



Volatility in the Raw Materials Market and Risk Mitigation Methods

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Abstract

Companies in the raw materials market operate in a volatile and unstable market. Business downturns exert a particular effect on the level of cash flows and generate insolvency risk among companies, all the more so when crises are driven by objective circumstances beyond human control. Being well-versed with these risks, a company should take steps to mitigate the risk of raw materials price volatility affecting the planned results in at least the medium term. The subject of this analysis is to point out the interdependencies between the basic economic categories when it comes to how the steel market functions and the risks stemming from the volatility of the raw materials market. Moreover, it portrays the main financial instruments that can be used to mitigate the consequences of the risk of movement of raw materials prices.

Keywords: financial risk, hedging, risk mitigation

Introduction

The stable operation of a company and its development are driven by macroeconomic factors and the ability to secure sources of funding business on the debt market as well as using financial instruments to hedge risk. This analysis assumes that growth is driven by the consumption of goods manufactured by the company and the resultant development of other industries. Therefore, one may venture to assert that three key elements should be analyzed whether during business cycle upturns or during a crisis, i.e.:

- to what extent GDP, population and the production of steel and coking coal are related,
- to what extent random events affect price volatility in raw materials markets, thereby contributing to corporate performance,
- how can the risks of random events be mitigated through the selection of optimal hedging instruments.

During business downturns the prices of raw materials bottom out. Sharp price decreases affect the profitability of companies operating in the raw materials sector: in recent years these companies have experienced greater turbulence than companies in other sectors. These circumstances are also unpredictable due to objective conditions beyond a company's control. Hence these companies need financial instruments to be able to hedge effectively the risk of prices falling and efficiently manage the volatility of raw materials prices.

This article endeavors to illustrate the nature of the relations between economic categories such as the population, GDP, coking coal consumption and steel production. The relevance of factors beyond a company's control is referenced and selected instruments to hedge price risk related to raw materials are presented.

Volatility of the raw materials market

As G.A. Holton points out, risk entails two indispensable factors: exposure and uncertainty. Precisely this risk weighs heavily on raw materials markets and related markets. The steel market and coking coal consumption play a major role in the global economy, generating GDP linked to consumption levels. The financial statements of major companies in the mining industry have been analyzed. On this basis one may claim that the raw materials industry heavily hinges on the business cycle phase and on related markets such as the steel market.

M. Krzak and A. Paulo also note that global steel production and consumption have risen over a century very unevenly, outpacing population growth. Four periods were observed: slow growth before 1945, post-war acceleration in 1945–1980, slowdown in 1980–2000 and rapid acceleration driven by China after 2000. The disruptions to economic growth precipitated by financial and economic crises in 1929–1932 and 2008–2009 were reflected in steel production levels and proved to be of short duration. Moreover, the authors note that urbanization is a global economic phenomenon. It extends to the construction industry as it employs reinforced concrete on a great scale, travel and transport infrastructure, mechanical vehicles, household appliances, sewage systems, etc. This is particularly visible in developing countries. The authors stress that urbanization is likely to trigger higher demand and thereby elevated steel production. They write that an important premise for forecasts concerning iron raw materials market is the assessment of demographic growth, while this growth is a factor stimulating consumption and production, as confirmed in the analysis presented in this article in the context of coking coal consumption in steel production.

The analyzed financial statements of companies in the raw materials industry indicate that the steel market is domi-

nated by global smelting conglomerates, with steel manufacturing being increasingly concentrated in Asia. In 2015 the global production of raw steel recorded its first downswing since 2009. The greatest decrease in terms of tonnage was recorded in Asia where steel production slumped 26m tons (2.3% y/y). China, which accounts for 49.5% of global output recorded a drop of 19m tons (2.3% y/y). Lower steel production was also recorded in Japan, Korea and Taiwan. The region with the steepest decline in 2015 was North America where production decreased by almost 9% from 2014. That was caused by steel production in the US falling by as much as 10.5%. Raw steel production in South America dipped 2.5%. Total steel production in Europe in 2015 was 304m tons, which was 3.2% lower than 2014. Steel production in the European Union dropped by over 3m tons, while in the CIS it fell by 4.5m tons.

Price drops and the coal glut on global markets triggered significant deterioration of the financial standing of numerous companies in the mining industry, leading many of them to bankruptcy or business suspension or curtailment. Many coking coal producers pursued profound restructuring plans to align their operations to the soft market. Some producers sold selected mining assets and the entire industry implemented comprehensive cost cutting plans. US producers, including Alpha Natural Resources, Arch Coal, Mechel, Patriot Coal, Walter Energy, James River and Suncoke announced they would limit their coal mining operations. Australian mining companies, including BHP, Peabody, Glencore and Yancoal also announced their attention to cut back on coal mining. The implementation of restructuring plans entailed planned or actual downsizing in the largest coal mining companies across the world. The total reduction in coking coal production worldwide at approx. 50m tons was announced. Due to the coking coal glut on the market, in 2015 coal prices posted their lowest levels since 2009.

To determine the interdependencies among the key indicators of the raw material market and related markets, their performance in 2006-2015 was examined. In that period the global economy underwent a full economic cycle, i.e. its business trough in 2008-2009, economic expansion in 2011-2013 and another deep downturn in 2015 with a rebound at the turn of 2016 and 2017.

The purpose of the analysis was to determine the nature of the relation between the independent variable (steel production, population and GDP) and the dependent variable (coking coal consumption) with coking coal being a strategic raw material in the production of steel needed in the process of manufacturing environmentally-friendly goods such as electrical cars, wind farms, etc.).

Linear models were employed to conduct this analysis. The period of 2006-2015 was studied. The analysis drew on information from standalone and consolidated quarterly financial statements of companies in the raw materials sector as well as data from the website World Development Indicators.

The analysis consisted in selecting the data and building an appropriate model. In order to examine the interdependencies between the variables and estimate the parameter for a given value of the independent variable, the least squares method was used. For example, the impact of coal consumption on steel production, population and GDP was to be de-

termined. Simple linear regression was adjusted to determine the population, steel production and GDP for a given value of coal production. To make the linear regression analysis applicable, the following requirements were assumed to be met:

- observations must be independent.
- The dependent variable Y must be random.

The use of linear regression analysis allowed us to determine whether two variables are related without having to draw any conclusions on a cause and effect relationship.

Stepwise regression was used for the analysis. Stepwise regression is an automated tool used to build the best model for selected variables. The process automatically returns the most relevant variable or removes the least relevant variable with each step. The results below show the regression models after the tool's use. To examine whether there is a relation between coking coal consumption and population, steel production and GDP on individual continents, separate linear regression analyses were made for each continent.

Africa

The data in table 1 below show that the estimator value for population in millions is 1.33×10^{-5} . The coefficient indicates that as the population grows by one million, coking coal consumption may be expected to grow on average by 1.33×10^{-5} Mt.

Based on the analysis, we note that only population is statistically significant as a predictor ($p < 0.01$).

The model explains 58% of the variability of the dependent variable around the mean.

Asia

The regression result indicates that the "steel production" variable is statistically significant ($p < 0.001$). The value of this estimator in Mt is 0.52933. With steel production growth of 1 Mt, coal consumption rises 0.52933 Mt.

The model explains 97% of the variability of the dependent variable around the mean.

Australia

Population is statistically significant as a predictor ($p < 0.01$). The value of this estimator in millions is 1.262×10^{-2} . The coefficient indicates that each additional million inhabitants in population leads coking coal consumption to grow on average by 1.262×10^{-2} Mt.

The model explains 81% of the variability of the dependent variable around the mean.

Europe

Population, steel production and GDP are statistically significant predictors. The p-value for steel production is lower than 0.001, for population it is lower than 0.01, and for GDP it is lower than 0.05. The value of the estimator for steel production is 8.813×10^{-2} , for population it is -3.431×10^{-4} , and for GDP it is -4.876×10^{-13} .

The model shows that as steel production grows by 1 Mt, coal consumption rises 8.813×10^{-2} Mt. When population or GDP increases by a million, coking coal consumption falls 3.431×10^{-4} and 4.876×10^{-13} Mt, respectively. All predictors explained 97% of the variability of the dependent variable.

Tab. 1. Coking coal consumption and population
 Tab. 1. Zużycie węgla koksowego a liczba ludności

	Estimator value	Standard error	t-value	p-value
Intercept	-9.653×10	3.740×10	-2.581	0.12738
Population	1.33×10 ⁻⁵	3.599×10 ⁻⁶	3.696	0.000414
Determination coefficient	0.5774			
P-value of the model	0.004155			

Tab. 2. Increase in steel production and coking coal consumption in Asia
 Tab. 2. Wzrost produkcji stali a zużycie węgla koksowego w Azji

	Estimator value	Standard error	t-value	p-value
Intercept	43.80486	26.77427	1.636	0.1101
Steel production	0.52933	0.02917	18.144	0.000000
Determination coefficient	0.999999			
P-value of the model	0.000000			

Tab. 3. Population and increase in steel production in Australia
 Tab. 3. Liczba ludności a wzrost produkcji stali w Australii

	Estimator value	Standard error	t-value	p-value
Intercept	2.633×10 ²	9.102×10	2.892	0.0045
Steel production	8.813×10 ⁻²	1.556×10 ⁻²	5.663	0.000001
Population	-3.431×10 ⁻⁴	1.246×10 ⁻⁴	-2.753	0.0075
GDP	-4.876×10 ⁻¹³	1.532×10 ⁻¹³	-3.183	0.0015
Determination coefficient	0.999999			
P-value of the model	0.000000			

Tab. 4. Steel production and coking coal consumption in Europe
 Tab. 4. Produkcja stali a zużycie węgla koksowego w Europie

	Estimator value	Standard error	t-value	p-value
Intercept	-2.821×10 ²	8.990×10	-3.138	0.01197
Population	1.262×10 ⁻²	3.052×10 ⁻³	4.134	0.00254
GDP	-3.849×10 ⁻¹¹	1.757×10 ⁻¹¹	-2.190	0.05624
Determination coefficient	0.8097			
P-value of the model	0.0005722			

Tab. 5. Steel production and coal consumption in North America

Tab. 5. Produkcja stali a zużycie węgla w Ameryce Północnej

	Estimator value	Standard error	t-value	p-value
Intercept	-1.242×10^3	5.688×10^2	-2.191	0.0598
Steel production	7.316×10^{-1}	3.414×10^{-1}	2.143	0.0645
GDP	-1.636×10^{-11}	1.104×10^{-11}	-1.482	0.1767
Population	4.424×10^{-3}	2.098×10^{-3}	2.109	0.0680
Determination coefficient	0.7322			
P-value of the model	0.01122			

Tab. 6. Increase in steel production and coking coal consumption

Tab. 6. Wzrost produkcji stali a zużycie węgla koksowego

	Estimator value	Standard error	t-value	p-value
Intercept	-3.522×10	9.348×10	-3.800	0.00524
Steel production	1.778×10^{-1}	6.219×10^{-2}	2.860	0.02116
GDP	-2.727×10^{-13}	1.694×10^{-13}	-1.610	0.14607
Population	5.599×10^{-5}	1.518×10^{-5}	3.689	0.00614
Determination coefficient	0.8149			
P-value of the model	0.01122			

North America

The table above shows that steel production and population are statistically significant predictors ($p < 0.1$). GDP is not a statistically significant predictor; its value is higher than the significance level 0.1.

Based on the estimated parameters it may be noted that as steel production grows by 1 Mt, coal consumption growth of 7.316×10^{-1} may be expected. If the population grows by a million, coal consumption will increase by 4.424×10^{-3} Mt.

The model explains 73% of the variability of the dependent variable.

North and Central America

Steel production and population are statistically significant predictors.

Based on the regression analysis, as steel production rises by 1 Mt, coking coal consumption may be expected to grow by 1.778×10^{-1} Mt. With a population increase of a million, coal production will grow by 5.599×10^{-5} Mt.

The model explains 81% of the variability of the dependent variable around the mean.

Various dependencies between coking coal consumption and other variables result from the above regression analysis. The dependence between coal consumption and population was observed in Africa, Australia, Europe, North America, South and Central America. The analysis showed significant correlation between coking coal consumption and steel production in Asia, Europe, North America, South and Central America. The dependence between coal production and GDP was observed only in Europe.

One may venture to claim that companies operating in the raw materials sector are largely exposed to objective stimuli fundamentally beyond their control. Likewise, a crisis in consumption may contribute to the emergence of crisis foci, which are also significantly enhanced by natural factors. Information published by a leading company in the mining industry concerning relevant factors contributing to coking coal price levels (TSI HCC Premium \$/t FOB Australia) is presented below:

- 2Q2017 – cyclone Debbie (constraints in extraction and transport) – price growth to approximately \$314/t;
- 2Q2017 – opening of a railway line in Queensland and greater export opportunities – price decline to \$140/t,
- 3Q2017 – force majeure in South, strike in Oaky North, Hunter Valley, extraction problems in China, high margins on steel – price above \$200/t,
- 4Q2017 – pressure to cut spot prices – availability of spot loads and announced cuts in steel and coke production in China – price at approximately \$180/t,
- 4Q2017 – shortages in the supply of HCC premium coal, logistic problems in Australia and USA – over \$263/t,
- turn of 2017/2018 – gridlock in an Australian port, ships wait over 3 weeks to be loaded compared with the average of 10 days, supply problems of producers in Australia – price at approximately \$260/t,
- 1Q2018 – clearing of the bottleneck in an Australian port, higher coal supply, downward trend in steel and coke market - price at approximately \$214/t,

- 2Q2018 – dispute concerning the Australian Aurizon railways, steel market in China exhibits upward trend – price at approximately \$180/t,
- 3Q2018 – rebuilding of coking coal inventories after the monsoon season in India and replenishing of stock before winter in China – price at \$180/t,
- 3Q2018 – fire and announcement of a force majeure event in the North Goonyella mine in Australia – price growth to approximately \$200/t,
- 4Q2018 – fear of cyclone Owen in the Queensland region contributed to elevated coking coal purchases to secure volume before the cyclone – price growth to approximately \$220/t.

After the soft period of 2014-2016, the coal price rebounded in 2017. The demand for steel is generated above all by investments: in the construction industry (this sector accounts for almost half of domestic steel consumption), roads, energy and railways. Also, the construction and machinery industry, ship building, household appliances sector and automotive industry are major consumers of steel. However, as presented above, economic growth is supported not only by attempted reconstruction after a downturn, but also by relevant random factors beyond a company's control.

Selected methods of managing raw materials price risk

As noted by R. Węgrzyn, the role of risk management in a company increases in particular in turbulent times in financial markets. From the vantage point of risk mitigation it is important to curtail the risk of lower future financial results exposed to fluctuations in the prices of products and the costs of materials, energy and services, in particular cash flows; determine the maximum level of cash in the company to secure continuity of the core business and secure continuity of investment, that is the business targets defined in the strategy and ensure stability during business downturns.

Throughout the business cycle a company is affected by a series of risks influencing its financial condition and cash position. The risks include:

- currency risk related to the index quotations for main products,
- counterparty risk related mainly to the assessment of creditworthiness (credit risk) of the financial institution with which hedging transactions and derivatives are concluded, and the assessment of a counterparty's creditworthiness,
- liquidity risk related to the loss or curtailment of the ability to pay current payables and unplanned expenditures under a given trade,
- operating risk resulting from the structure and implementation of risk management processes in a company's on-going operations (e.g. IT risk, legal risk, etc.).

Apart from these risks, A. Węgrzyn also enumerates business risk, legal risk and event risk. Therefore, it is not difficult to observe that throughout the business cycle a company – regardless of the sector in which it operates – uses hedging instruments suitable for the type of operations without the possibility of affecting macroeconomic factors. Mining sector

companies are particularly susceptible to fluctuations in the prices of raw materials.

Steps taken to hedge the risk of raw materials prices focus on crafting a risk management strategy. Hedging is an effective tool to overcome the adverse effects of price movement to stabilize cash flow. As stated by M. Baxter, each market practitioner selling derivative instruments for its own account will say that hedging is the key to valuation.

Hedging is the basic function of every commodity market. The basic philosophy that underlies hedging is its use as a form of protection against sudden changes in market prices. Additionally, it is a mechanism for price discovery on organized exchanges and contains no speculative elements, hence it should not be treated as an instrument to generate income but merely as a tool to stabilize cash flow.

Other goals pursued as part of raw materials price risk management are to reduce financial market volatility, increase the likelihood of achieving the owner's strategic assumptions, increase the likelihood of maintaining financial liquidity and optimum financial results and secure funds in the future proceeds for investment activities. Equally important tasks include the reduction of revenue sensitivity to lower prices of raw materials and currency exchange rates.

The choice of the nature of the transaction should take into account the cost of implementing a given hedging strategy (e.g. the premium to buy an option) and depends on the flexibility of this strategy (e.g. the possibility of using price increases in raw materials markets) as well as on the expected financial situation of the company. As part of hedging strategies and hedging transactions companies use the following instruments:

- futures / forward contracts,
- commodity swap contracts,
- sell options for acquired commodities.

In the futures / forward contracts the core group comprises forward contracts. A forward contract is a contract concluded at present, obliging the party unconditionally (regardless of any future circumstances) to buy or sell a quantity of foreign currency or another underlying instrument at a set term in the future at the exchange rate agreed by the parties at the time of concluding the contract. A forward contract is an over-the-counter contract with one of its parties usually being a bank. Both parties to the contract agree the contract terms and conditions such as the quantity of the underlying instrument, term of fulfilment. The bank specifies (quotes) the price of the contract and the price may be negotiable. At the moment of concluding the contract neither party makes a payment, while contract settlement occurs at the term. The futures contract is a contract on the stock exchange in which the parties thereto take appropriate positions by placing their buy and sell orders. The terms and conditions of the contract such as the quantity of the underlying instrument and term of fulfilment (that is expiry term) are determined by the stock exchange. In turn, the parties to the contract determine the contract price by placing their orders.

A swap contract is a derivative instrument in which two parties to the contract undertake to make payments to each other at determined moments in the future. Swap contracts consist in simultaneous both parties buying and selling series

of financial streams characterized by a fixed or floating interest rate, in the same or difference currencies whose value is considered to be equal by the parties to the transaction at the moment of concluding the contract.

An option is the other fundamental derivative. It differs from other derivatives by being an asymmetrical instrument. There are two basic types of options: a call option (also called a call) and a put option (also called a put). A call option is the right to buy a determined quantity of the underlying instrument at a determined price at a specific term. A put option is the right to sell a determined quantity of the underlying instrument at a determined price at a specific term. A call option (a call) is the right to receive at a specific term an amount of money depending on the difference between the value of the underlying instrument and the strike price. A put option (a put) is the right to receive at a specific term an amount of money depending on the difference between the value of the underlying instrument and the strike price.

The optimum hedging strategy, including the choice of instruments, should begin with understanding the changing market and determining the main market variables. Apart from developing a risk map, the key activities include:

- analysis of exposure to price risk,
- analysis of the market situation of raw materials and hedging instruments,
- determining the volume to be hedged,
- time horizon of hedging and selection of optimum hedging instruments,
- preparation and analysis of hedging scenarios,
- preparing an analysis of potential effects of hedging strategy implementation,
- assessment,
- concluding of a hedging transaction and its monitoring.

As the raw materials market is extremely unstable, the hedging strategy should first of all use natural hedging by transferring the risk of changes in raw materials prices to offtakers, e.g. by agreeing a fixed contractual price.

After exhausting the possibilities offered by natural hedges, hedging activities that rely on derivative transactions in operational hedging and strategic hedging are used. Derivative transactions should have the following characteristics:

- liquidity in the derivative instrument market should be aligned to the scale of hedging followed by a company,
- have an opposite risk profile to offset the risk profile resulting from exposure,
- their quotations are based on the same future price curve as the curve constituting the base for determining changes in the reference index value in contracts positing physical delivery,
- the company has the ability to conduct independent valuation of these trades.

As I. Šperanda and Z. Tršinski write, in the contemporary political and economic world the level of uncertainty is extremely high. Numerous political, social and other factors may affect the prices of various instruments and commodities in global markets. Effective and broadly used hedging instruments offer protection against these price fluctuations. Hedging methods were developed by contemporary brokers and managers in response to the high risk of loss potential. Global trade, liberalization of nearly all world economies and ever broader opportunities of trade in futures markets gave rise to hedging. That is why the primary role of hedging as a futures contract is to protect a business against risk, i.e. against rapid and significant increase / decrease in commodity prices or international service market.

The authors write further that risk refers to the possibility and, to a certain degree, the probability of the occurrence of an event with adverse effects. Therefore, risk and business results are negatively correlated. The fact that business in a highly globalized world is risky is beyond doubt. This trend will become more pronounced in the future.

An important issue raised in the publication of S. Lleo and W. T. Ziembra entitled: *How to Lose Money in Derivatives: Examples From Hedge Funds and Bank Trading Departments* is the choice of institution with whose participation a company conducts its hedging transactions as well as the risk appetite a company has taking into account opportunities and threats.

Conclusion

The practices pursued by companies in the raw materials sector worldwide indicate that raw materials risk is one of the actively managed risks. Derivatives are commonly used to manage this risk. They are a response to the current, changing economic situation as well as an attempt to offset the effects of objective random events. However, the most important purpose of these practices is to stabilize cash flows and financial results in the medium term. The price level of raw materials is also affected by global events beyond a company's control (e.g. weather events, competitors' logistic problems). They may significantly undermine financial liquidity. A company's identification of its key tasks in raw materials price risk management, division of responsibilities, analysis of risk exposure and market situation, as well as sensitivity and scenario analysis constitute a pillar in the correct completion of the process. One pillar of success will be to articulate a correct hedging strategy based on which a company enters into transactions and subsequently monitors their performance in the form of duly posted records in financial accounts, settlements and management accounting.

As C.J. Hull and E. Dziawgo write, the skillful use of derivative instruments is one of the most efficient ways to manage financial risk. The financial leverage effect that can be obtained by using derivative instruments in financial transactions professionally enhances the attractiveness of these instruments, since significant transaction values may be obtained with low capital exposure.

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Zmienność rynku surowców i wybrane instrumenty finansowe ograniczenia tego ryzyka

Przedsiębiorstwa branży surowcowej funkcjonują na zmiennym i niestabilnym rynku. Okresy dekonstrukcji w szczególności sposób wpływają na poziom przepływów pieniężnych i generują ryzyko niewypłacalności spółek, tym bardziej że kryzysy wspierane są przez obiektywne okoliczności, na które człowiek nie ma wpływu. Mając wiedzę o tych ryzykach, przedsiębiorstwo powinno podjąć działania ograniczenia wpływu ryzyka zmienności cen surowców na planowane wyniki w okresie co najmniej średnioterminowym. Przedmiotem analizy jest wskazanie zależności pomiędzy podstawowymi kategoriami ekonomicznymi w aspekcie funkcjonowania rynku stalowego oraz ryzyk wynikających ze zmienności rynku surowcowego. Zaprezentowane zostały ponadto podstawowe instrumenty finansowe, które mogą złagodzić skutki ryzyka zmiany cen surowców.

Słowa kluczowe: ryzyko finansowe, hedging, mitygowanie ryzyka