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Non-Market Price Determinants of Fossil Energy Raw Materials

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Abstract

Technological changes related to, among others, the process of computerization of the economic space have an impact on raw material markets and their surroundings. Apart from classic economic factors shaping the prices of goods in connection with their production costs, the impact of factors not previously associated with stock exchange quotations of an exemplary barrel of crude oil or a cubic meter of natural gas is increasingly visible. Among these factors, the following were highlighted: speculation, changes in logistics, adoption of thesaurus values by fossil fuels, emissions trading, and political dependencies. The reasons behind the situation are complex and include the following: changes in the roles of the existing or emerging bodies and institutions, changes in legal regulations, new types of transactions, changes in the nature of stock exchange quotations, maladjustment of the legislative process to current needs, and destabilization of markets.

Keywords: oil, natural gas, speculation, thesaurization, logistics, raw material markets, stock exchange

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Introduction

Prices of energy raw materials from up-stream to down-stream are assessed and analyzed through the prism of strictly economic factors, which, in principle, find their logical justification in the necessary costs borne by manufacturers. However, they do not have a decisive impact on the final level of the costs incurred by the demand side, which are additionally shaped by elements not clearly related to the market. Their identification and analysis were adopted as the main goals of the present investigation. The process of separating these elements is extremely complex. Methodologically, it was dominated by the procedure appropriate for the economic calculation used in the standard procedure of estimating the costs of manufacturing goods (Klepacki 2009, 43–44). It was compared with stock exchange listing statistics and transactions concluded for the purchase of hard coal, oil and natural gas supplied by means of pipelines and in the form of LNG. In the classic approach, economic, market and statistical analyses are used (Chotkowski 2011, 79–80). The next stage of the research procedure, which was related to the determination of the specificity of each of the distinguished elements, was carried out from the perspective of historical institutionalism using broadly understood comparative studies, heuristics, and proceedings appropriate for institutional and legal analyses (Bäcker et al. 2016, 62ff.).

1 Speculation

Trading in fossil fuels on the stock exchange is not limited by distance criteria. It has a universal and global dimension, which also gives transactional goods values that are not a simple implication

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of the level of price quotations resulting from their basic application (Davidson 2008). The size of supply offers or a significant number of bidders are not factors that constitute an effective speculative barrier (Stevans and Sessions 2010). Until the last decade of the 20th century, the actual demand for individual raw materials and their available quantities in sales offers were the main determinants of their price level. Its upward or downward movements were determined by changing any of these parameters. In the case of oil, this state of affairs was fully reflected in OPEC's activities. The cartel, using the mechanism of setting production limits for its members, for almost three decades effectively influenced the quotations of a barrel of this raw material. However, it is impossible to attribute a speculative character to these actions, at least in the contemporary 21st-century meaning of this term.

It is mostly oil that is primarily affected by the problem of exchange rate fluctuations determined by factors that cannot be identified in the traditional approach of economics as market regulators in the raw material area related to energy. Oil also serves as a benchmark in the area of trade in goods (commodities) used as energy carriers, both minerals and biofuels. Their exchange rate changes are closely correlated with those recorded by the traditional barrel, and not vice versa.

The benchmark dimension of oil in relation to other carriers is already established. It results, on the one hand, from the ease with which it can be transported anywhere in the world and the volume of its extraction, and, on the other hand, from its suitability for the production of fuels used in transport (land, sea, air), heating and electricity. All these factors give oil its universal character. Using converters in the form of toe (ton of oil equivalent) or boe (barrel of oil equivalent) is a consequence of this state of affairs as oil is the most popular energy carrier.

The abovementioned qualities of oil increase its popularity as an energy carrier and make its exchange rate extremely susceptible to changes caused by events only indirectly related to its extraction and consumption volumes. Armed conflicts, international political tensions, natural disasters, and many other circumstances that affect public sentiment are traditionally associated with investment risks in the oil sector. Its valuation is a determinant of the commodity's price in spot transactions and, through them, in forward contracts.

The elevation of derivatives such as futures contracts in the field of energy commodities to the role of independent items in exchange trading significantly influenced oil quotations. The dynamic growth of interest in them led to the detachment of their exchange rate as a base value from the supply and demand for it in the world economy. For example, the period preceding the crash in 2008, when the increasingly popular futures, as reflected by the volume of trading them (Majewska 2012, 241–242), became one of the levers bringing the oil barrel rate to the unprecedented level of almost USD 150/bbl.[1] However, this price was not the actual market value and was adjusted to USD 32/bbl in December 2008.[2]

The whole situation reflects the role played by emotions and moods in trading such instruments in the case of oil futures quotations. Their association with macroeconomic data on specific commodities is difficult to define strictly, but this does not deprive them of their impact on the price of the raw material itself.

In the case of crude oil, it is significant differences in the costs of obtaining this raw material that are especially conducive to speculative practices and the possibility of exchange rate fluctuations. These differences allow for a temporary reduction in prices to almost every level.

2 Thesaurization

Correlations between the exchange rates of, for example, crude oil and precious metals—i.e., the traditional means of thesaurization, are easily noticeable (Fulp 2018). This allows us to attribute a similar character to the first one (Tamakoshi and Hamori 2012). It is a consequence of the aforementioned (see section 1) limited amount of oil resources, as well as gold and platinum. Unlike the

1. See: "Crude Oil Rises to Record Above $144 After U.S. Stockpile Drop" by Christian Schmollinger, news published on July 2, 2008 at https://www.bloomberg.com/ (accessed 2022-11-07) [currently not available—Ed.].

2. Data retrieved from the U.S. Energy Information Administration (EIA) database: "Spot Prices for Crude Oil and Petroleum Products" webpage, available at https://www.eia.gov/dnav/pet/hist/RWTCD.htm (accessed 2021-11-08).

last two, it must be perceived as a short-term or medium-term investment due to its physicochemical properties and the associated storage costs. The indicated chronological framework does not apply to natural reserves of raw materials remaining in the ground, which have all the characteristics necessary to protect the accumulated goods against depreciation. The resulting attractiveness of hydrocarbon fossil fuels is one of the distinguishing features of trade in them, but not the only one.

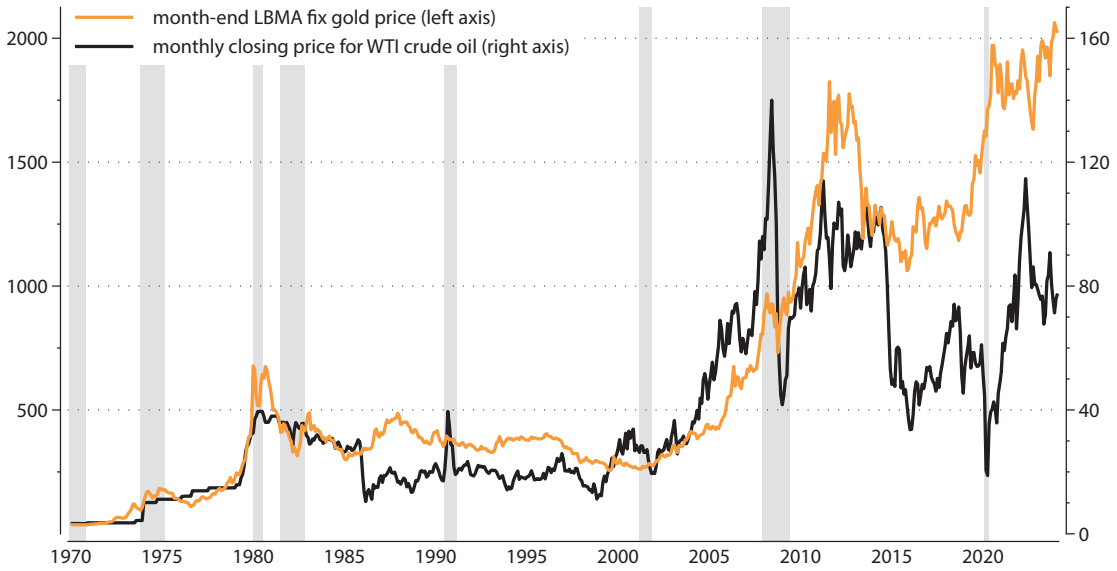

Figure 1. Correlation of oil and gold prices since 1973

Data source: "Gold Prices vs Oil Prices—Historical Relationship" published at macrotrends website, at https://www.macrotrends.net/1334/gold-prices-vs-oil-prices-historical-correlation (accessed 2022-01-04).

3 Political dependencies

One of the important elements of the energy commodity market is its politicization. Such factors as interstate relations, membership in international organizations or foreign policy often determine the interaction between the bidder and the recipient. This relationship is particularly noticeable in the trade in hydrocarbons. Examples include the limits imposed by the international community on the purchase of oil and its products from Iraq in 1991–2003[3] or the sanctions imposed by the United States on Iran,[4] which resulted in the practical elimination of the suppliers affected by the embargo (Brzoska 2014).[5] The impact of bilateral relations is reflected in the case of non-existent economic relations between the neighboring republics of Armenia, which is a consumer of oil and natural gas, and Azerbaijan, which is a producer of these commodities.

The political impact on the energy commodity market is not limited to trade preferences in which the choice of the contractor is determined by international relations or internal political systems, as mentioned above. It has a significant impact on the durability of concluded contracts

3. From UN Resolution 705 (1991) of 15 August 1991 (available at https://documents.un.org/doc/resolution/gen/nr0/596/42/pdf/nr059642.pdf?token=D1MYesklAxm9ZL0i5Q&fe=true) to the "oil for food" programme introduced by UN Resolution 986 (1995) of 14 April 1995 (available at https://documents.un.org/doc/undoc/gen/n95/109/88/pdf/n9510988.pdf?token=zcibGtuGkNLwxHcdp4&fe=true).

4. See: Executive Order 12959—Prohibiting Certain Transactions With Respect to Iran. May 6, 1995, Administration of William J. Clinton, May 7, 1995, page 784, available at https://www.govinfo.gov/content/pkg/WCPD-1995-05-15/pdf/WCPD-1995-05-15-Pg784.pdf; Remarks by President Trump at Signing of Executive Order on Iran Sanctions, issued on June 24, 2019, available at https://trumpwhitehouse.archives.gov/briefings-statements/remarks-president-trump-signing-executive-order-iran-sanctions/.

5. In the first case, by making the purchase, potential buyers would violate the applicable regulations and expose themselves to the legal consequences of their violation, while in the second case, they would face restrictions from the US administration. Nominally, the world powers sitting as permanent members of the Security Council are responsible for the enforcement of United Nations regulations. Indeed, the military and economic hegemony of the United States determines the effectiveness of the sanctions in the interest of that state.

and their characteristics, including their profitability. The legitimacy of choosing business partners and strengthening relationships with them by means of an agreement in which the criterion of profitability is of additional importance is explained, among others, by security issues, strategic considerations, and others. Each time, however, their nature is strictly political. This is well reflected in the agreement for the supply of LNG between the Polish company PGNiG and American companies.[6] The agreement is valid until 2042, a time in which the United States, according to all industry reports, including the government's EIA, will no longer have natural reserves of this raw material. In the contract, the promiser is not a producer but an intermediary. Buying from an entity from the country of origin of the raw material would practically be identical to importing from Russia or Iran. Reservations concerning the first option overshadowed the economic aspect, and trading with the other country, the Polish concern risked sanctions from the United States government.

4 Logistic specificity

It is not only political circumstances that determine the characteristics of trade in energy resources but also logistic requirements, which are unique and diverse, too. This is due, among other things, to the specificity of the transport of such goods and their amount, which cannot be compared with any other commercial goods. For example, the consumption of oil is almost 4 bbl per person per year in Azerbaijan, 1.1 in Armenia and 1.8 in Georgia, whereas the consumption of natural gas is 1,100 m^3, 770 m^3 and 484 m^3 per capita per year, respectively.[7]

Every element influencing the cost of the transfer is important with such volumes. In this respect, the infrastructure for transmission, reception and storage is of key importance. It often determines the profitability of entire supply concepts, as well as affects economically and technically the possibility of their implementation. It may be regarded as an element co-creating the market and the investor relations prevailing on it. Oil and gas pipelines, and, more precisely, their routes, reflect these dependencies for hydrocarbon carriers. They are the simplest and cheapest source of supply. Free access to the open sea is also an important advantage. In the case of liquids and gases, transport by sea is always more expensive than by pipelines, but in their absence, it is the only supply alternative. Its importance is systematically growing, along with the growing popularity of liquefied gas trading. For solid fuels such as coal, freight remains the most economically viable method of transport. In the case of inland transfers, rail invariably plays a leading role, also for hydrocarbon fuels, in areas where there are no oil or gas pipelines. The importance of road transport in the international trade in energy resources is completely marginal, which is also an interesting feature.

5 Mining subsidies

The indicated example of directing financial aid to support mines is explained, among others, in social and economic policies, and, more precisely, in the repercussions that the expected elimination of coal entails for them. It is justified by the pace of changes in the process of their elimination. This process results from structural constraints related to the need to replace jobs intended for liquidation with more prospective ones, retraining personnel, etc. However, allocation of support alone does not have an impact on the costs of obtaining this raw material and its market quotations.

With a high degree of probability bordering on certainty, these sources, the use of which generates increased greenhouse gas emissions to the atmosphere, e.g. through the production of various devices, will be considered non-prospective. The very context of these air pollutants has become a separate market area related to energy. Trade is common and the price has an impact on kWh.

6. Cheniere Energy (USA): 0.7 billion m^3 in 2019-2022 and 39 billion m^3 (approx. 2 billion m^3 per year) in the years 2023-2042; Venture Global Cacasieu Pass (USA): 1.35 billion m^3 per year for 20 years from 2022 (free-on-board); Venture Global Plaquemines LNG (USA): 1.35 billion m3 per year for 20 years from 2023 (free-on-board).

7. Own calculations based on data on natural gas consumption of Socar, Gazprom Armenia and Socar Georgia.

6 Emissions trading

Indicating this area as a non-market factor may be considered a debatable issue. After all, there is an extensive system of trade in permits for gaseous post-production waste polluting the atmosphere. This is well reflected in the case of marketing permits for industrial carbon dioxide generation. However, these are more or less voluntary burdens imposed by states to force pro-environmental measures on their producers of goods and electricity, and at the same time to support environmental protection. Their use does not constitute a conditio sine qua non of the technological process as a result of which a given product is created and, importantly, such use is not universal.

The concept of charging for industrial emissions of harmful chemicals is closely linked to the idea of environmental protection, which is intended to limit emissions of such contaminants. In the United States in the early 1980s, this solution was introduced to reduce air pollution by tetraethyl lead from leaded gasoline commonly used at that time (Stavins 2008, 300). This move brought the desired improvement. Fuel producers eliminated tetraethyl lead from the composition of their products, and the cost of the entire project turned out to be economically acceptable for them (Thomas 1995, 314–316). Similar intentions guided the 1990 U.S. regulations on emission trading with regard to compounds that caused acid rain.[8]

Restrictions on climate change gases, and hence trade in them, were envisaged in the Kyoto Protocol in 1997. The protocol listed carbon dioxide, methane, nitrous oxide, and HFCs, PFCs and SF6, which were recognized as responsible for the greenhouse effect. Signatories to the agreement pledged to reduce their emissions by 2012, each individually according to their negotiated volumes. The minimum requirement was a reduction not lower than 5% (Kyoto Protocol, 1997).[9]

The Chicago Climate Exchange (CCX), which was opened in 2002 and operated until 2010, became the first licensing exchange for carbon emissions.[10] The very concept of CCX underpinned the establishment of the Emission Trading Scheme (ETS) by the European Commission according to Directive 2003/87.[11]

The entry into force of the Kyoto Protocol may be seen as a materialization of the idea of world-wide reduction of greenhouse gas emissions as a factor contributing to climate change. The trade in allowances unites the 192 members of the international community who are signatories to the agreement. It also works in and affects the economies of countries that have not ratified it, such as the United States or Canada, which has withdrawn from its declared reduction (Barnes 2010).[12]

The impact of this is reflected in the cost of using fossil fuels, which is additionally increased by the price of permits for the emission of harmful chemicals into the atmosphere. This applies to all types of industrial facilities, and, in particular, to those related to energy-intensive industries or electricity generation itself. To put it simply, carriers generating fewer unwanted emissions are more expensive to purchase by an amount not less than the difference in costs resulting from their use, which the buyer would have to leave in order to purchase additional allowances in the event of

8. See: "Progress Report," https://www3.epa.gov/airmarkets/progress/reports/program_basics.html (accessed 2022-12-09) and it's legal basis: Clean Air Act Amendments, Nov. 15, 1990/[S. 1630], Public Law 101-549-Nov. 15, 1990, available at https://www.govinfo.gov/content/pkg/STATUTE-104/pdf/STATUTE-104-Pg2399.pdf.

9. See: Kyoto Protocol to the United Nations Framework Convention on Climate Change, United Nations 1998 and Protokół z Kioto do Ramowej konwencji Narodów Zjednoczonych w sprawie zmian klimatu, sporządzony w Kioto dnia 11 grudnia 1997 r. [Kyoto Protocol to the United Nations Framework Convention on Climate Change, done at Kyoto on 11 December 1997] DzU z 2005 r. nr 203 poz. 1684.

10. The efficiency of the system introduced in 2005 in the EC Member States was the inspiration for the draft law on harmful emission trading in the United States. The end of the trade mentioned in the main part of the text was related to legislative issues. Of key importance in this respect was the 2009 rejection by the upper house of the US Congress of the draft regulation introduced by Senators H. Waxman and E. Markey.

11. See: Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (Text with EEA relevance), OJ L 275, 25.10.2003, p. 32-46.

12. The most powerful exchanges in Europe are the Intercontinental Exchange (ICE) in London and the European Energy Exchange (EEX) in Leipzig. The transactions concluded there have an international dimension and do not affect the Old Continent only. In addition, the trade also takes place on domestic markets and through direct sales contracts between interested parties.

choosing a raw material that contributes to the production of a larger amount of CO_2 for the same final product, such as a material that raises the temperature of the facility, generates a certain amount of energy, etc.

Hence, in simple terms, in the countries that intend to reduce CO_2 emissions by means of emission certificates, we could assume that the cost of a raw material borne by an energy producer consists of its market price increased by the efficiency of its generating facilities and the product of the amount of generated emissions and the price of permits for those emissions. This interdependence can be determined by the following formula:

$$K = C_r(O \times \eta) + (E \times C_c). \tag{1}$$

Emissions:
K — the cost of a raw material for an energy producer
E — CO_2 emissions released during the combustion of 1 ton of a given raw material
O — the calorific value of a ton of a raw material
η — the efficiency of the device
C_c — the certificate price
C_r — the market price of the raw material

The impact of CO_2-related expenditure on producers' cost of electricity generation is reflected in spreads (Grudziński and Stala-Szlugaj 2015), which are the difference between the price that electricity producers obtain and the costs that they incurred for the energy carrier they used to generate a certain amount of power, taking into account the efficiency of the process:[13]

$$S = C_{EE} - C_r(O \times \eta), \tag{2}$$

where:
S — Spread,
C_{EE} — electricity sale price.

Taking into account the costs of CO_2 emissions (i.e., for the so-called Clean Spread):

$$S_C = C_{EE} - K, \tag{3}$$

where S_C is clean spread.

Conclusion

The growing share of factors not directly related to the production process or the market in the sense of classic economics can be described as a kind of *signum temporis*. It is not difficult to see in this phenomenon the consequences of changes in the area of institutional and legal regulations, resulting, among others, in the emergence of previously non-existent bodies and institutions, legal regulations, internal corporation regulations related to risk analysis, new types of transactions related to the IT revolution, changes in the principles of stock exchange quotations, etc. The observed progress and dynamics of change are ahead of legislative possibilities that would eliminate activities resulting in price fluctuations and destabilization of markets, which are dangerous to broadly understood social security. The aforementioned differences in the assessment of the risks behind market volatility and the huge profits derived from speculative behavior are examples of this.

The imbalance resulting from such activities, in turn, contributes to the treatment of durable, so-called commodities, in the case of which fossil fuels can be considered a means of securing capital. Petroleum and natural gas are gradually beginning to play a role until recently reserved only for precious metals. As a result, their price is additionally increased due to the thesauristic value they have acquired — a property that, in a very simplified way, contributes to their temporary withdrawal from the market. The problem of international political relations, along with interstate

13. See: "Analiza zmian hurtowych cen energii elektrycznej w 2018 r." [Analysis of changes in wholesale electricity prices in 2018], Wersja 4, poprawiona i uzupełniona, 09.10.2019 [Version 4, revised and supplemented October 9, 2019], available at https://kigeit.org.pl/FTP/Raporty/20191009_Analiza%20zmian%20cen%20energii%20elektrycznej%20w%202018%20r.pdf.

disputes and conflicts of interest, has been gradually returning in stock market quotations since the early 1970s and the so-called Fuel Crisis of 1972–1973. Its nature — thanks to technological progress and transformations in logistics — has taken on a new dimension, extrapolating its meaning. In the political dimension, it is also possible to consider the context related to the impact of environmental protection activities (including emission allowances) on the prices of raw materials. Their limits are determined by international agreements, so their cost depends largely on their allocated amount, which is later traded. The demand side, by discounting the expenses incurred in the energy production process, influences the price of fossil fuels, indirectly making it dependent on the results of the aforementioned agreements aimed at stopping climate change.

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