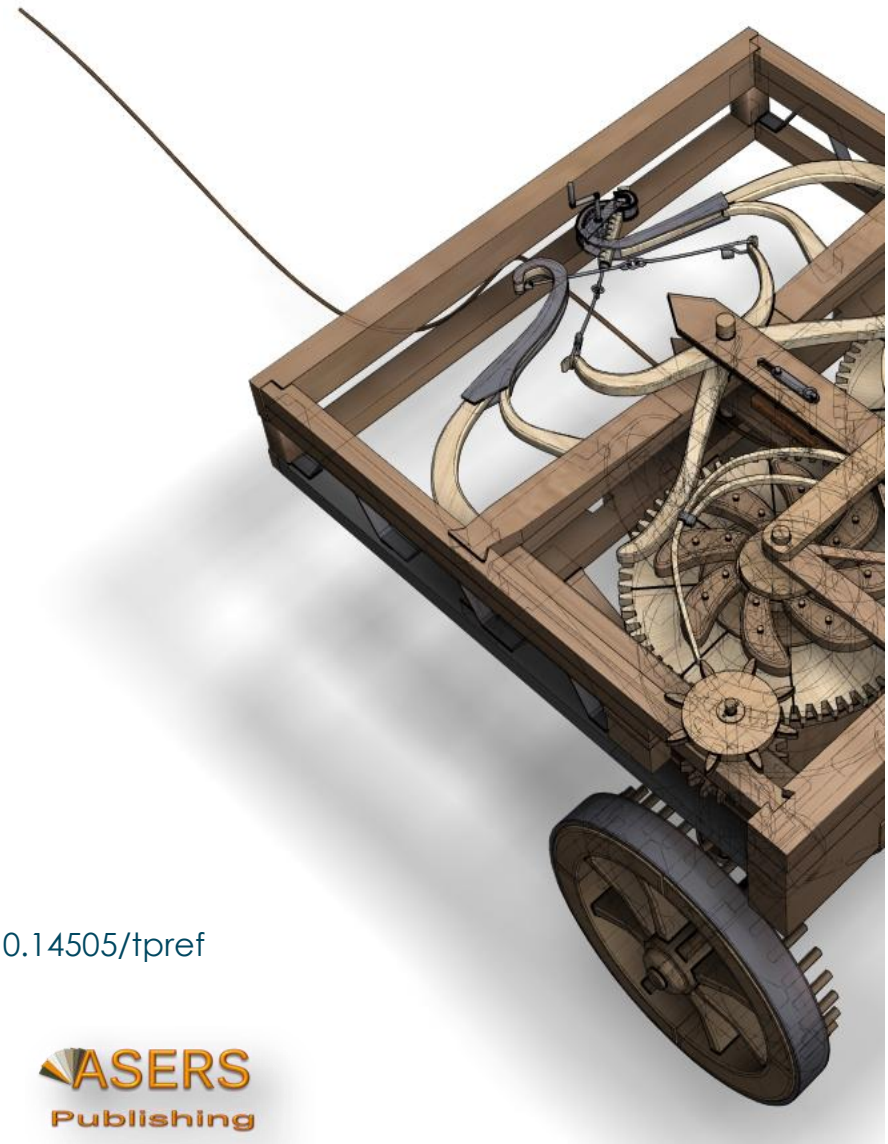
Theoretical and Practical Research in Economic Fields



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Theoretical and Practical Research in Economic Fields

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The Role of International Energy Agreements in Price Band Formation

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Abstract: The price of energy is one of the key determinants of the well-being of numerous countries, therefore, analysis of the factors of influence on such price formation is of great importance. This work aims at the determination of the main vectors of influence of international energy agreements on the formation of the price bands on the example of the Organization of the Petroleum Exporting Countries. Statistical analysis method, descriptive method, and correlation analysis method were used in the study. As a result of the study, the significant role of international energy agreements in the formation of the price bands was proved. Using the characteristic of the mechanism of influence of oil exporters on the prices of oil, the control major oil exporters can have over price formation. The analysis of price fluctuations in time enabled combining these fluctuations with key geopolitics and economic events of the relevant period, as well as explaining the influence of oil exporters on the price change. The offer of the members of the Organization of the Petroleum Exporting Countries significantly affects the prices of crude oil, spot prices, and prices of products, which was confirmed using correlation analysis. The influence of exporters is larger than that of the states outside the organization. Gasoline, Diesel, and Jet/Kero are the most sensitive to fluctuations in the offer of the Organization of the Petroleum Exporting Countries. Not only official energy agreements but also informal practices significantly influence the formation of price bands, which was demonstrated through the analysis of the revenue from Russian oil exports. Governments and energy companies may use these results for optimisation of strategies for managing risks associated with the actions of international organizations.

Keywords: international energy agreements; price bands; prices of energy; oil exporters; energy security; price control.
JEL Classification: F10; F16; F38; G13.

Introduction

The energy sphere plays a key role in the world economy as it directly affects the well-being of states through the development of production and infrastructure (Khan *et al.* 2021b; Li & Leung, 2021). Changes in prices of energy cause inflation rate fluctuations and increase or decrease in the income of the state and private sector and influence the level of competitiveness of economies (Kilian & Zhou, 2022; Abdallah & Kpodar, 2023). In turn, a whole series of geopolitical and economic factors, including conflict escalation, global uncertainty, financial crises, etc. influence the prices of energy (Wen *et al.* 2021; Nerlinger & Utz, 2022).

Various energy agreements can contribute to the mitigation of the negative effects of the factors mentioned above for the states entering into them (Mišík, 2022). Moreover, they enable an influence on the price of energy, providing advantages to the state-members (Kisswani *et al.* 2022). Different agreements between the Organization of the Petroleum Exporting Countries (OPEC) may be outlined among the most influential energy agreements in recent decades (Derbali *et al.* 2020; Pirani, 2022). Oil is one of the key energy sources and plays a strategic role in geopolitical space (Yang *et al.* 2022). Expansion of the organization within the OPEC+ agreement enables strengthening control of this organization on the world oil market (Ulatowski, 2020; Na & Hongmei, 2022).

OPEC+ has significant control over oil production and can establish quotas for member states. Production reduction means a reduction of oil supply, which leads to a price increase. This affects both members of the cartel and other states, exporting oil, which is reflected in their incomes. An increase in the price of oil causes additional expenses and strengthens the economic pressure on import-dependent states, especially in case of insufficient import diversification (Mazaraki *et al.* 2021; Kudyrko *et al.* 2024).

This study aims to determine the main vectors of influence of international energy agreements on the formation of the price bands in the example of OPEC+. The tasks of the study are:

- to analyse the dynamics of the price of oil as one of the strategically important resources, to determine the causes of fluctuations and the role of OPEC and OPEC in it;
- to characterise the mechanism of influence of OPEC and OPEC+ on the prices of energy;
- to conduct correlation analysis between the prices of crude oil and products on the one side and parameters of demand and supply of different organizations on the other side;
- to study the influence of sanctions on Russia as a part of international energy policy.

1. Literature Review

The price of energy is affected by numerous factors, which are noted in numerous works of scientists. Researchers aim to detect and analyse different macroeconomic factors of influence to confirm or refute their influence on the prices of energy. Su et al. (2020) analysed the dependence of the price of oil on the factors of guerrilla conflicts (in the example of the USA), the dollar index, and oil production in the USA. Khan et al. (2021a) conducted an analysis directed at detecting the influence of different bubbles on crude oil prices. Beckmann et al. (2020) selected the narrow direction, studying the relationship between the prices of oil and exchange rates. Lin & Bai (2021) noted the significant influence of uncertainty on oil prices. Uncertainty can be caused by various financial crises and other economic and political phenomena and events. Wang et al. (2022) studied the relationship between inflation rate and economic growth on the one side, and oil price fluctuations on the other side.

The mentioned works significantly contribute to the studied theme, explaining numerous cause-effect relationships between oil prices and various geopolitical and economic factors. However, it is important to analyse the influence of international energy agreements in the formation of prices of energy as well, as such agreements can have a significant influence on prices depending on the influence of macroeconomic factors. For example, agreements between large oil suppliers, as in the case of the OPEC+, can make significant changes to the price policy in the absence of a direct relationship with economic growth, currency rate, etc (Çemrek & Bayraç, 2021). Ji et al. (2019) noted that the OPEC members are the most important players among oil exporters. These states produced approximately 40% of oil and had over 81% of the world's oil at their disposal. Quint & Venditti (2023) studied changes in oil prices due to a reduction in production by the members of OPEC+, as well as further shock due to COVID-19 and the price war between organization members.

In light of aggravating climate issues, the other important area of research is the influence of various "green" agreements on the energy market (Litvak & Litvak, 2020; Prokopenko *et al.* 2023). Lee *et al.* (2021) analysed the relationship between the US green bond index, geopolitical risks and the oil price. Referring to the Kyoto Protocol and the Paris Agreement, Rasheed *et al.* (2022) studied the relationship between the prices of oil and the use of fossil and renewable fuels.

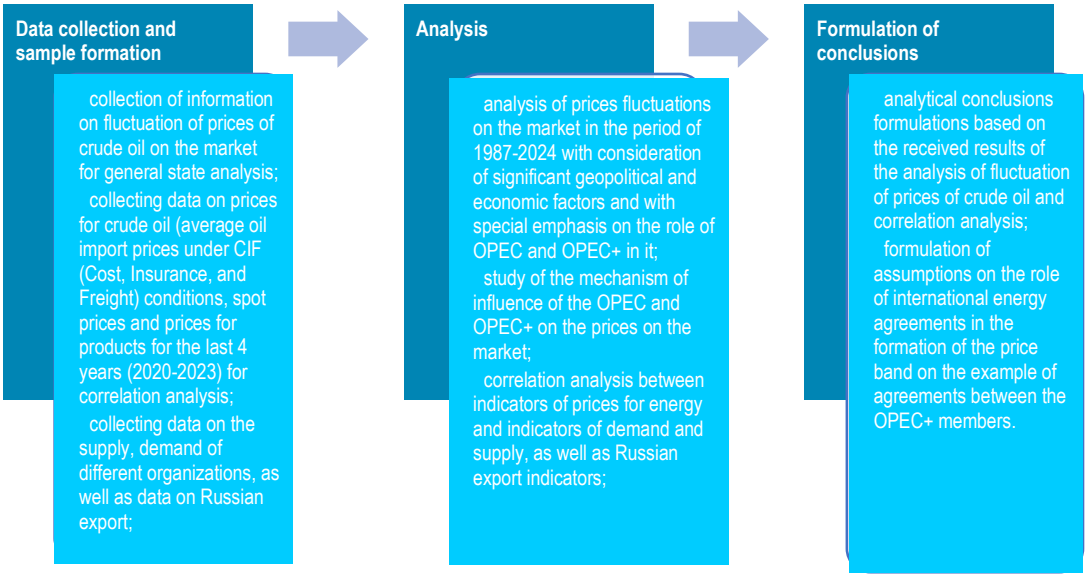
Considering the influence of numerous factors on the price of energy, this work focuses on the analysis of the modern state of the energy market and the OPEC+ influence on it. This is related to the significant influence members of OPEC+ can have on the energy market through the control of over 40% of oil production and the major share in the export of this energy source. Hence, as oil is the main energy source, its price affects the price of other energy resources. The necessity for extending studies in the mentioned theme is stipulated by the lack of works, containing profound analysis of the influence of international energy agreements on prices of energy. In turn, such agreements can have decisive meaning along with other geopolitical and economic factors.

2. Research Methodology

2.1. Study Procedure

The study procedure provides for the realisation of standard stages: data collection, analysis, and formulation of analytical conclusions. The analysis stage contains the analysis of price fluctuations, the study of the mechanism of influence of OPEC and OPEC+ on the price, and the correlation analysis between price indicators and indicators of demand and supply. The stages of the study are interrelated and consistently present the content of the received results (Fig. 1).

Figure 1. Study procedure



Source: construed by the authors

2.2. Sample

The sample of indicators for the study is presented in Tables 1 and 2. The period covered by data in these tables is limited to the latest available data for 2020-2023. Table 1 contains data on prices of crude oil, spot prices and prices of oil products.

Table 2 contains the main indicators, which can influence oil prices - supply, and demand - divided by regions, in price, OPEC. This enables analysis of the influence of the agreements between the members of this organization on price formation. Table 2 also contains data on Russian exports and revenues from oil. These indicators were included in the analysis for evaluation of the latest changes in the market, related to the Russian invasion of Ukraine and the influence of these events on the prices of energy. In particular, it is important to analyse the influence of sanctions on the revenues of Russia from energy exports. Although sanctions are not full-fledged international agreements, they also play an important role in international energy policy and, thus, have a direct relation to the theme of the work.

Table 1. Prices of crude oil and products

	2020	2021	2022	4Q22	1Q23	2Q23	3Q23
CRUDE PRICES IEA CIF Average Import							
IEA Europe	42.91	70.67	100.22	89.42	82.16	79.75	87.94
IEA Americas	37.31	64.78	90.77	77.18	67.91	70.63	78.24
IEA Asia Oceania	46.28	70.41	102.56	96.43	86.14	83.19	84.91
IEA Total	42.19	68.87	98.2	87.96	79.25	78.03	84.49
SPOT PRICES							
North Sea Dated	41.76	70.82	101.1	88.36	81.11	78.02	86.74
North Sea Dated M1	42.9	71.51	101.17	89.54	82.37	78.02	86.69
WTI (Cushing) M1	39.25	68.1	94.58	82.82	75.96	73.54	82.51
WTI (Houston) M1	40.71	69.01	96.19	84.33	77.74	74.69	84.01
Urals	41.21	69	76.58	62.46	46.77	54.63	72.79
Dubai M1	42.36	69.35	96.27	84.68	80.2	77.56	86.54
PRODUCT PRICES Northwest Europe							
Gasoline	44.64	80.07	117.01	99.41	96.17	99.44	112.44
Diesel	49.34	78.41	142.36	139.55	113.71	96.12	119.87
Jet/Kero	45.8	77.31	139.91	130.9	114.74	95.43	120.67
Naphtha	40.18	71.58	86.51	72.63	77.95	67.47	71.72
HSFO	33.99	61.18	76.58	59.55	60.51	67.96	82.63
0,5% Fuel Oil	48.5	76.78	107.05	87.19	83.99	79.21	88.17
Mediterranean Europe							
Gasoline	45.57	80.5	119.73	103.89	100.36	98.77	112.74
Diesel	48.82	77.93	136.11	130.46	112.08	94.97	118.1
Jet/Kero	45.57	77.19	140.02	131.28	114.89	95.43	120.6
Naphtha	39.04	70.65	84.62	70.36	75.83	65.93	69.99
HSFO	34.17	60.05	73.4	56.73	56.97	65.19	81
US Gulf Coast							
Gasoline	47.3	86.49	123	103.04	105.58	103.93	117.09
Diesel	50.26	84.73	145.74	141.65	120.39	100.11	124.92
Jet/Kero	46.3	77.95	140.05	134.73	125	94.79	120.4
Naphtha	40.12	72.24	91.24	76.09	80.92	74.87	72.92
HSFO	34.71	59.9	76.96	55.48	57.1	64.07	78.65
0,5% Fuel Oil	49.88	79.69	112.92	92.69	90.54	82.18	93.2
Singapore							
Gasoline	45.28	78.49	110.86	89.89	95.15	89.57	99.68
Diesel	49.6	77.8	135.47	126.25	108.44	93.09	115.23
Jet/Kero	45.06	75.29	126.9	118.3	106.38	91.57	112.47
Naphtha	40.94	71.02	83.79	70.92	74.21	63.26	80.28
HSFO	38.33	63.2	77.65	58.6	62.36	68.53	80.28
0,5% Fuel Oil	52.85	80.81	116.78	97.77	90.95	86.97	94.06

Source: generalised by the author based on the data of IEA (2024)

Table 2. Parameters, having an influence on oil prices

	2020	2021	2022	4Q22	1Q23	2Q23	3Q23
DEMAND							
OECD Demand	42.1	44.8	45.7	45.7	45.4	45.7	46
NON-OECD Demand	49.8	52.7	53.8	54.6	54.9	56.1	56.8
Total Demand	91.9	97.5	99.5	100.2	100.2	101.8	102.9
SUPPLY							
OECD Supply	28	28.2	29.3	30	30.4	30.5	31.2
NON-OECD Supply	31.7	31.6	32.2	32.5	32.7	32.4	32.4
Total Non-OPEC Supply	64.4	64.9	66.8	67.7	68.1	68.6	69.6
OPEC Supply	29.7	30.6	33.3	33.7	33.8	33.2	32.4
Total Supply	94.1	95.5	100.1	101.4	101.8	101.8	101.9
Russian Oil Exports							
Total (Crude and Products)		7.2	7.5	7.3	7.9	7.1	7.4
Export Revenue		15.7	19.5	14	14.2	13	18.8

Source: generalised by the author based on the data of IEA (2024)

2.3. Methods

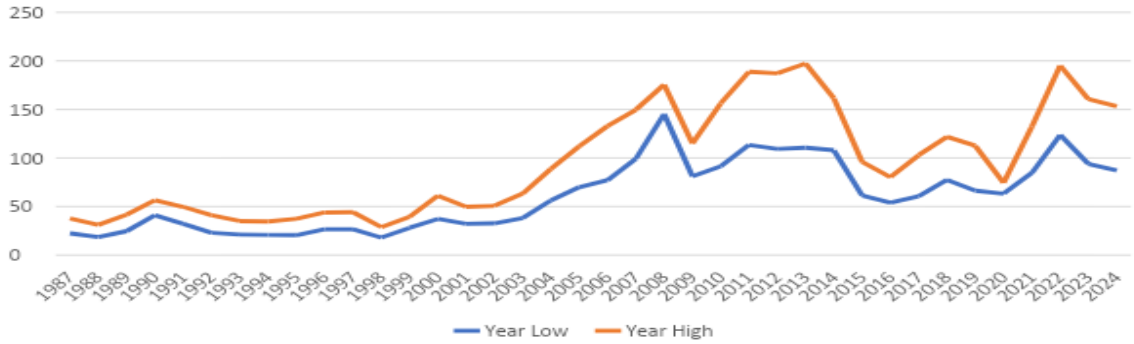
Statistical analysis method was used in the process of this study for the study of fluctuation of prices of crude oil in time. Using this method, the most important changes in prices of oil during the studied period. The enabled comparison of the detected 'jumps' in prices with certain geopolitical and economic events. Moreover, the possible relationship between the activity of OPEC and OPEC+ with detected fluctuations was analysed. The descriptive method was used to characterise the influence of OPEC and OPEC+ on the prices of oil. The use of this method enables the description of the mechanism of such influence and an explanation of cause-effect relations and whole organizations. Correlation analysis was used to detect changes between the studied indicators of prices of energy and indicators of demand and supply from different organizations. Correlation analysis enabled the detection of the relation between price dynamics and supply and demand dynamics, the determination of the most significant correlations and relation area.

3. Results

3.1. General Tendencies on the Market

The last two decades were marked by significant fluctuations in oil prices on the global scale (Figure 2). The gradual price increase after 2001 ended with a sharp drop in 2008-2009 due to the economic crisis, which affected global demand and the financial market. After a short-term recovery, prices sharply decreased again in 2010-2013, which could be related to a complex of different factors. In particular, such a situation was caused by the extension of shale oil production in the USA along with the refusal of OPEC to shorten production for price stabilisation, which caused an increase in resource supply. Further, in 2016 Saudi Arabia and Russia agreed to maintain the prices of oil. Finally, OPEC+ was created, which involved members of OPEC as well as other states. Production reduction by OPEC members, in particular Saudi Arabia, contributed to the gradual increase in the prices of oil. Further price decreases may be explained by the consequences of the COVID-19 pandemic, which among others influenced demand reduction. The new price recovery occurred alongside the recovery of economic activity after the pandemic. Prices of oil achieved their peak in 2022 - the year of the Russian full-scale invasion of Ukraine. This was provoked by the fear of price increases due to supply disruptions related to sanctions imposition against Russia. The situation with prices of oil somewhat improved after 2022, which could be related to the production increase in other countries. Herewith, the opening of the US Strategic Petroleum Reserve and other geopolitical factors could contribute to this situation.

Figure 2. World prices of crude oil



Source: developed by the author according to data of Macrotrends (2024)

Referring to the data from the report of the International Energy Agency (IEA, 2024), it is worth noting the slowdown in the increase in global oil demand among other tendencies at the beginning of 2024. The slowdown is related to macroeconomic fluctuations, strengthening efficiency standards, slowdown of the growth in China, increase in electric vehicle fleet. Herewith, the supply of energy by the increase in production in such countries as the USA, Canada, Brazil, and Guyana. Herewith, production increase will be more noticeable for countries outside OPEC+. Production of the last remains stable. The other tendencies are an increase in the production of Russia and the reduction of global oil reserves. Generally, the forecast of the World Bank provides for the reduction in prices of oil from 84 USD per barrel in 2024 to 79 USD in 2025. The main risks in the prognosis may be noted as conflict escalation, lower than expected energy supply in Northern America, as well as the increase of the global GDP lower than expected (Agnolucci & Temaj, 2024).

3.2. Influence of OPEC+ on Oil Prices

From the previous paragraph, it can be summarised that OPEC+ has a significant impact on the energy market. 80% of the confirmed world reserve of oil and a significant share of exports are under the control of the organization (Bromberg, 2024). The organization regulates oil supply to control prices on the world energy market. Other goals of this association may be named as counteracting other countries in their ability to produce oil, limiting supply control and prices of OPEC+ itself. In 2022, OPEC+ used production reduction to increase prices of oil, which failed due to the possibility of recession.

The essence of OPEC+ activity is supply reduction by its members to stimulate an increase in prices in case of dissatisfaction with oil prices. Herewith, supply reduction leads to income decrease, which may be unprofitable for separate states of the organization. Being the main exporters, Russia and Saudi Arabia aim for a supply increase, as they have possibilities to expand production. On the other side, other countries of the organization may not have such possibilities, therefore, they can object to supply increase, which leads to internal differences. It is possible to assume that the influence of OPEC+ is mostly short-term, as the correlation of oil production in the future can change under the influence of its increase in other countries. The long-term influence of international “green” agreements stimulating the transition to renewable energy sources, and thus affecting the structure of fossil fuels demand, is not excluded.

3.3. Correlation Analysis

Correlation analysis on the basis of the data was conducted to confirm previous conclusions (Table 1 and Table 2). The results of correlation analysis are presented in Table 3. Correlation analysis between the prices of crude oil and products on the one side and parameters of demand and supply of different organizations on the other side was conducted. The correlation value obtained as a result of the calculations is shown at the intersection of the two indicators.

The following conclusions can be made on the results of the conducted correlation analysis. High correlations are observed between indicators of OPEC supply and prices of crude oil. Hence, the price of crude oil is significantly less correlated with the supply of states, which are not OPEC members. Gasoline, Diesel, and Jet/Kero have the tightest relation to the supply of OPEC, which is characteristic of all studied regions. This means that the level of supply of OPEC has a significant influence on the prices of crude oil. Herewith, Gasoline, Diesel, and Jet/Kero are the most sensitive to such changes.

Table 3. Correlation analysis results

	OECD Demand	NON-OECD Demand	Total Demand	OECD Supply	NON-OECD Supply	Total Non-OPEC Supply	OPEC Supply	Total Supply	Total Russian Export (Crude and Products)	Russian Export Revenue
CRUDE PRICES IEA CIF Average Import	0.708	0.171	0.294	0.283	0.423	0.322	0.615	0.505	0.290	0.577
IEA Europe	0.632	0.077	0.210	0.126	0.173	0.181	0.395	0.311	0.088	0.704
IEA Americas	0.640	0.098	0.210	0.243	0.519	0.274	0.762	0.546	0.294	0.318
IEA Asia Oceania	0.685	0.130	0.255	0.238	0.398	0.280	0.616	0.479	0.246	0.545
IEA Total	0.708	0.171	0.294	0.283	0.423	0.322	0.615	0.505	0.290	0.577
SPOT PRICES										
North Sea Dated	0.648	0.092	0.218	0.202	0.352	0.242	0.563	0.428	0.291	0.618
North Sea Dated M1	0.631	0.070	0.195	0.193	0.369	0.229	0.583	0.429	0.321	0.594
WTI (Cushing) M1	0.645	0.089	0.217	0.190	0.310	0.231	0.514	0.398	0.266	0.662
WTI (Houston) M1	0.649	0.097	0.224	0.203	0.330	0.243	0.529	0.412	0.288	0.655
Urals	0.129	-0.224	-0.125	-0.316	-0.557	-0.261	-0.447	-0.379	-0.335	0,842*
Dubai M1	0.728	0.219	0.340	0.323	0.421	0.362	0.584	0.514	0.321	0.637
PRODUCT PRICES Northwest Europe										
Gasoline	0,870*	0.499	0.605	0.543	0.476	0.589	0.544	0.639	0.216	0.629
Diesel	0.679	0.160	0.270	0.326	0.550	0.346	0.709	0.564	0.360	0.390
Jet/Kero	0.710	0.214	0.323	0.381	0.581	0.400	0.716	0.600	0.432	0.449
Naphtha	0.064	-0.397	-0.309	-0.242	0.068	-0.235	0.309	-0.004	0.612	0.596
HSFO	0.646	0.500	0.576	0.412	0.038	0.464	-0.029	0.281	-0.049	0.800
0,5% Fuel Oil	0.473	-0.084	0.042	0.012	0.163	0.053	0.404	0.230	0.320	0.725
Mediterranean Europe										
Gasoline	0,850*	0.439	0.547	0.524	0.538	0.562	0.625	0.660	0.317	0.595
Diesel	0.708	0.207	0.315	0.373	0.578	0.392	0.717	0.596	0.404	0.424
Jet/Kero	0.709	0.213	0.321	0.380	0.583	0.399	0.718	0.601	0.432	0.444
Naphtha	0.020	-0.431	-0.345	-0.289	0.006	-0.280	0.250	-0.062	0.586	0.615
HSFO	0.599	0.478	0.550	0.374	-0.033	0.426	-0.116	0.215	-0.102	0.805
US Gulf Coast										
Gasoline	0,819*	0.464	0.564	0.532	0.503	0.569	0.564	0.635	0.352	0.642
Diesel	0.670	0.159	0.267	0.333	0.560	0.349	0.708	0.565	0.408	0.407
Jet/Kero	0.648	0.190	0.284	0.390	0.651	0.395	0.767	0.620	0.556	0.360
Naphtha	0.191	-0.275	-0.186	-0.142	0.197	-0.122	0.495	0.161	0.500	0.434
HSFO	0.546	0.344	0.429	0.258	-0.074	0.313	-0.085	0.158	-0.035	0,868*
0,5% Fuel Oil	0.484	-0.065	0.057	0.055	0.234	0.088	0.458	0.278	0.403	0.701

	OECD Demand	NON-OECD Demand	Total Demand	OECD Supply	NON-OECD Supply	Total Non-OPEC Supply	OPEC Supply	Total Supply	Total Russian Export (Crude and Products)	Russian Export Revenue
Singapore										
Gasoline	0.677	0.273	0.376	0.368	0.432	0.401	0.549	0.519	0.460	0.673
Diesel	0.692	0.172	0.285	0.331	0.531	0.353	0.688	0.558	0.387	0.467
Jet/Kero	0.736	0.252	0.360	0.413	0.593	0.432	0.718	0.622	0.432	0.464
Naphtha	0.292	-0.078	0.015	0.019	0.009	0.031	0.048	0.036	0.502	0,917*
HSFO	0.555	0.411	0.484	0.320	-0.028	0.372	-0.066	0.204	-0.009	0,822*
0,5% Fuel Oil	0.521	-0.057	0.070	0.052	0.247	0.092	0.509	0.307	0.293	0.620

Source: calculated by the author based on the data of IEA (2024)
* Statistically significant correlations are marked

Statistically significant correlations are characteristic of indicators of OECD Demand and prices of Gasoline in Northwest Europe, Mediterranean Europe, US Gulf Coast. The increase in demand for gasoline occurred in association with quarantine restrictions removal and stimulated price increases. The other significant factors were limitations of OPEC+ production, pressure due to the war in Ukraine, and reduction of oil reserves in Europe and the USA.

It is also worth noting high and statistically significant correlations between the revenue of Russia from export and a number of price indicators for energy and products. Thus, Russian export revenue is tightly correlated with the spot price of the Urals, prices of HSFO in the US Gulf Coast and Singapore, as well as prices of Naphtha in Singapore. Thus, regardless of sanctions, the revenues of Russia from oil export increase, which can be connected to shadow fleet expansion. This enables the state to exceed the price cap for oil and receive high revenue. China and India are the largest importers of Russian crude oil, and importers of oil products are Turkey, China, Brazil, the UAE, Malaysia, Singapore, India, and Saudi Arabia.

4. Discussions

The analysis conducted in this work proved the significant role of international energy agreements in the formation of the price band. In particular, the example of OPEC+ was used to show the impact of agreements between member states on prices by setting production limits. Correlation analysis proved the significant role of OPEC+ in the formation of prices of crude oil and products. The analysis of indicators of the revenue from Russian oil export enabled us to assume that not only official energy agreements, but also informal practices, significantly influence the formation of price bands.

It is important to consider the issue of price band formation in the energy market within the context of different geopolitical and economic factors of influence. The author's work conclusions on the relation between oil prices and geopolitical and economic events of the relevant period correspond to the results of other researchers. In such a way, based on the data of the USA, Su *et al.* (2020) proved that guerrilla conflicts influence the prices of oil, but such influence is lower compared to the effect of the dollar rate. Oil production volume in the USA was found to have less influence. Khan *et al.* (2021a) found that prices of oil are affected by different "bubbles". The "bubble" factors include world economic growth, decline in the dollar, excessive supply of OPEC, US production levels, and insufficient demand for energy in developing countries. Beckmann *et al.* (2020) concluded that prices of oil undergo significant influence from exchange rates from a long-term perspective. This may be useful for forecasting, although scientists noted that such influence significantly changes with time. Lin & Bai (2021) found that oil prices negatively react to uncertainty. Herewith, price shocks significantly influence oil exporters. Wang *et al.* (2022) proved that prices of oil, in their turn, have a significant influence on economic growth and financial development. This influence is experienced by both states-importers and states-exporters of energy. The influence of various factors on price band formation is considered, but special attention is given to international energy agreements. This is the advantage of the study for understanding price fluctuations, which may not be directly related to geopolitical situations.

The significant influence of OPEC on price bands is noted both in the work of the author and in other works. Çemrek & Bayraç (2021) expressed their confidence in the significant dependence on the global industry and export of oil in OPEC states. Ji *et al.* (2019) noted the significant influence of OPEC on the oil security of China, Japan, and Southern Korea as key oil importers. The scientists concluded that political uncertainty in

OPEC countries can have a significant influence on countries and influence these prices. The conclusions of the mentioned researchers correspond to the results of the author of this article. However, unlike this study, Quint & Venditti (2023) have not found a significant influence of OPEC+ on the price of oil. The scientists explained this as a result of oil producers' deviations from the assigned quotas. In general, scientists found that the price of oil was lower by 6% than actual ones without reductions, caused by OPEC+.

Scientists touched on the theme of the issue of the "green" policy for the prices of energy in some works. Lee *et al.* (2021) found a dependence between the prices of oil and the index of green bonds in the USA. Rasheed *et al.* (2022) found that an increase in oil prices can stimulate a more rapid transition from renewable energy sources, which changes the demand structure. These issues were not covered in depth in the author's work, although their potential influence on prices from a long-term perspective. The received results may be used by governments to improve the efficiency of policymaking in the energy sector. The relationship found can be used for better forecasting the consequences of the actions of international partners and their consideration during the development of risk management strategies.

Conclusion

The study of factors of influence on prices of energy is important from the position of significant influence of price fluctuation on the well-being and competitiveness of national economies. Such factors can include global uncertainty, crises, conflicts, etc. International energy agreements can mitigate the destructive influence of negative events. In turn, such agreements also influence price formation, which may be beneficial or, on the contrary, it is unprofitable for different countries.

The results of the conducted study prove the significant role of international energy agreements in the formation of price bands. The significant influence of agreements between large oil exporters, controlling a significant share of the market on price formation, was proved by the example of the activity of OPEC and OPEC+. This is above all realised by establishing quotas for oil production.

The influence of OPEC and OPEC+ on the energy market is clearly observed in the course of the analysis of fluctuations in the price of crude oil. Periods of oil price increase are often accompanied by decisions of the organization on production reduction. The offer of the members of the OPEC was proved to significantly affect the prices of crude oil, spot prices, and prices of products, using correlation analysis. Herewith, the influence is more significant compared to the influence of the states outside the organization. Products such as Gasoline, Diesel, and Jet/Kero are the most vulnerable to changes in OPEC supply. Additionally, it is worth noting that not only official energy agreements, but also informal practices and arrangements significantly influence the formation of price bands. This was proved by the example of analysis of revenues of Russia from oil export, received regardless of current sanctions. Long-term consequences of the influence of international energy agreements on price bands shall be considered in further studies. Herewith, it is worth analysing whether OPEC+ will save its controlling positions with time. It will be also useful to study the influence of international "green" agreements, which can change fossil fuels demand structure, with long-term consequences.

The novelty of the work lies in the elimination of the existing scientific gap by conducting a thorough analysis of the impact of international energy agreements on pricing in the energy sector. In particular, the study considers these agreements as one of the determinants along with other geopolitical and economic factors, which allows for a more comprehensive understanding of the mechanisms of energy price formation, which emphasizes the importance of the study.

Credit Authorship Contribution Statement

Oksana Okhrimenko: Methodology, Providing Survey, Formal Analysis.
Ihor Samsin: Methodology, Providing the Survey, Data Curation.
Tetiana Zubko: Validation, Formal Analysis, Writing.
Elena Lytvynenko: Writing and Editing, Visualization.
Ihor Kiiakh: Conceptualization, Project administration, Writing and Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-assisted technologies

The authors declare that they have not used generative AI and AI-assisted technologies in the writing process before submission, but only to improve the language and readability of their paper and with the appropriate disclosure.

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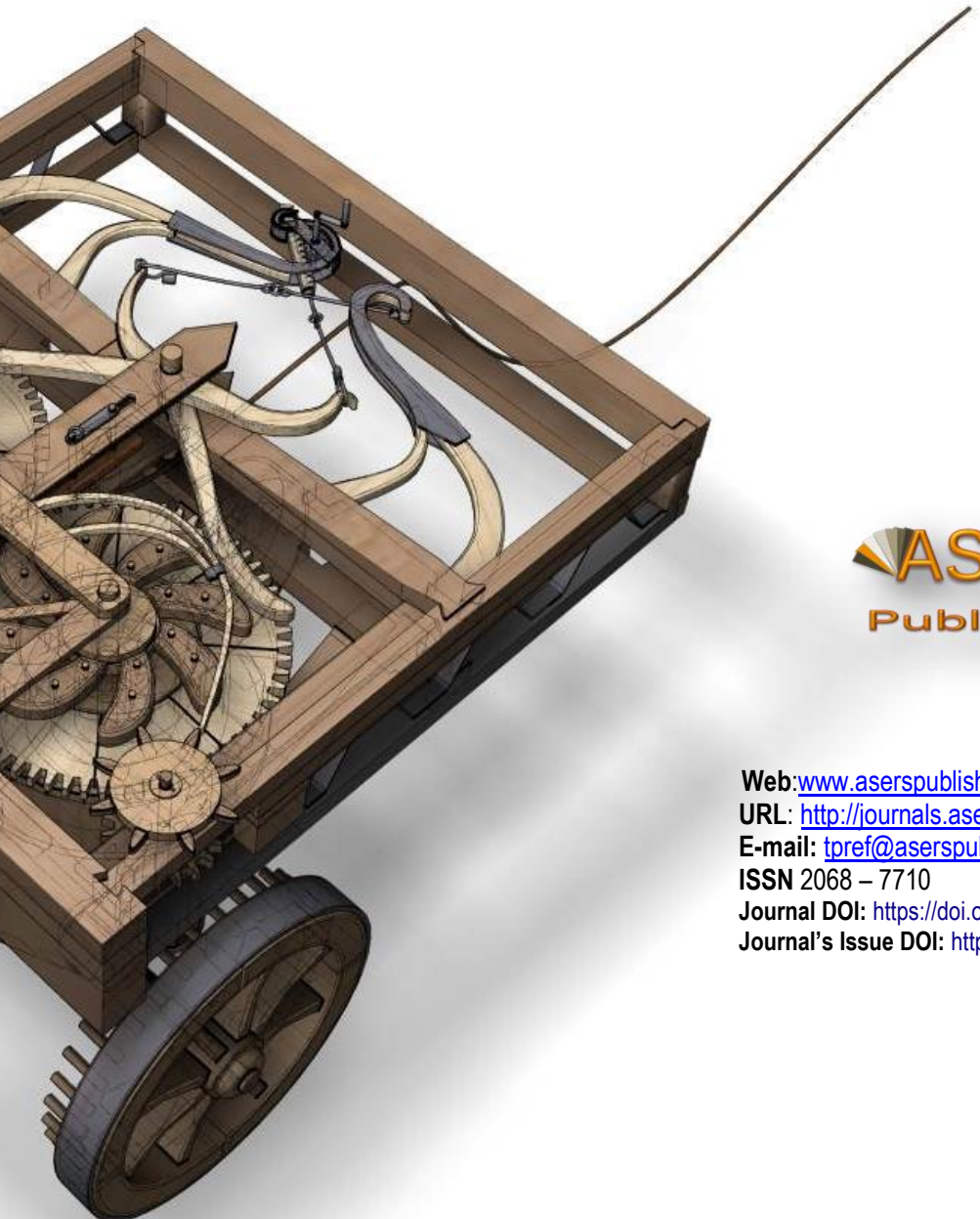

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