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EXPLORING THE EFFECTS OF OIL PRICES ON ROAD FREIGHT IN POLAND AMIDST COVID-19 AND RUSSO-UKRAINIAN WAR

Destructive market forces are multiplying as the world faces the worst global energy crisis in history. The continuing economic downturn and fluctuating oil prices, triggered by OPEC+'s plan to reduce supply, are slowing down global oil demand. In this respect, the situation in the transport services market is changing. Changes in the price of oil are indirectly influencing the formation of wholesale diesel prices; consequently, road freight should also change. However, are these changes correlative and do oil price fluctuations directly affect freight rate changes? This article aims to investigate the correlation between fluctuations in oil prices on world markets and their impact on wholesale diesel prices and, thus, the development of net road freight in Poland. In the study, the authors developed a model called "fuel adjustment," containing the fluctuations in wholesale diesel prices, which were taken into account in determining the average deviation in the road freight level over the analyzed period. In this way, it became possible to determine the amount of road freight and its fluctuations depending on the development of oil prices on world markets. The results of the study confirm that there is a strong and positive relationship between the analyzed variables. When the prices of crude oil on world markets fall, this should be followed by reductions in diesel prices in individual countries, including Poland. Consequently, the amount of road freight should also have a downward trend. Will this happen?

Keywords: crude oil, economics, fuel model, fuel prices, pandemic, road freight, transport.

1. INTRODUCTION

In recent years, crisis situations such as natural disasters, pandemics, economic crises, migration crises, political conflicts or terrorist attacks have had a significant impact on the

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economic policy-making of countries around the world. This has brought one of the main economic motors of each country, i.e. transport in its broadest sense and the accompanying transport services, to the centre of turmoil. This is also the case in Europe, where the transport market is evolving intensively towards liberalisation and efficiency of access, harmonisation of economic, financial, technical and social relations, increased interoperability and uniform rules of intra-industry and inter-industry competition (Liberadzki, Mindur, 2008).

Fluctuations in the volume of transport services are not without an impact on the social environment. This is because the main consumer product of transport underwent significant changes in the years of 2021 and 2022. The global markets have seen rapid fluctuations in oil prices (Silvennoinen, Thorp, 2013; Galinis et al., 2020; Llamosas, Sovacool, 2021; Sheng et al., 2020), which have had a significant impact on the environment, energy efficiency, the economy, the financial markets and, above all, the level of inflation worldwide and in Europe in particular (Kilian, 2009; Kilian, 2010; Shah et al., 2020; Sun et al., 2021; Ahmadi et al., 2022; Song et al., 2022;). The last year clearly demonstrated how the dynamic fluctuations in oil prices are becoming a major premise for the rising social cost of living levels across Europe.

The price of the crude oil from which diesel is produced is a key element influencing transport costs. Undoubtedly, changes in oil prices on world markets, indirectly influencing global inflation, are also changing the face of the transport services market. The situation is similar in Poland, which has some of the most important transport channels in Europe. Transit channels from Western Europe to Eastern Europe and Asia, as well as transport channels from Northern Europe to the Mediterranean, all cross in Poland. Therefore, transport is of key importance not only for Poland's development, but above all for the stable life of its citizens (Sadowski et al., 2021).

Until now, little scientific research has covered and analysed the period of the armed conflict in Ukraine and the period of the COVID-19 pandemic in Central and Eastern Europe in the context of the impact of oil prices on the situation of the transport branch in Europe. Few scientific studies analysing the relationship between oil price fluctuations and the amount of road freight in a specific European country have been published. Mostly studies on terrorism and its impact on the operation of oil producers and oil transport appear in the literature (Frey, Kucher, 2000; Frey, Kucher, 2001; Abadie, Gardeazabal, 2003; Amichud, Wohl, 2004; Bird et al., 2008; Drakos, 2010; Kollias et al., 2013; Pchan et al., 2021; Nabin et al., 2022). There are also papers that describe the so-called 'trade war' between the US and China, or formerly Saudi Arabia and Russia, as another element strongly affecting fuel prices (Kilian, 2009; Kilian, 2010; Kilian, 2019; Aastveit et al., 2015; Baumeister, Kilian, 2016; Kamber, Wong, 2020; Ma et al., 2021; Zhnag, 2022; Carlomagno, Albagli, 2022). In the literature, one can find studies on for example, the long-term impact of oil price changes on the price of refined petroleum products in European markets using the Johansen multivariate test (Asche et al., 2023). Borenstein et al. described an asymmetric error correction model and confirmed an asymmetric relationship between oil prices and fuel prices (Borenstein et al., 1997). Borenstein and Shepard's study also identified significant lags between fluctuations in world oil prices and wholesale fuel prices in different countries (Borenstein, Shepard, 2002). Chouinard and Perloff examined the impact of various factors on retail and wholesale fuel prices in the USA and found that fluctuations in oil prices were the dominant driver of their fluctuations (Chouinard, Perloff, 2007). However, there is a lack of studies presenting the relationship between fluctuations in crude oil and diesel prices and their impact on the formation of road freight in a European

country such as Poland. Therefore, there is a research gap that needs to be filled in order to answer the question of how oil price fluctuations affect the price of diesel and whether there is a relationship (and if so, what kind of relationship) between oil prices and road freight.

The article therefore adopts two working hypotheses:

H1: Oil price fluctuations influence the change in diesel prices in Poland.

H2: Oil price fluctuations affect road freight rates in Poland.

The aim of this article is to examine the relationship between fluctuations in crude oil prices on world markets and their impact on wholesale diesel prices and thus the development of net road freight in Poland. The basis in the deduction process was a review of international literature and websites dedicated to the subject, as well as analyses of correlations using primary and secondary data.

Primary data was obtained from an in-house survey conducted among a group of private transport companies belonging to the small and medium-sized enterprises (SMEs) sector operating in Poland. The data concerned the amount of road freight in September 2021 as a basis for further research.

The considerations, analysis and conclusions of the study, which constitute its value, may contribute to the illustration of the situation of Polish road freight transport, its conditions and profitability as key factors affecting the development and competitiveness of enterprises on the transport, shipping and logistics (TSL) market. In addition, the obtained results of the analysis will indicate whether there is a relationship between the fluctuation of oil prices on the market and the amount of road freight, how strong it is and what type of relationship it is. The sample selection for the study was purposive. The study, based on primary data, was conducted in October and November 2022. It used the desk research method of statistical data analysis, the comparative analysis method and the method of critical analysis of the available literature. The study used Pearson's correlation analysis, the aim of which was to examine the relationship and significance between fluctuations in the average prices of diesel oil in Poland and the net amount of road freight, as well as the impact of changes in the price of BRENT and WTI crude oil on the average net price of diesel oil in Poland.

2. LITERATURE REVIEW

The political situation in Central and Eastern Europe caused by the COVID-19 coronavirus pandemic and the war in Ukraine, which was started by Russia, has led to historic geopolitical changes in global oil markets. As a result, economic relations between many countries practically around the world have changed. Countries such as China, Serbia, Hungary and India, which have not fully acceded to the economic sanctions imposed by most European countries and the US to withdraw from the purchase of fossil fuels from Russia, benefit by sourcing cheap Russian oil. These countries, through the following of such a purchasing policy, contribute to the financing of Russia's war activities. The opponent of such a strategy is Europe, which is diversifying its purchases of fossil fuels by minimising or completely cutting supplies from Russia. The sharp shift away from Russian oil is raising fuel prices in Europe, which directly affect the price of transport services. In turn, transport costs affect the prices of products, materials, goods or services. It seems that countries that now benefit from cheap Russian oil will pay the costs of their inadequate political decisions in the future, by losing the confidence of coalition countries and thus reducing the exchange of goods in these countries.

The literature often refers to oil as the 'blood' of any country's economy (Long, Zhang, 2022). When analysing the oil market, it can be seen that oil consumption is steadily increasing. In December 2022, global consumption of this crude was around 99 million barrels per day (MMbbl/d) and, according to the International Energy Agency (IEA), will increase to 101.5 MMbbl/d in Q1 2023. Global oil demand is projected to grow to around 1.7 MMbbl/d in 2023 due to the transition of the electric power industry to oil fuel, especially in Europe, due to high natural gas prices (Oil Market Report, 2022).

The United States accounted for the largest share of global oil production in 2021 and its influence on the level of global oil prices in financial markets, with the United States accounting for 16.6 MMbbl/d, Saudi Arabia 10.9 MMbbl/d and Russia 10.5 MMbbl/d (Amoros, 2022). This also confirms the worrying trend regarding Russia's share and its influence on crude prices. However, after Russia's military aggression against Ukraine in February 2022, due to sanctions imposed by Western countries, the price of Russian oil dropped significantly, and this country currently does not play a significant role in shaping oil prices on world markets. The phenomenon of relationality between oil producers and their influence on oil price formation has already been the subject of academic research (Ansari, 2017; Behar, Ritz, 2017; Bessembinder, 2018; Bradshow, van de Graaf, 2019; Parnes, 2019; Plante, 2019).

The war in Ukraine and the existing COVID-19 pandemic have caused considerable market turbulence with regard to global oil price levels. Changes in oil prices negatively affect the economic situation of individual countries, including Poland. In order to cope with the existing social challenges, more attention needs to be paid to sustainable development (Trojanowski, Kazibudzki, 2021). Unfortunately, the BRISC summit[5] that took place in June 2022 indicated that Europe may have major problems related to rising inflation, which can currently be seen in Poland. The problems with curbing inflation are largely due to the fluctuation of oil prices on world markets. This is confirmed by international studies that clearly show a high dependence of inflation on oil price fluctuations, as well as on the occurrence of the COVID-19 pandemic (Apergis, Apergis, 2020; Gil-Alana, Monge, 2020; Xun-Zhang et al., 2022; Li et al., 2022). For example, studies by Kamber and Wong or Long and Zhang show that energy commodity prices have a very strong impact on global inflation (Aastveit et al., 2015; Baumeister, Kilian, 2016; Long, Zhang, 2022; Carlomagno, Albagli, 2022), while Hamilton's research revealed for the first time a close correlation between oil price shocks and macroeconomic results (Hamilton, 1983). Thus, numerous studies confirm that global oil price fluctuations affect macroeconomic variables to varying degrees (Lord et al., 2009; Katircioglu, 2015; Zulfigarov, Neuenkirch, 2020).

Worldwide, one can observe the efforts of individual countries in the search for suppliers of cheap oil. If information is additionally taken into account that in China the economy is beginning to recover from the lockdown after the COVID-19 epidemic, it should be assumed that the price of this raw material will grow dynamically (Song et al., 2022). Although, in the case of China, as the largest oil beneficiary in the world, the alliance with Russia provides the country with a low purchase price for this commodity. Thus, it seems that China will not significantly participate in the purchase of oil on European markets and, consequently, the price of this raw material in Europe should relatively

[5] BRISC summit is the summit of the group of developing countries: Brazil, Russia, India, China and since 2011 South Africa.

stabilise. However, before this happens, it will mean enormous problems for the world, including European countries, and a massive increase in inflation rates.

On the other hand, the latest global oil production figures confirm that OPEC countries and its allies have agreed to cut oil production limits in order to raise prices, which have fallen in fear of an economic slowdown (E-petrol, 2022). OPEC's actions and China's economic slowdown due to the ever-present COVID-19 pandemic, as well as the relatively stable oil supply situation in Europe, are driving oil prices down. How long this process will be and what consequences it will have for the European economy will become clear in the near future.

3. RESEARCH METHODOLOGY

The main objective of the study was an attempt to identify the relationship between fluctuations in the price of Brent crude oil (which is the reference unit for Europe) and West Texas Intermediate (WTI), and the development of the wholesale price of diesel and its impact on road freight in Poland.

In order to verify the hypotheses, an analysis was conducted of the relationship between Brent and WTI crude oil price fluctuations and the wholesale diesel oil price, and then its impact on the development of road freight in Poland was examined. In the paper, a model called ‘fuel correction’ was developed, containing fluctuations of wholesale diesel oil prices on the basis of which average deviations of the road freight level were determined in the analysed period. The study used primary and secondary data obtained from a critical analysis of the available literature, as well as from reports of leading analytical agencies, including: IRU, Upply and TI. The monthly average price of Brent and WTI crude oil was determined on the basis of data published in BM Reflex agency reports on daily oil price quotations on world markets.

Subsequently, on the basis of data obtained from the leading fuel producer in Poland, PKN Orlen, data presenting the development of daily wholesale diesel prices were obtained. Based on these, as in the case of oil prices, monthly harmonic averages were calculated for the variable in question. The data obtained for the study covered the period from September 2021 to August 2022. Based on the collected statistical material, graphs were constructed showing the analysed variables along with their dynamics. In addition, an analysis of the relationship between selected variables characterising the wholesale diesel fuel price market and the amount of road freight in Poland was conducted. This study was carried out using Pearson's linear correlation coefficient with its significance test. Linear regression equations were also determined for individual pairs of variables characterising the study area. Correlation and regression analysis was conducted using the IBM SPSS statistics programme.

In the article, the authors assumed that the determinant of the amount of road freight in the analysed period is the deviation from the average freight rate that was in operation in September 2021 by the difference in the wholesale purchase price of diesel in Poland. This was due to the fact that it is practically impossible to determine specific freight rates in individual months of the research period, as their level depends on a great number of factors, including: the size of the company, the scope and quality of services provided, the length of the route, the means of transport, the type of cargo. Therefore, a model of the so-called 'fuel correction' was developed, which in the analysed months showed the amount of road freight calculated as the adjusted value of the average base freight amount by 40% of the net purchase price of diesel. The average base road freight amount was determined

on the basis of the primary survey conducted covering domestic Full Truck Load (FTL) transport. The transport unit was a standard neutral general cargo – non-unitised.

The sample selection for the study was purposive. On the basis of data obtained from public administration sources available on websites (Ranking of TSL companies, 2021), 10 randomly selected private transport enterprises belonging to the SME sector were identified, regardless of their capital and period of operation on the market. On the basis of the information obtained from the companies regarding the amount of road freight expressed as PLN rate per loaded kilometre and PLN rate per kilometre of mileage, a harmonic average was calculated for each form of transport in September 2021. Then, the obtained results of the average freight amounts for the individual forms of transport were averaged, determining the average base road freight amount falling in September 2021. Once the relevant data had been entered into the 'fuel correction' model, road freight heights were calculated for the individual months of the study period. In the developed 'fuel correction' model, a 40% share of the wholesale purchase price of diesel fuel in the total freight amount was assumed. This percentage was assumed on the basis of information obtained from the companies surveyed and data published in transport magazines. The data showed that, depending on the size of the company, its financial condition, the quality of its rolling stock and other factors, this share varies between 30% and 60%. On this basis, a harmonic mean of 40% was calculated.

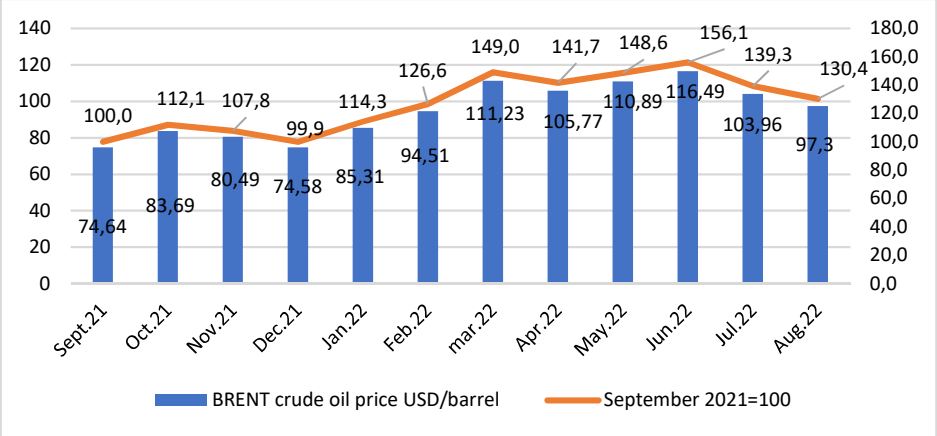
The study, based on primary data, was conducted in October and November 2022. It used the desk research method of statistical data analysis, the comparative analysis method and the method of critical analysis of the available literature. Computer-Assisted Telephone Interviewing (CATI) and Computer Aided Personal Interview (CAPI) techniques were used to obtain primary data.

However, it should be noted that the determination of the real amount of road freight is possible only on selected relations and with the adoption of certain parameters. Thus, the presented results of the study concerning its amount are based on the forecast model of 'fuel correction' as the only criterion of their changes. Therefore, they may not fully reflect the real amount of freight for the entire transport market in Poland (Gońka, Wiśnicki, 2010).

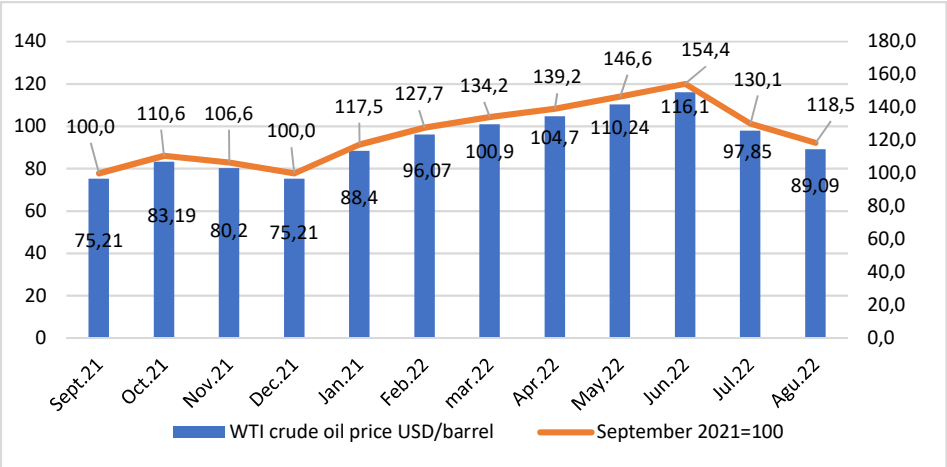
4. RESULTS

The first stage of the research analysis was to determine the average prices of Brent and WTI crude oil on the basis of stock market indices and to indicate the dynamics of change of these indices expressed in percentage terms during the period under study.

From September 2021 to February 2022, the average price of Brent crude oil as well as WTI crude oil on the world's stock exchanges remained at similar levels. From February 2022 there was a dynamic increase in the price of oil on the exchanges, which lasted until June 2022, where there was the largest increase of more than 56% for Brent oil and more than 54% for WTI oil compared to the base period. This was caused by the imposition of economic sanctions on Russia as a consequence of the war with Ukraine. This was followed by systematic declines in both Brent and WTI crude oil prices in subsequent periods, which reached USD 97.3/barrel for Brent and USD 89/barrel for WTI crude at the end of August 2022.



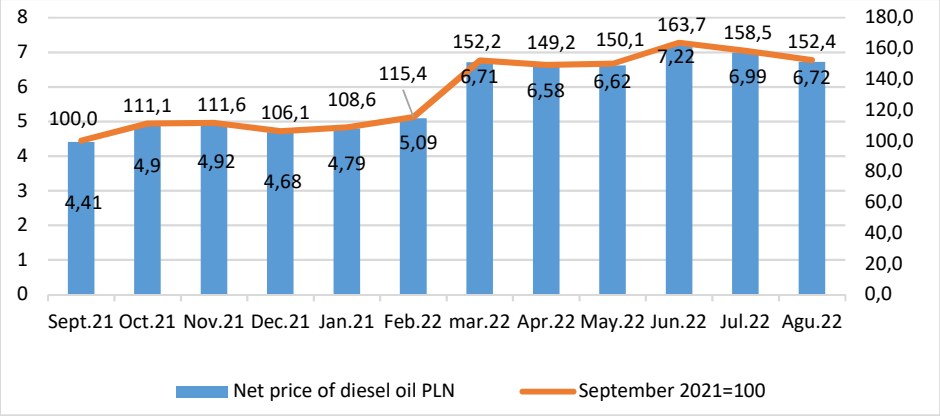
Graph 1. Average Brent crude oil price USD/barrel along with the dynamics of change
Source: own elaboration based on: https://www.reflex.com.pl/ceny-brent.



Graph 2. Average WTI crude oil price USD/barrel along with the dynamics of change
Source: own elaboration based on: https://www.reflex.com.pl/ceny-brent (28.10.2022).

Taking into account fluctuations in the average prices of Brent and WTI crude oil on world markets, an analysis was made of the impact of these prices on the wholesale price of diesel in Poland, as an element significantly influencing the amount of road freight.

From September 2021 to February 2022, the average wholesale price of diesel in Poland remained at a similar level. Its sharp increase was observed in March 2022 by more than 50% compared to the base period. In the last analysed period, i.e. August 2022, the average monthly net price of diesel amounted to PLN 6.72 and was 52.4% higher than in September 2021.



Graph 3. Average wholesale price of diesel oil PLN/L in Poland along with the dynamics of change

Source: own elaboration based on: https://www.orlen.pl/pl/dla-biznesu/hurtowe-ceny-paliw#paliwa-archive (05.11.2022).

In the further part of the research process, due to the fluctuation of wholesale diesel prices in Poland, as well as taking into account the percentage impact of diesel prices on the amount of road freight, which averages 40%, a so-called 'fuel correction' model was developed, which took into account the fluctuation of the amount of car freight in individual months as an adjusted value of the base price by the value resulting from the fluctuation of diesel purchases in net prices.

Table 1. 'Fuel correction' model showing average net road freight

Period	Average net diesel price PLN/L (base)	Variance to base	Difference %	Road freight adjustment	Month-to-month adjustment of road freight (%)	The average net road freight rate PLN/km
Sept.21	4.41	100.00	0.00%	0.00%	0.00%	**3.37**
Oct.21	4.9	111.11	11.11%	4.44%	4.44%	**3.52**
Nov.21	4.92	111.56	11.56%	4.63%	0.18%	**3.53**
Dec.21	4.68	106.12	6.12%	2.45%	-2.18%	**3.45**
Jan.22	4.79	108.62	8.62%	3.45%	1.00%	**3.48**
Feb.22	5.09	115.42	15.42%	6.17%	2.72%	**3.58**
Mar.22	6.71	152.15	52.15%	20.86%	14.69%	**4.10**
Apr.22	6.58	149.21	49.21%	19.68%	-1.18%	**4.06**
May.22	6.62	150.11	50.11%	20.05%	0.36%	**4.07**
June.22	7.22	163.72	63.72%	25.49%	5.44%	**4.29**
July.22	6.99	158.50	58.50%	23.40%	-2.09%	**4.20**
Aug.22	6.72	152.38	52.38%	20.95%	-2.45%	**4.10**

Source: own elaboration.

On the basis of the achieved results, it can be noted that in the period from September 2021 to February 2022, the amount of road freight was at a similar level, i.e. approx. PLN 3.50 per kilometre. This level of freight was recorded practically from the beginning of 2021. A dynamic change occurred in March 2022, where the amount of freight increased by almost 21% in relation to the base period, which was September 2021. This increase was primarily dictated by large fluctuations in oil prices on the global markets resulting in higher wholesale diesel prices. These increases were undoubtedly a consequence of the reduction in Russian oil imports due to the sanctions imposed on Russia. The largest increase in the amount of freight occurred in June 2022, up 25.5% compared to the base period and amounted to PLN 4.30 net per kilometre.

The first stage of the analysis related to the influence of chosen factors on the amount of road freight was to examine the relationship between the average wholesale price of diesel (PLN/L) and the net amount of road freight in the period from September 2021 to August 2022. As a consequence of changes that occurred in the area of oil and diesel price fluctuations, an analysis of correlations between variables characterising the fuel market situation and their impact on changes in the amount of road freight in Poland was conducted.

Table 1 presents the results of Pearson's linear correlation coefficients for the four analysed variables. The analysis confirmed that there is a strong and positive relationship between the analysed variables. Moreover, all the correlations proved statistically significant at $\alpha = 0.01$. The highest value of the correlation coefficient ($ryx = 1$; $p = 0.000$) was recorded in the case of the study of the relationship between the average wholesale price of diesel (PLN/L) and the amount of road freight (PLN/km), which indicates a functional relationship. On the other hand, the lowest value ($ryx = 0.834$; $p = 0.001$) was recorded for the price of WTI crude oil and average wholesale diesel prices.

Table 2. Matrix of Pearson's linear correlation coefficients

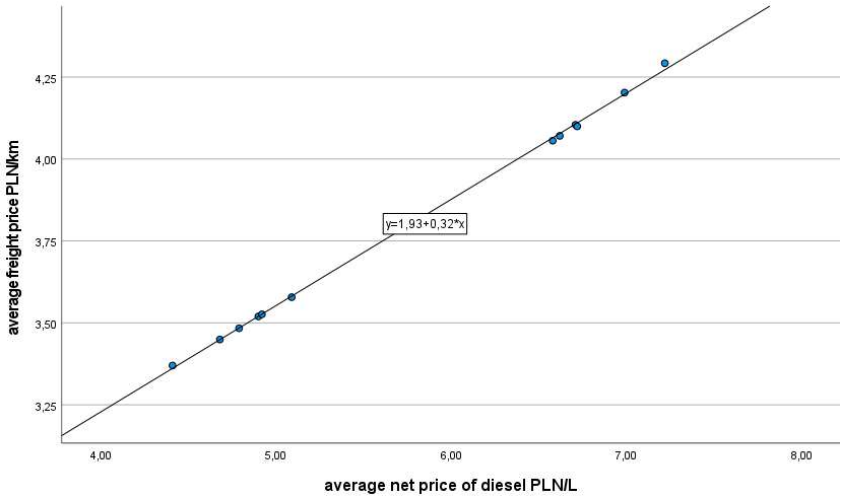
	Average wholesale diesel oil price PLN/L	**Average BRENT oil price USD/barrel**	**Average WTI crude oil price USD/barrel**	**Road freight price PLN/km**
Average wholesale diesel oil price PLN/L	1	,930**	,834**	1,000**
		0,000	0,001	0,000
	12	12	12	12
Average BRENT oil price USD/barrel	,930**	1	,963**	,930**
	0,000		0,000	0,000
	12	12	12	12
Average WTI crude oil price USD/barrel	,834**	,963**	1	,836**
	0,001	0,000		0,001
	12	12	12	12
Road freight price PLN/km	1,000**	,930**	,836**	1
	0,000	0,000	0,001	
	12	12	12	12

** Correlation significant at 0.01 level (two-sided)

Source: own elaboration.

As a consequence of the presence of a bilaterally significant correlation, a simple regression analysis was performed for selected pairs of variables characterising the study area.

Based on the data included in diagram 4, it can be concluded that the relationship between the analysed variables is linear. Therefore, it was justified to determine the Pearson linear correlation coefficient. On the basis of the estimated regression equation, it can be concluded that an increase in the average wholesale price of diesel by 1.00 PLN generally results in a net increase in road freight by 0.32 PLN/km. The fit of the estimated regression equation to the empirical data is 99% ($R^2 = 0.999$). The analysis showed that 99% of the variation in net freight depends on the variation in the average wholesale price of diesel.

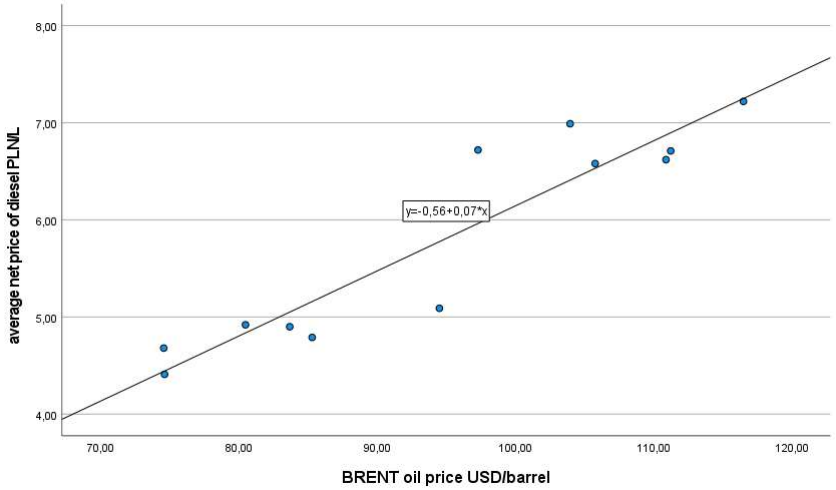


Graph 4. Scatter diagram for the average wholesale price of diesel and the amount of road freight in Poland

Source: own elaboration.

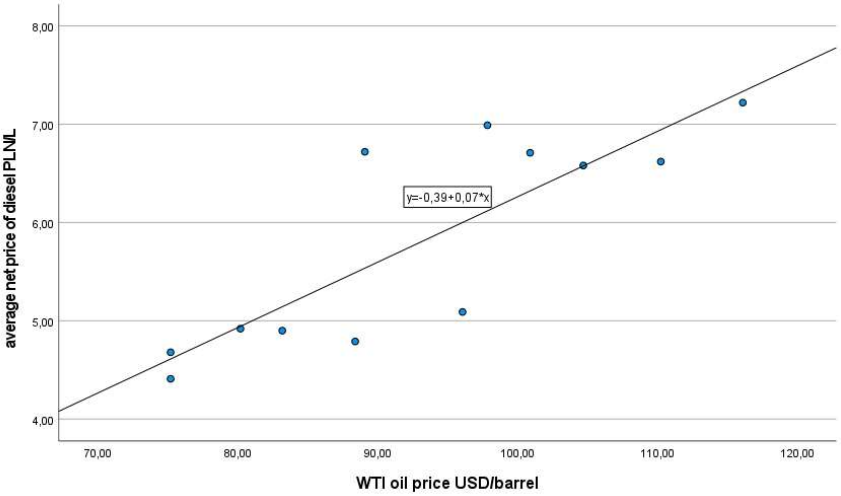
Another cause-and-effect relationship analysed was the study of the impact of BRENT and WTI crude oil price changes on the average level of the net price of diesel in Poland.

Based on the data presented in the scatter diagrams for the analysed variables (cf. Graph 5 and Graph 6), it can be concluded that the relationship is linear and the estimated regression equation is of the form: $\hat{y}=0.56+0.07+x\_i$. The fit of the estimated regression equation to the empirical data is quite good at 87%. A USD 1 increase in the BRENT oil price results in a net increase in the diesel price of 0.07 PLN/L on average (cf. Figure 5). Similarly to the WTI crude oil price, its increase by 1 USD generally causes an increase in the average net price of diesel by 0.07 PLN/L, with a determination coefficient for the estimated regression function of nearly 70%.



Graph 5. Scatter diagram for BRENT oil price and average net diesel price

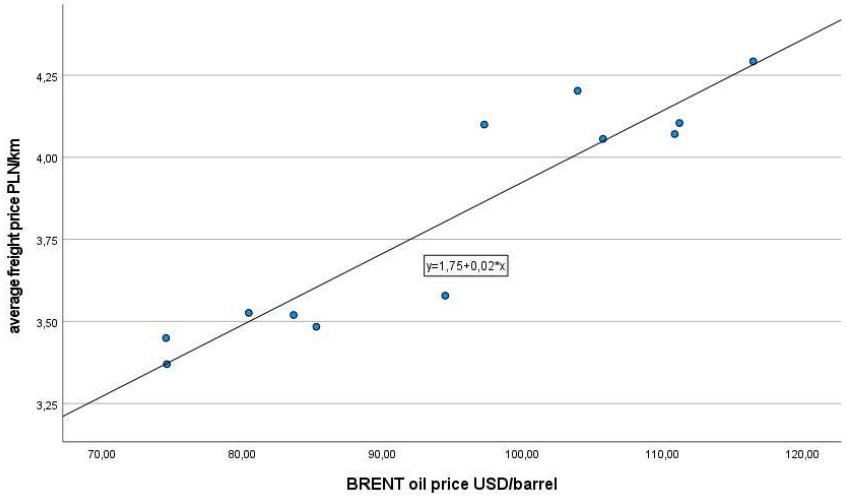
Source: own elaboration.



Graph 6. Scatter diagram for WTI oil price and average net diesel price

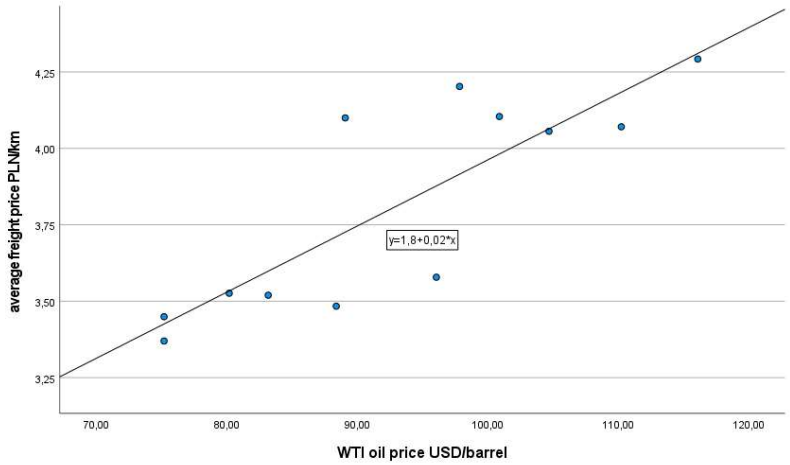
Source: own elaboration.

The final stage of the research analysis conducted was to analyse the impact of BRENT and WTI oil prices on the net amount of road freight in Poland.



Graph 7. Scatter diagram for Brent crude oil price and net amount of road freight

Source: own elaboration.



Graph. 8 Scatter diagram for the WTI oil price and the net amount of road freight

Source: own elaboration.

In the case of both analysed variables, the effect of Brent and WTI crude oil prices on the net amount of road freight in Poland happened to be positive. An increase in crude oil prices by 1 USD results in an average increase of 0.02 PLN/km. The estimated regression equation for the variables in question is fairly well fitted to the empirical data. In the case of the WTI oil price, the coefficient of determination reached ($R^2 = 0.699$), while for the BRENT oil price variable, the coefficient in question reached ($R^2 = 0.866$).

5. DISCUSSION

The growth rate of prices recorded by stock exchanges after the outbreak of the war in Ukraine has reduced and has been recording a slow decline in recent months. Such a trend will continue to minimum level of crude oil production. Undoubtedly, this is related to the constantly deteriorating world economic situation, and the temporary higher prices caused by the OPEC countries' plan to reduce oil supply are slowing down global demand for oil. As a result of the analyses, based on the estimation of Pearson's linear correlation coefficients for the analysed variables, it was found that there is a strong and positive relationship between all the analysed variables. Furthermore, all of these correlations were found to be statistically significant at $\alpha = 0.01$.

According to the CSO report, in 2020, 2331.8 million tonnes of freight were transported by road, 21.4% more than in 2019, and transport work in tonne-kilometres was 16.8% higher. Commercial transport accounted for 59.2% of total freight, while economic transport accounted for 40.8% (Transport, 2022). Further growth in the volume of transport services is also expected in the coming years (Sustainable, 2022). This is due to the fact that the war in Ukraine has caused a change in political courses of most countries and, consequently, the formation of new coalitions of economic cooperation, e.g: Russia, China and Brazil. Unfortunately, the Arab countries are also benefit from cooperating with Russia. Furthermore it is still unclear whether it will be possible to supply oil from Iran to Europe, although this seems unlikely given the increasing cooperation between Iran and Russia in the military area. The news channels reporting on Iranian arms deliveries to Russia could lead to a blockade of this direction in oil deliveries to Europe. OPEC-affiliated countries, on the other hand, are not interested in lowering the oil price, despite suggestions from the US. An alternative for Europe and the world could be oil from Venezuela.

Poland's main fuel producer PKN Orlen expects Brent crude oil prices in the range of USD 90-110/barrel and expects a temporary increase in refining margins on European markets in the coming quarters. Such expectations stem from the fact that global demand for oil is declining as a result of the economic slowdown caused primarily by lower economic activity in China. Additionally, the release of strategic oil reserves by the US and a strong dollar with OPEC+ declaring lower production by two million barrels per day deteriorate this situation (PKN Orlen's Q3, 2022).

Considering recent months, average Brent crude oil prices ranged from USD 75.64 per barrel in September 2021 to USD 97.30 in August 2022 (Average oil prices, 2022). In contrast, in Poland, the wholesale purchase price of diesel (ecodiesel) from a leading producer such as PKN Orlen in September 2021 averaged 4411.36 PLN/1000 L. Average prices for August 2022 are 6720.02 PLN/1000L. Converting the average price of a barrel of Brent crude oil (which is the reference unit for Europe) into the Polish zloty, in September 2021 it cost PLN 288.9, while in August 2022 a barrel of oil cost PLN 453.4. Thus, over the analysed period, the price of a barrel of Brent crude oil expressed in PLN increased by 57%, while diesel oil in the same period at the Polish producer rose by 52.4%. This shows that wholesale diesel prices over the period increased to a much lesser extent than crude oil.

However, this situation is not as obvious as it might seem. As the data presented in the graphs show, the difference between the scale of the increase in wholesale diesel and oil prices appeared sharply at the end of January 2022. At that time, there was no war in Ukraine yet, and oil was getting more expensive. Undoubtedly, this resulted in an increase in wholesale diesel prices across Europe, but in Poland the upward trend was mitigated.

Diesel prices began to fall in relation to European prices. At that time, a difference in price between Brent crude oil and the wholesale price of diesel was created, which remains at a more or less similar level. This difference, to a large extent, is the effect of the anti--inflation shield introduced in Poland through the government's reduction of VAT on fuel from February 2022. Therefore, paradoxically, diesel became more expensive to a lesser extent than oil on world exchanges during the period under review, thanks to the actions of the Polish government, which took protective measures.

Such activities in Poland have had a real impact on the amount of road freight. This is mainly due to the share of diesel purchase costs, which are one of the largest variable costs that a transport company has to bear. It is estimated that fuel purchase costs can account for approximately 30-60% of all expenses incurred for transport operations (Transport Orders.pl., 2022). In contrast, the price of diesel, in addition to various refining costs, margins and taxes, is primarily driven by the purchase price of a barrel of crude oil on world markets and is directly linked to the US dollar exchange rate. An increase in the price of a barrel of crude oil or the US dollar exchange rate can significantly reduce the profitability of transport services. So it is a fact that fluctuations in oil prices on world markets are significantly affecting the net amount of road freight not only in Poland, but worldwide. According to the IRU World Road Transport Organisation, transport rates increased by 6.1% during the quarter to a record 121%. This is an increase of 13.1% on Q2 2021 after four consecutive quarters of rate increases. The freight market index almost doubled, up 11.8% on Q1 2022 and 20.1% on Q2 2021 (IRU Annual Report 2021, 2022). Data from the CNR shows that in the European Union, the cost of diesel accounted on average for more than 25% of the total cost of operating a truck in 2019. (Comité National Routier, 2022).

In 2019, the average price of diesel in Europe was around €1.33 per litre. A price increase in early 2022 to €1.9 per litre suggests that fuel will now account for around 40%-60% of total operating costs (The Q2 2022 European Road Freight Rate Benchmark, 2022). In Poland, the increases on domestic routes for FTL transport were not much smaller. In March 2022, the average net freight rate was PLN 4.10, 11.4% higher than in the previous month and 11.7% higher than in January 2022. The year-on-year increase was 32.4% (Trans for Forwarders, 2022). The outbreak of war in Ukraine led to a dynamic increase in oil prices and, consequently, fuel prices at fuel stations. As a result, the fuel price reductions resulting from the anti-inflation shield were quickly consumed.

6. CONCLUSIONS

Oil is the most widely used resource in the world. According to the IEA, it accounts for more than 31% of the world's primary energy, at the same time being the most widely used resource for transport. Many wars have been fought over this so-called 'black gold'. The price of oil is being closely monitored by everyone - especially since the coronavirus crisis and now the war in Ukraine. Since the early months of 2022 , the price of oil on the world's stock exchanges has risen by 97%. Meanwhile, history teaches that when the price of oil rises by 100% in a year, there is always a recession (Machalica, 2022).

Consumers around the world are affected by higher prices as the protracted COVID-19 pandemic and the war in Ukraine cause oil prices and natural gas prices to rise. Nusair and Olson suggest that oil price shocks have an asymmetric impact on the rates of return of several Asian countries, but do not consider China. Such a situation undoubtedly affects the economic situation of individual European countries, where transport is mainly

dominated by one industry, road transport (Nusair, Olson, 2019), which is described as the main carrier in the market (Apergies, Apergies, 2020). In freight transport, its steadily but consistently increasing share now reaches about 84% of all land transport calculated in tonnes of freight transported, due to the fact that oil will continue to play an important role in the global economy over the next few decades (Xunzhanga et al., 2017).

The huge reduction in OPEC+ oil supply increases the risks in terms of global energy security. Even taking into account lower demand expectations, this will significantly reduce the much-needed increase in oil stocks in the 2023. (Oil Market Report, 2022). Thus, in the post-pandemic era, the growth rate of global oil demand will gradually decline after slight increases, but this will allow supply capacity to be maintained and the international oil price to remain medium to low USD 60-70/barrel between 2023 and 2025 (CNPC 2021, 2022). Looking ahead to the next few years, the coronavirus pandemic and OPEC's production policy will remain the two main factors influencing the supply and price of oil on the world market.

As the results show, there is a strong and positive relationship between the analysed variables. Therefore, when crude oil prices on world markets fall, and forecasts for this raw material indicate such a tendency in the nearest future in connection with the slowdown of world economies and the spectre of their recession, this should be followed by reductions in diesel prices in individual countries, including Poland. Therefore, the amount of road freight should also have a downward trend, being strongly correlated with the price of Brent or WTI crude oil, which is the main determinant of diesel prices. However, according to experts, this will not happen. These experts predict the situation will be just the opposite. Due to the expiry of the anti-inflation shield introduced by the Polish government from the first of January 2023 which will result in an increase in fuel prices. In addition, the existing global inflation associated with the COVID-19 pandemic and the war in Ukraine causing sharp price increases for transport services and thus products of all kinds, will contribute to maintaining this trend in the future. The uncertain situation in the Middle East and economic fluctuations in China will intensify fluctuations in oil prices on global markets. Therefore, the price of diesel used in transport will not decrease but will actually increase in the long term. This, in turn, will contribute to systematic increases in the amount of road freight not only in Poland, but also throughout Europe. The year 2023 showed that the conducted research analyses confirm market trends regarding the impact of average wholesale diesel prices on road freight prices. Fluctuations in oil prices on global markets are within the adopted forecasts, and road freight prices remain at a similar level as in 2022. However, the very difficult and unstable political situation in the world makes it very difficult to indicate the direction in which the policy will be shaped. pricing of freight transport.

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