than the risk of the stock market of large companies. On the other hand, the correlation remained positive in two cases at a similar level (LWB and PGNiG), and for the remaining two companies it was significantly higher. This means that JSW and KGHM closely follow the stock market of large companies during the economic crisis,
 - ◆ investments in commodity contracts during the pandemic period resulted in a strongly positive rate of return for hard coal and, at the same time, a very strongly negative rate of return for crude oil. Copper contracts were characterized by a positive rate of return at a low level, which was unsatisfactory in terms of investments.

The general conclusions from the research quite clearly indicate that the raw materials sector in the area of indirect forms of investment does not show the characteristics of above-average efficiency. On the contrary, the rates of return tend to be lower than on the stock market. Furthermore, such investments are generally unprofitable in times of economic crisis. The rates of return of those shares are not higher than the rates of return from the market (in this case, the market of large companies).

Obviously, share prices fluctuations are a natural process, but amplitude and causes of them are different for particular companies (and not always of financial or economic nature). It is worthwhile to take it into account while analyzing e.g. Polish coal companies due to significance of coal as a basic power raw material. In this case the business cycle is disturbed by a variety of many political factors. Nevertheless, the share price is an exogenous variable for investors, independently of the events influencing its level.

The firmest conclusion concerned can be drawn for crude oil and contracts for this commodity. Namely, a long position for crude oil contracts is a very effective form of investment in periods of economic growth, while the period of economic crisis is a time of heavy losses in this position. Naturally, the conclusion for the party issuing the crude oil contracts is symmetrically the opposite.

Research funding from the University of Economics in Katowice.

REFERENCES

- Buła, R. 2019a. Implications of the fractal market theory for the risk assessment of financial investments (*Implikacje teorii rynku fraktalnego dla oceny ryzyka inwestycji finansowych*). Warszawa: KNF, 143 pp. (in Polish).
- Buła, R. 2019b. Investing in shares of socially responsible companies in the light of fractal analysis (*Inwestowanie w akcje spółek społecznie odpowiedzialnych w świetle analizy fraktalnej*). [In:] Wojewnik-Filipkowska, A. and Szczepaniak, K. *Investments and real estate. Contemporary challenges (Inwestycje i nieruchomości. Współczesne wyzwania)*. Gdańsk: UG, pp. 237–250 (in Polish).
- Court, V. and Fizaine, F. 2017. Long-Term Estimates of the Energy Return on Investment (EROI) of Coal, Oil, and Gas Global Productions. *Ecological Economics* 138, pp. 145–159.
- Franik, T. 2012. Study on factors influencing the level of capital expenditure spent in mining. *Gospodarka Surowcami Mineralnymi – Mineral Resources Management* 28(4), pp. 71–86.
- Hain et al. 2018 – Hain, M., Hess, J. and Uhrig-Homburg, M. 2018. Relative value arbitrage in European commodity markets. *Energy Economics* 69, pp. 140–154.
- Jawadi et al. 2017 – Jawadi, F., Ftiti, Z. and Hdia, M. 2017. Assessing efficiency and investment opportunities in commodities: A time series and portfolio simulations approach. *Economic Modelling* 64, pp. 567–588.
- Jensen, G.R. and Mercer, J.M. 2011. Commodities as an Investment. *The Research Foundation of CFA, Institute of Literature Review* 6(2), pp. 1–33.
- Krawiec, W. 2012. The commodity mutual funds and their effectiveness in the period of turbulence on financial markets (*Fundusze surowcowe i ich efektywność w okresie zawirowań na rynkach finansowych*). *Annales Universitatis Mariae Curie-Skłodowska Lublin* 44(4), pp. 437–447 (in Polish).
- Levine et al. 2018 – Levine, A., Ooi, Y.H., Richardson, M. and Sasseville, C. 2018. Commodities for the Long Run. *Financial Analysts Journal* 74(2), pp. 55–68.

- Moskal, A. and Zawadzka, D. 2017. The efficiency of commodity funds in bull and bear market (*Efektywność funduszy surowcowych w Polsce w okresie hossy i bessy*). *Annales Universitatis Mariae Curie-Skłodowska Lublin* 51(6), pp. 236–241 (*in Polish*).
- [Online] <https://markets.businessinsider.com/commodities> [Accessed:2020-09-10].
- Pera et al. 2014 – Pera, K. Buła R., and Mitrenga, D. 2014. *Models investment (Modele inwestycyjne)*. Warszawa: Wyd. C.H. Beck, 278 pp.
- Sierpińska-Sawicz et al. 2020 – Sierpińska-Sawicz, A., Sierpińska, M. and Królikowska, E. 2020. Where the EBIT-DA metric is used in coal companies. *Gospodarka Surowcami Mineralnymi – Mineral Resources Management* 36(2), pp. 109–126.
- Sobczyk et al. 2020 – Sobczyk, E., Kaczmarek, J., Fijorek, K. and Kopacz, M. 2020. Efficiency and financial standing of coal mining enterprises in Poland in terms of restructuring course and effects. *Gospodarka Surowcami Mineralnymi – Mineral Resources Management* 36(2), pp. 127–152.

**INVESTMENT ATTRACTIVENESS OF NATURAL RESOURCES COMPANIES AND COMMODITY
CONTRACTS – A COMPARATIVE ANALYSIS FOR THE FIRST HALF OF 2019 AND 2020
MOTIVATED BY THE SARS-COV-2 PANDEMIC**

Keywords

financial effectiveness, rate of return,
shares of natural resources companies, commodity contracts

Abstract

The paper deals with the issue of financial efficiency, measured by the arithmetic rate of return, of indirect financial investments in the area of strategic raw materials (hard coal, copper, crude oil). Two forms of indirect investments were analyzed: shares of natural resources companies listed on the Warsaw Stock Exchange and futures contracts for strategic commodities: hard coal, copper and crude oil.

The time of the analysis is the first 6 months of 2019 and 2020. The year 2019 was regarded as an analysis of the period of economic growth, and the year 2020 was the analysis of the period of economic crisis. The comparisons were made in two dimensions. Firstly, it whether indirect commodity investments show the characteristics of efficiency resilience to the time of the economic crisis was checked (by comparing the achieved rates of return in the two analyzed periods). Secondly, which of the analyzed forms of investment (stocks, contracts) gives better investment results during economic growth and economic crisis was compared.

As it was shown in the paper, indirect commodity investments do not show an above-average rate of return neither during economic growth nor economic crisis. The achieved rates of return on shares compared to changes in the WIG20 index in the analyzed first half of 2019 were negative. Only one company showed a positive and significantly higher than the market rate of return. Very similar results were achieved by the analyzed companies in 2020.

On the other hand, the analysis of prices and rates of return on commodity futures contracts showed that in the period of economic growth it is effective to take a long position on crude oil contracts and a short position on hard coal contracts. In a period of economic crisis, the opposite position is profitable due to the observed growth in hard coal prices and a significant drop in crude oil prices.

The answers to the research questions posed in the paper do not provide indications for recommending indirect forms of investment in commodities as an alternative to analogous forms of other sectors of the economy. The analysis shows that the impact of the economic situation on the efficiency of commodity investment is most noticeable for crude oil, and the least (among the analyzed commodities) for indirect copper-based investments.

**ATRAKCYJNOŚĆ INWESTYCYJNA SPÓŁEK SUROWCOWYCH I KONTRAKTÓW NA SUROWCE –
ANALIZA PORÓWNAWCZA ZA OKRES PIERWSZEGO PÓŁROCZA 2019 I 2020 ROKU
W ZWIĄZKU Z PANDEMIĄ SARS-COV-2**

Słowa kluczowe

efektywność finansowa, stopa zwrotu, akcje spółek surowcowych, kontrakty na surowce

Streszczenie

W artykule przedstawiono zagadnienie efektywności finansowej, mierzonej arytmetyczną stopą zwrotu, pośrednich inwestycji finansowych w obszarze strategicznych surowców (węgiel kamienny, miedź, ropa naftowa). Jako inwestycje pośrednie potraktowano dwie ich formy: akcje spółek surowcowych notowanych na Gieldzie Papierów Wartościowych w Warszawie oraz kontrakty terminowe na strategiczne surowce w postaci: węgla kamiennego, miedzi i ropy naftowej.

Czas analizy to dwa pierwsze półrocza lat 2019 i 2020. Rok 2019 potraktowano jako analizę w czasie wzrostu gospodarczego, a rok 2020 był analizą czasu kryzysu. Porównań dokonano w dwójakim przekroju. Po pierwsze, sprawdzono, czy pośrednie inwestycje surowcowe wykazują cechy odporności efektywnościowej na czas kryzysu gospodarczego (poprzez porównanie osiągniętych stóp zwrotu w dwóch analizowanych okresach). Po drugie, porównano, która z analizowanych form inwestowania (akcje, kontrakty) daje lepsze rezultaty inwestycyjne w czasie wzrostu i w czasie kryzysu.

Jak wykazano w artykule, pośrednie inwestycje surowcowe nie wykazują ponadprzeciętnej stopy zwrotu ani w czasie rozwoju gospodarczego, ani w czasie kryzysu. Osiągnięte stopy zwrotu z akcji odniesione do zmian indeksu WIG20 w analizowanym pierwszym półroczu 2019 roku były ujemne. Jedynie jedna spółka wykazała się dodatnią i znacznie wyższą od rynkowej stopą zwrotu. Bardzo podobne są wyniki osiągnięte przez analizowane spółki w 2020 roku.

Z kolei analiza cen i stóp zwrotu kontraktów terminowych na surowce wykazała, że w okresie rozwoju gospodarczego efektywne jest zajmowanie pozycji długiej na kontraktach na ropę naftową i krótkiej na kontraktach na węgiel kamienny, a w okresie kryzysowym opłacalna jest pozycja przeciwna, ze względu na zaobserwowany wzrost cen węgla kamiennego i znaczny spadek cen ropy naftowej.

Odpowiedzi na postawione w artykule pytania badawcze nie dają wskazań do rekomendowania pośrednich form inwestowania w surowce jako alternatywy dla analogicznych form innych sektorów gospodarki. Z przeprowadzonej analizy wynika, że wpływ koniunktury gospodarczej na efektywność inwestycji w surowce jest najbardziej zauważalny dla ropy naftowej, a najmniej (spośród analizowanych surowców) dla inwestycji pośrednich opartych na miedzi.