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Article

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The Relationship between Geopolitical Events and the Crude Oil Prices: An Application of ARDL Model

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ABSTRACT

This paper aims to explore the short-run and long-run relationship between geopolitical events and crude oil prices for the period 2000-2023. In addition to geopolitical events, we included the market factors whose data were available in the right part of the equation. To investigate long-run cointegration, this paper used quarterly data and employed the Autoregressive distributed lagged (ARDL) bounds testing approach developed by (Pesaran et al., 2001). Study findings from the ARDL bound testing approach confirm the existence of a long-run and short-run association between geopolitical events and crude oil prices. Furthermore, the findings from the ARDL model revealed that, among others, world crude oil production; OECD's crude oil stocks, and OECD economic growth have a significant effect on the dependent variable (crude oil prices) both in the long run and short run.

Keywords: Geopolitical Factors, Oil Prices, ARDL Model, Oil Supply and Demand, Cointegration
JEL Classifications: P27, P28, Q41, Q43, C32

1. INTRODUCTION

Crude oil is a strategic raw material and a vital commodity, both for the producer and for the solely consumer countries of this commodity. In addition to being a source of energy for transport and transportation, a source of electricity generation, a basic raw material in the engineering, chemical, and food industries, crude oil is also an important source of income for many developed and developing countries. For these reasons, oil is the subject of competitive struggle, serious disputes, and war conflicts, not only civil and regional but also international wars. Oil as a primary commodity still has an important place in the economies that produce it, particularly the developing countries, because this commodity is the main, and in some cases, the only source of their income. Although the share of this commodity in total global output and trade has gradually declined over the past century, fluctuations in its price have a significant impact on global economic activity. In many, especially developing countries, fluctuations in the prices of this raw material have a significant impact on macroeconomic indicators, not only on the gross domestic product, the balance of payments, government budget policy, but also due to the complex problems it poses for macroeconomic policy implementation.

Fluctuations in oil prices also affect the economic activities of countries dependent on energy imports, albeit to a relatively lesser extent. This logically results in a positive effect of rising oil prices for the economies of developing countries exporting crude oil, and the opposite effect for countries importing this commodity. However, this positive effect of rising oil prices is diminishing for developing countries over time, as oil prices rise to catalyse the rise of the prices of finished products in the countries importing of crude oil, especially in developed countries, which results in - given developing countries' dependence on imports almost of all finished products - rising import prices and, as a result, reduced export earnings from rising oil prices.

Oil prices have developed dramatically since the early 1970s, but especially since the early 21st century. This development has stimulated further scientific discussions about the causes of this dramatic development. Is it a normal price cycle? Was it caused by the market or other non-market factors (geopolitical events) or both? Our hypothesis is: Geopolitical events affect crude oil prices in the world oil markets. We try to answer these and other questions in this paper, particularly from the commencement of the 21st century.

Therefore, this paper will focus on exploring the short-run and long-run relationship between geopolitical events and crude oil prices for the period 2000-2023. In addition to geopolitical events, we included the market factors whose data were available in the right part of the equation. To investigate long-run cointegration, this paper used quarterly data and employed the Autoregressive distributed lagged (ARDL) bounds testing approach developed by (Pesaran et al., 2001).

2. THEORETICAL INVESTIGATION

Most entities - governments, monetary authorities, companies, investors, investment funds, speculators and consumers, as well as suppliers and countries buying goods - are interested in commodity prices. All these participants monitor not only the short-term behaviour of prices but also their movement in the long term. Possessing information on commodity price behaviour is crucial for economic authorities to design and implement economic policy, as this could affect prices as well as national income, the exchange rate, the current account, and the fiscal balance. For the rest of the participants, commodity price behaviour is determined by investment portfolios and consumer decisions (Arango et al., 2008).

Crude oil is one of the most important commodities. Therefore, countless questions have been discussed about crude oil prices and their relation to other macroeconomic indicators. One of them is the question of the extent to which oil revenues are used in the economic growth of developing countries and in overall economic and social development. Some authors have used the term curse or blessing, especially regarding the efficient use of oil in the economic development of producer countries, such as Deaton (1991) or Blattman et al. (2007) or Collier and Goderis (2007), etc. Indubitably, the price boom in the oil market has, on the one hand, a direct positive effect on the economic growth of exporting countries through the trade balance or net exports, thereby resulting in increased government investment in development programs, and the indirect effect of increasing investment (domestic and foreign) in the development of the oil sector, including the petrochemical industry. On the other hand, the oil price boom can lead to an appreciation of the domestic currency, and thus to a reduction in the competitiveness of other export sectors of manufacturing, which looks at the so-called "Dutch disease," according to Corden and Neary (1982), and Edwards and Ostry (1992).

In this paper, we focus on the theoretical basis related to drivers of movement of crude oil prices and focus on the extent to which the geopolitical events have influenced the crude oil prices during the selected period. Caldara and Iacoviello,(2023) defined geopolitical risk "as the threat, realization, and escalation of adverse events associated with wars, terrorism, and any tensions among states and political actors that affect the peaceful course of international relations." While crude oil is not only a primary commodity, and at the same time a strategic raw material, an energy source, but also an important intermediary in the automotive, chemical, food industries, every geopolitical event has more or less impact on the movement of crude oil price. According to the World Energy Outlook – IEA (2021), the share of oil as an energy source is around 32%, and despite its decline from 46% in 1973 in favour of natural gas, coal, and nuclear energy, the share of oil remains the largest among other energy sources. Therefore, oil is the most influential commodity affecting the world economy. Its price is determined on commodity exchanges through futures contracts. Spot prices represent only 5-10% of the global oil trade.

Many economists try to explain the movement of oil prices using the classical economic model, which assumes that price is a function of supply and demand: Price = f (supply, demand). Basically, there are two main theories explaining the determinations of oil prices. The main protagonist of this theory is Harold Hoteling (1931), who sees oil as an exhaustible resource, fixed in terms of quantity (Van Vactor, 2010). It follows that the depletion of this resource depends on the intensity of supply and demand. According to Hoteling, in the case of an exhaustible resource, the price should exceed marginal costs, even if the oil market is perfectly competitive. Since oil is resource-exhaustible, theoretically its price is partly based on this fact. According to Ederington et al. (2011): "...oil price models can be grouped into three broad categories: (1) structural models, designed to capture the interplay of underlying supply and demand conditions and the factors influencing supply and demand; (2) reduced form or hybrid models based on hypotheses about the reduced form in the stochastic behaviour of oil prices; (3) econometric models that assume specific types of time series behaviour for conditional first and second moments of the oil price time series." Notably, the first group of models can also include the model of Harold Hotelling, which assumes optimal resource extraction within the competitive market for an exhaustible resource, Hotelling, H. (1931). Thus, the resource is mined at a constant rate per unit time in order to maximize the present value of future profit (price minus mining costs), constructing its model assuming zero mining costs.

The second theory, which does not assume a fixed quantity of oil, was introduced by Adelman (1972). Adelman contends that the current level of production and the level of reserves that support them are flexible because they depend on current technology and motivation to discover. It must be said that this theory can be agreed with and has been proven in the past since the beginning of the discovery of oil. Although it was difficult to extract and mine oil at the beginning of the 20th century, things have improved thanks to the emergence of new technologies, which increases its reserves and supply. As the price of oil rises, there are growing motives to discover new technologies, to search for new oil deposits with the possibility of extracting unconventional methods (such as shale oil and gas extraction), to prolong peak oil production, or to find substitutions.

Noguera-Santaella (2016) examined the relationship between armed, civil conflicts and the price of oil (the impact of 32 geopolitical events on real oil prices since 1859-2011) - 11 of them in the 21st century. Geopolitical events impacted oil prices before 2000, but there was little influence in the 21st century. Kilian and Murphy (2014) examined the role of commercial stocks and speculative trading in the global oil market. There is some impact of speculation on the global oil market. One of the research questions asked in the study of Kilian (2017) was: To what extent has the American shale oil boom helped reduce the price of oil to the world markets? The second research question was: to what extent did the US shale oil boom help reduce Saudi Arabia's income. According to both specifications of the counterfactual analysis, the cumulative decrease in the price of Brent was around 70 USD/b (and therefore would only be 6 USD higher than in the actual data). So, there is no support for the view that the US shale oil boom was the main cause of this specific drop in oil prices in Saudi Arabia's net foreign assets continue to decline as, in the period from January 2015 to January 2016, Saudi Arabia's net foreign assets can be expected to deplete by the beginning of 2020.

Oil prices are determined by several factors. The most important are market factors (supply and demand). Then there is the value of the US dollar, speculation in the futures market, and the so-called non-market factors (geopolitical factor - political unrest, civil, regional, and international wars and natural disasters - hurricanes, earthquake floods). Oil prices are the most fluctuating among other prices of primary commodities. Which factor plays a significant role in such a frequent movement in the price of this commodity? "Since the end of 1998, analysts, oil companies and oil-producing countries have made mistakes in every oil price forecast, which clearly proves not only that they no longer control the fundamental market mechanism, but are not even able to understand its true dynamics – it's like an invisible architect lost his pencil" (Carollo, 2012).

Most analysts attribute the phenomenon of a boom in the crude oil market from 2007 to 2008 to high consumption growth in China and India, but also in other emerging economies. However, in addition to this factor, others have more or less caused the rise in oil prices: speculation in commodity markets, the presence of investors in the markets, the weakening of the US dollar, geopolitical factors, etc. Many authors in the last three decades argued, that speculative factors play an important role in the movements of oil prices. Dicembrino and Scandizzo (2012) investigated the recent evolution of the oil price, intending to analyse the main drivers that have led to the unstable path and the volatility persistence in the international oil market in the last fifteen years. They opine that the "oil price is composed of two components, deterministic and speculative. The first one can be defined as the certain one, and it is referred to as the fundamental component given by supply and demand interaction. Differently, the uncertain one is given by unclear changes in the price structure, and it is assumed to be linked to the speculative activity."

The oil market is, in fact, directly or indirectly linked, by certain complex forms, to several markets and entities which operate separately and independently. In North America, they have been intensively extracting unconventional oil (shale) since 2008 thanks to new technologies and suitable conditions in the oil market. This has changed the global energy scene and to a large extent the theory and approaches associated with it to date, especially about peak oil theory. Kilian (2017) pointed out that, "The American boom in shale oil production is an example of a technological change in one sector in one country that is affecting international trade around the world. Increased shale oil production in the US has shifted oil exports from Arab oil-producing countries over time, partly because the United States no longer uses oil from Arab producers and US refineries increasingly export refined products such as gasoline or domestic oil, reducing the need for other countries to import oil. While the benefits of the "shale boom" to the US economy are well known at this point, less is known about the losses these developments have caused to foreign oil producers. Understanding the implications of the US "slate boom" is important not only for policymakers in Arab economies deciding how best to respond to the boom, but is also a good example of a well-identifiable exogenous shock in terms of the terms of trade of primary commodity exporters."

3. THE FACTORS AFFECTING OIL PRICE MOVEMENT

In this section, we will look at the development of individual determinants of oil price movements, focusing on those whose development has already been captured in the available literature. Several factors can be seen that are cointegrated and interact behind this volatile development. This implies that one factor may trigger oil price movements, but there will be no upward or downward movement in oil prices without the reaction of others, especially market factors.

The development of oil prices has been fluctuating since the first half of the 1970s and remained very dynamic and drastic since the beginning of the 21st century, especially since 2002. Oil prices in this period not only exceeded the "psychological limit" of 100 USD/bl, but also attacked the limit of 150 USD/bl in July 2008 (based on the WTI price) (Figure 1). Subsequently, they fell sharply to around USD 40/bl in less than a year, a decrease of 68.5% (based on monthly average prices). Another price boom above USD 80/bl lasted 53 months - from October 2010 to October 2014, which was one of the longest periods with such a high price of oil in the history of this commodity. Then oil prices started to fall relatively sharply by January 2016, to USD 27/bl (based on WTI) and around USD 23/bl (based on the OPEC price basket), a decrease of more than 72% compared to the price of June 2014.

After the OPEC+ agreement in 2017 under the leadership of Saudi Arabia and the Russian Federation to reduce oil production by 1.8 million bl/d, oil prices experienced recovery until the end of 2018, when they attacked the 80 USD/bl. This was followed by 2019, which was a year of high oil price collapse as a result of the COVID-19 pandemic, when they reached an historical minimum during the last 17 years at an average level of 21 USD/bl in April 2020 (WTI, 16.50 USD/bl). On the same day, for a short time, Texas WTI crude futures were sold at negative values at around -40 USD/bl, as traders tried to get rid of May contracts, even at a negative price, in order not to have to pay high values for its subsequent storage. After the relaxation of measures related to the restrictions of the COVID-19 pandemic and the revival of oil demand, oil prices also began to rise until they approached the limit of 95 USD/bl at the beginning of 2022 (Figure 1).

After the outbreak of the military conflict in Ukraine, oil prices rose sharply and during the first 5 months of the conflict hovered around $120/bl on monthly average. After the markets recovered from the shock and countries dependent on Russian crude oil began looking for other sources of oil, prices gradually stabilized at the level of about 80 USD/bl by the end of 2023.

3.1. Oil Supply and Demand

The importance of oil supply as a primary energy source is beyond doubt. The reserves of this strategic commodity vary from year to year according to the level of maturity of the exploration technology. The amount of oil on our planet has been estimated by many specialised organisations by the end of the 20th century at 2 trillion barrels. In the previous 141 years, since the beginning of oil production in 1860, half of the world's supply has been consumed (1 trillion barrels). The current rate of annual oil consumption is 27 billion barrels, which remains unchanged in the coming years after a normal calculation and assuming that annual consumption, means that we will run out of oil during 36 years - in 2041. These estimates need to be taken with a grain of salt, as large oil companies sometimes try to estimate the reserves in their favour using the methods of their experts. However, it is possible this announcement was made to obtain a larger production quota from the Organization of the Petroleum Exporting Countries (OPEC); according to OPEC's principles, the more oil reserves a Member State has, the more oil it is allowed to produce.

With the development of exploration technology, the estimate of recoverable reserves changes. According to the International Energy Agency (IEA, 2010), the total oil resources (conventional and unconventional) technically recoverable by the end of 2015 amount to 6118 billion barrels (of which conventional oil 2201 billion bl and LNG 548 billion bl) World Energy Outlook (2016). It follows from the above that Adelman's theory is justified. At the beginning of the third millennium, many experts claimed that global oil production would reach a ceiling in 2006. Others assumed that the ceiling would be reached between 2006 and 2010, thus reducing the amount of available oil. We are not even talking here about Hubert's theory of the peak of oil production in the 1950s, which, in my opinion, was based only on the then-existing historical data on conventional oil. In addition, it was based on a relatively simple way of adjusting the curves (Medlock III, 2013).

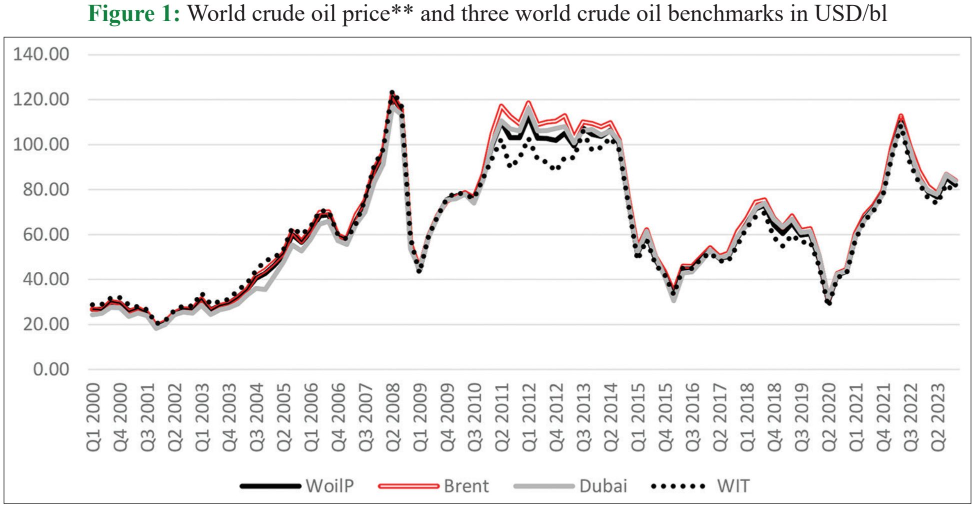
To meet the growing oil demand, OPEC production has been gradually increasing. The organization's oil production, with a slight fluctuation, has been on an upward trend since 1986. It should be noted that despite its minority share of world production, OPEC's oil production has kept pace with world production, compared with OPEC's non-member countries (Figure 2). Of course, this development is different from the development of production quotas set for the member states of this organization.

The Organization of oil-exporting countries, which still plays an important role on the international oil scene, at least theoretically until the mid-1980s, has not always decided according to market expectations and has sometimes gone against the interests of Member States. For example, at the end of 2005, it decided not to increase its reserve capacity, which remained at the level of 1.5 mil. barrels, despite the sharp rise in oil prices on world markets.

The supply of non-OPEC countries also had a growing trend of around 60% of world production by the end of the 1980s. However, in the following years, production has gradually increased. The Russian Federation and the USA accounted for the largest share of this growth. Oil production in other OECD countries has declined to a lesser extent. However, in Africa, there has been an increase in production in non-OPEC countries. Having said that, the most significant growth in oil production has been recorded in the USA since 2009, especially after more intensive shale oil production, which has surpassed the largest producer country - Saudi Arabia and the Russian Federation.

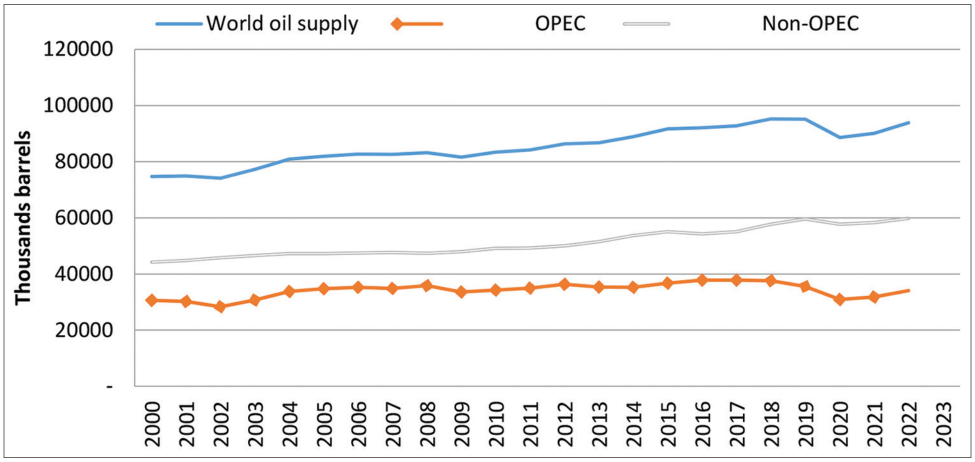
According to many studies, there are still huge oil reserves in the world, but their extraction costs are ten times higher than

Figure 1: World crude oil price** and three world crude oil benchmarks in USD/bl



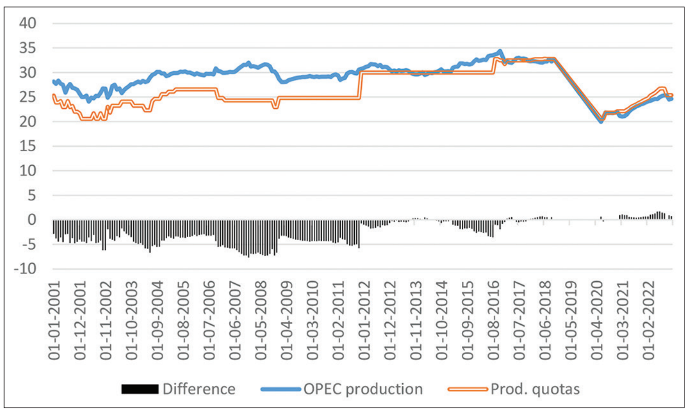
**World crude oil price (Brent) is an average of prices of Brent, Dubai and WIT. Source: World bank data, 2024

Figure 2: World crude oil supply



Source: Author's calculation based on the BP Database, 2024

Figure 3: Real OPEC production versus production quotas (million bl/d)



Source: Author's calculation based on the BP Database, 2024 and Reuters

the reserves in the Middle East. Heavy oil is one of these newly discovered raw materials. This oil is much more difficult and expensive to process than conventional light oil, and its processing causes great environmental damage. To produce one barrel of oil, it is necessary to refine two tons of heavy oil, for example, from the Canadian oil field Tar Sands. According to a report by the Canadian Petroleum Producers Association, 60 billion Canadian Dollars (CAD) has been allocated to develop oil projects over the next 5 years (Canadian Energy report, 2009). The report further assumes that the output of the Tar Sands oil field in 2020 will reach 4 million barrels. However, according to them, extraction is effective only when oil prices are at least at the level of 75 USD per barrel. In general, it should be emphasised that limited global oil production and refining capacity, combined with relatively high global demand for oil, have been key factors in rising oil prices. However, geopolitical problems and tensions and the consequent abuse of the situation by speculative trades were major factors in price volatility.

About 70% of oil reserves are located in OPEC countries, which accounted for 44% of global production in 2016. Between 2010 and 2015, non-OPEC cartel countries increased their production by 5.3 million bl/d compared to the increase of 3 million bl/d attributable to OPEC. The increase was mostly sourced from 5 countries: the USA (+ 5.1 million bl/d) and Canada (+ 1 mbl/d 1 million bl/d), Saudi Arabia (1.9 million bl/d) and Iraq (1.5 million bl/d) and Russia (0.6 million bl/d). Oil from shale deposits and low-permeability sands in the US has become a major contributor to the global oil supply and has been the most important reason for the increase in US oil production (Obadi and Korček, 2017). Due to low oil prices in 2016 (in January 2016, the price of the WTI barrel fell below USD 27/bl and the OPEC price basket below USD 23/bl), which were on average at USD 43/bl, many oil companies operating in the extraction of shale and heavy oil reduced investment and production, as a result of which oil production in the US decreased by more than 500 thousand bl/d. Apparently, and especially after the recovery of global oil prices in 2017, the US remained the world's largest oil producer in the years to come, as Saudi Arabia has pledged to reduce its oil production by 480,000 bl/d after an agreement with the Russian Federation for stabilizing the oil market and support the "justice" rise in oil prices.

Thanks to the shale oil boom and favourable oil prices, the US has increased its oil production in 2018 by 116% compared to 2011, making it the world's largest oil producer with a total production of 17,045,000 bl/d in 2019, exceeding Saudi Arabia's production by 5212,000 bl/d. This reality is in contrast with the prognosis of The International Energy "During the deep international financial and economic crisis in 2009, total world oil production was 84.8 million bl/d, which denoted a decline in production compared to the previous year by 1.8%. This decrease was mainly ascribed to the OPEC Member States, which reduced production by 6.4% compared to the previous year. The member states of this organisation were extremely disciplined in respecting the production quota, which reached more than 70%. However, non-OPEC countries recorded an increase in production of 1.5% compared to the previous year, mainly due to an increase in production in the Commonwealth of Independent States (CIS), where it increased by 2% (Russia) and by 9.2% (other CIS countries)" (Obadi and Korcek, 2019). The organization of oil-exporting countries has taken its place as one of the major global players influencing oil prices on world markets, but not always successfully, due to disagreements that sometimes occur between cartel members (Obadi and Korcek, 2019). “Examples of discrepancies between are quite numerous. For example, a meeting between OAPEC member states, most of which are members of OPEC, in Egypt in December 2010 agreed that there was no need to increase production. After the meeting, some OPEC members declared that the world economy could easily cope with the price of 100 USD per barrel. Meanwhile, in November 2014 in Vienna, when oil prices fell sharply by almost 30% since July of the same year, most cartel members decided not to cut production at a time when markets and analysts expected production to fall in an effort to halt the sharp decline in oil prices (Figure 3). At the meeting, several countries, led by Venezuela and Iran, have been advocating a reduction in production, despite Iran’s announcement shortly before the meeting that it would not vote to reduce production, because it expected the embargo imposed by Western countries to be lifted” (Obadi and Korcek, 2019). In principle, OPEC’s decisions have never been completely respected by the Member States. The largest (percentage) respected decision of OPEC to comply with the established production quotas, was about 79% in 2008 (Figure 3) (Obadi and Korcek, 2019).

In November 2011, OPEC member states decided to increase the quota from 24.85 million bl/d for over 30 million bl/d. as a reaction of high oil prices, which oscillated about 90 USD/bl and it considered as a threat to the recovery of global economy. “In essence, it was only a matter of legalizing part of the already higher production of most members than their respective quotas to reduce the gap between actual production and the quota set (OPEC’s actual production gradually increased from more than 28 million bl/d in May 2002 to around 38.5 million bl/d in July 2008, while the quota was around 24 million bl/d). Since 2011, both OPEC’s actual production and the quota of more than 40 million bl/d and more than 31 million bl/d in that order” (Obadi and Korcek, 2019).

Many analysts agreed that OPEC’s decision not to reduce production quotas was one of the main factors behind the decline in oil prices in late 2014 and early 2015 (Obadi and Korcek, 2019). “In fact, OPEC’s decision at the time was only a psychological factor in traders in the oil market (futures contracts) which translated into lowering the price of oil, because the markets were prepared to reduce prices, even if OPEC decided otherwise. There are several examples of the weak effect of OPEC’s decision. For example, in December 2008, after OPEC decided to reduce production by 4.5 million bl/d, oil prices continued to fall after a declining trend in oil prices, which reached USD 27/bbl in January 2016 and an OPEC price basket of around USD 23/bbl, coupled with a weak price recovery during 2016. Oil-exporting countries experienced significant losses compared to 2014 prices, especially countries that have planned high state budget expenditures and are highly dependent on revenues from oil sales. Saudi Arabia, the largest oil exporter, has started negotiations with the Russian Federation to reduce oil prices and stabilize the oil market. In September 2016, the mentioned countries signed a memorandum of cooperation, especially in the field of energy, based on which they agreed, among other things, to freeze, resp. reduce oil production in order to reduce oil supply in the market by 1.8-2 million, together with other countries supporting this agreement. bl/d. During the visit of the King of Saudi Arabia to Moscow in October 2017, they extended this agreement until the end of 2018. Since the signing of the memorandum between the countries, oil prices have recovered and currently reach more than 50 USD/bl” (Obadi and Korcek, 2019).

Global oil demand is witnessing a growing trend. In 2019, compared to 2000, demand increased by 28.5%. Emerging and developing countries, in particular, have contributed to this growth. While oil consumption as a whole has fallen by 05% in OECD countries as a whole, there has been an increase in oil consumption in Non-OECD countries (see Figure 4), particularly in emerging and developing countries, especially in China by almost 200%, and in India and Saudi Arabia, both of them by 133% (author’s calculation based on data from BP Database, 2024). China is one of the market forces responsible for global growth in oil demand. In 2022, China consumed 14.3 million barrels per day compared to 2.4 million barrels per day in 1990. In the year when the deepest economic crisis transpired, this gigantic economy consumed more than 8.5 million barrels per day. The average annual growth of oil consumption in China, during the period 2000-2023, was about 450 million barrels.

The oil market has had a turbulent year in 2022, marked by a number of shocks that led to extreme price volatility. Daily Brent crude prices ranged from a low of $76/bl to $133/bl, while the annual average reached $99.8/bl compared to a 2021 average of $70.4/bl. The Russian invasion of Ukraine at the end of February 2022, followed by sanctions, an embargo and a price ceiling on the import of Russian oil, the release of oil from strategic oil reserves in the volume of 221 mbl, fears of recession and inflationary pressures, as well as China’s uncompromising stance in the fight against the pandemic represented for oil market significant challenges that producers and consumers had to cope with. Despite the aforementioned shocks, it can be concluded that the market mechanisms worked and, despite all the aforementioned complications, physical deliveries were only minimally affected, and it can even be concluded that in 2022 the supply exceeded the demand by 470,000. bl/d, after the market was in a deficit of 2.3 mbl/d the previous year (IEA, 2022).

The crude oil consumption in the last 23 years was evidently growing trend also in other emerging and developing countries such as India, where the oil consumption has grown during the period 2000-2023 about 3.5% per annum, Saudi Arabia 3.7% per annum, and United Arab Emirates about 5.5% per annum.

3.2. Exchange Rate of US Dollar

The weakening of the dollar against major world currencies is the result of a growing US trade deficit as well as the deficit of the current account of the balance of payment and public debt. The trade deficit increased from −1.6 billion USD in 1976 to −22.5 billion USD in 1979, to −375 billion in 2000, to more than 610.5 billion USD in 2019. Rising inflation and the devaluation of the US dollar have reduced the real value of oil sales revenues and led OPEC member states to increase oil prices substantially. The real value of the dollar has fallen sharply since the early 1970s, when, for example, 1 USD in 1974 equated to 15 USD in 2004.

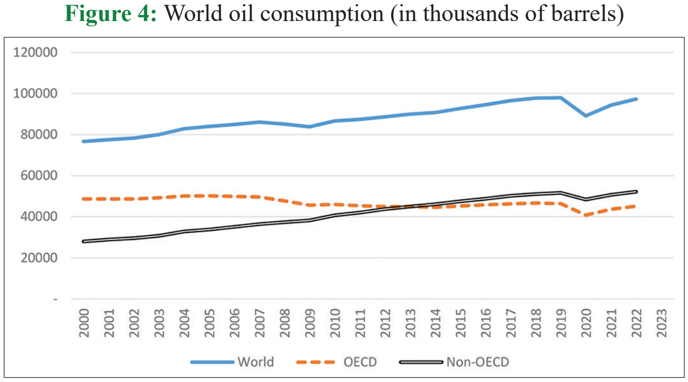
If we look at the historical development of oil prices and the value of the dollar against the yen and the former German currency, we find that there is a certain inverse correlation between oil prices and the dollar exchange rate (Obadi, 2006). This means that when the US dollar weakened, oil prices rose, and conversely, when the US dollar rose, oil prices reacted with a decline. It is notable that oil prices do not react immediately to the weakening of the US dollar, but after a few weeks of continuing the trend. When we look at the development of monthly oil prices and the USD exchange rate against the EUR (Figure 5), we see that since the beginning of 2002, oil prices have responded to the decline in the value of the US dollar against the EUR with gradual growth.

While the value of the dollar against the EUR fell by almost 42% between March 2002 and March 2008 (from 1096 per EUR to 1556 per EUR), oil prices rose by 330% over the same period (from USD 24.53/barrel to USD 105.54/barrel). The magnitude of this relationship varies from one period to another. The inverse relationship between US Exchange rate against EUR and oil prices (Brent) is one of the selected variables estimated in our ARDL model analysis (Section 4).

3.3. Geopolitical Factors

Geopolitical factors affect oil production quite significantly, especially when the change, as well as destabilization of the political environment, concerns the producing country, or oil-producing region - political unrest (violent demonstrations, sharp strikes in Nigeria and Venezuela, for example), civil war (for example in Libya, Yemen, Syria, etc.), or international war (for example between Iran and Iraq or between Ecuador and Colombia), or deterioration of international relations (for example, between the Russian Federation and Ukraine). Therefore, this is a restriction and disruption of oil supplies on the market, which leads to an increase in oil prices on world markets, or even to a price shock. The first oil shock in 1973-1974 was caused by the ability of Arab countries to use their dominance in OPEC and declare an embargo on oil exports to the United States and some Western European countries, which supported Israel in the war with Arab countries. The second oil shock in 1979 was caused by the Islamic Revolution in Iran, which led to the deterioration of the country's relations not only with the United States but also with many European countries. From a macroeconomic point of view, the standard explanation for the first oil shock is that OPEC member states, caused a supply shock with their almost monopolistic position in oil exports, which led to higher oil prices, leading to global inflation and subsequent stagflation.

Figure 4: World oil consumption (in thousands of barrels)



Source: Author´s calculation based on the BP Database, 2024

The causes of rising oil prices from 2000 to 2023 are a combination of geopolitical and macroeconomic factors: the ongoing war in Iraq, Libya, Yemen, Syria, Ukraine, political unrest in Nigeria, Venezuela, and other oil-producing countries, speculation in the oil market as well as uncertainty and concerns about the disruption of Iranian or Russian oil exports. On the other hand, growing demand for oil in emerging market economies, especially China and India and other oil-importing countries, as well as the depreciation of the US dollar, has not discouraged oil-importing countries from continuing the same intensity of oil imports despite its rising price. Natural disasters in the form of hurricanes and tsunamis, which have previously caused the production of offshore oil rigs and the interruption of production in refineries and the consequent reduction in oil supply on the market, such as Hurricane Katrina in August 2005, etc., are also contributing to rising oil prices.

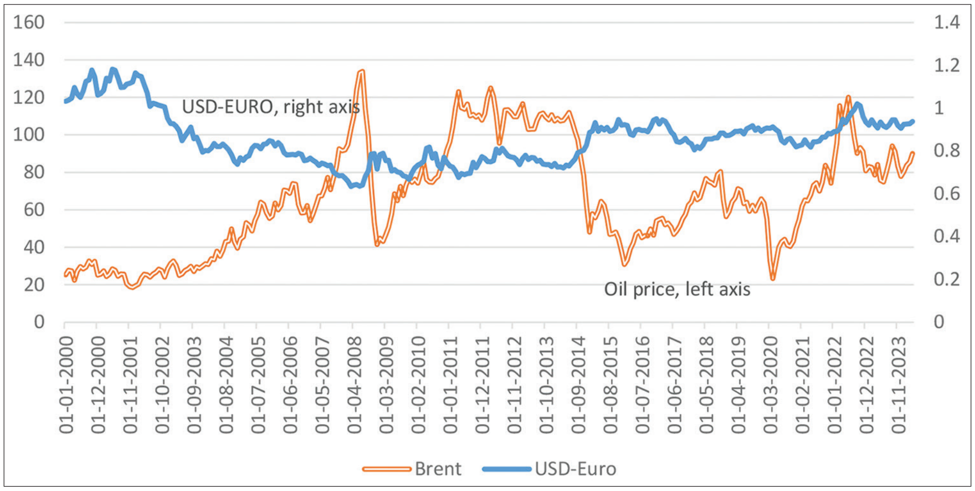
4. METHODOLOGY AND DATA

In this paper, we used quarterly data for the period 2000Q1-2023Q4 with 89 observations. The time series of selected variables are obtained from different public free sources (U. S. Energy Information Administration, World Bank Database, OECD, Federal Reserve Bank of St. Louis, and IMF). Monthly crude oil prices (Brent) are obtained from World Bank Database and adjusted by US CPI (Federal Reserve Economic Data, https://fred.stlouisfed.org) and then by averaging the monthly data of Brent we obtained the quarterly time series. The Index of geopolitical threats (GPRT) and the Index of geopolitical acts (GPRA) are obtained by averaging the monthly data downloaded from http://www.matteoiacoviello.com/gpr.htm on March 20.2024.

This paper uses the ordinary least square (OLS) based autoregressive distribution lag (ARDL) approach developed by (Pesaran et al. 2001) "to capture long-run cointegration among variables. Moreover, a dynamic error correction model (ECM) can be derived from ARDL by using the linear transformation (Banerjee et al. 1993)" (Qamruzzaman and Jianguo, 2018). This paper uses the ARDL model, which has many benefits over other cointegration models. "First, the autoregressive distributed lag model is appropriate regardless of sample size, which can be either small or finite and comprise 30 to 80 observations (Qamruzzaman and Jianguo, 2018). Second, this approach is more suitable when variables integrate in a different order, some variables are I(0), and some variables are I(1). Third, modelling ARDL with the appropriate lags is correct for both serial correlation and the indigeneity problem (Pesaran et al., 2001). Fourth, the ARDL model, simultaneously, can estimate long-run and short-run cointegration relations and provide unbiased estimation for the study (Pesaran et al., 2001)" (Qamruzzaman and Jianguo, 2018). Forth the ARDL model uses a combination of endogenous and exogenous variables, unlike a VAR model that is strictly for endogenous variables.

Theoretically, the ARDL model is a linear time series model, which explores the short-run and long-run associationship between

Figure 5: EUR-USD exchange rate and the world oil prices (USD/barrel)



Source: Author's calculation based on the World Bank Database, 2024 and Excelrates.com

dependent and independent variables. Specifically, if y_t is the dependent variable and X_1……… …X_k are k explanatory variables, a general ARDL (p, q..., q_k) model developed by Pesaran et al. (2001) is given by:

$$y_t = a_0 + a_1 t + \sum_{i=1}^{p} \alpha_i y_{t-i} + \sum_{j=1}^{k} \sum_{lj=1}^{qj} \beta_{j,l,j} X_{j,t-l_j} + \varepsilon_t \quad (1)$$

Where α_0 is a constant term, and α_1, α_i, and $\beta_{j,l,j}$ are the coefficients associated with a linear trend, lags of y_t and lags of the k regressors $X_{j,t}$ for j = 1, 2,…., k, and, ϵ_t are the usual innovations.

4.1. Model Specification

In this paper, we aim to ascertain whether there exists a long-run relationship between the dependent variable (*brent* –World crude oil price) and independent variables (*wop* – World crude oil production, *woc* – World crude oil consumption, *oecdgdpg* – OECD GDP growth, *chngdpg* – Chinese GDP growth, *indgdpg* – Indian GDP growth, *oecdst* –OECD crude oil stock, *USD-EURO* - USD exchange rate against EURO, *gprt* – geopolitical events as well as the index of geopolitical threats and *gpra* – geopolitical acts). The main model is presented as follows:

brent = f(wop, oecdgdpg, chngdpg,indgdpg, oecdst, woc, USD-EUR, gprt, gpra) (2)

The first step in our econometric process was to perform the Augmented Dickey-Fuller and Philips-Perron test for the stationarity of variables. The guideline in this test is: null hypothesis indicates that the time series is non-stationary and the alternative hypothesis indicates that the time series is a stationary. The stationary test shows the mixed order of integration of variables (Table 1). Among all the variables, *oecdgdpg, chngdpg, oecdst, and gprt* conform to stationary at the level I(0) whereas the remaining variables of our used model conform to stationary after the first difference in the order I(1). We employed the ADRL model developed by Pesaran et al. (2001) after conducting the ADF Unit Root Test and ensuring that there is no variable in order I(2). The variable *woc* – World crude oil consumption and *indgdpg* – Indian GDP growth has been excluded from the model because they show highly statistical insignificance and the results of the whole model were undesirable. The bounds test for this paper starts with the estimation of an unrestricted error-correction model (UECM) with no Constant and no Trend: $\alpha_0 = \alpha_1 = 0$ of the form:

$$\Delta y_t = b_0 y_{t-1} + \sum_{j=1}^{k} b_j x_{j,t-1} + \sum_{i=1}^{p-1} c_{0,i} \Delta y_{t-i} + \sum_{j=1}^{k} \sum_{lj=1}^{qj-1} c_{j,l_j} \Delta x_{j,t-l_j} + \sum_{j=1}^{k} d_j \Delta x_{j,t} + \varepsilon_t \quad (3)$$

Hypothesis:

H_0: $b_0 = b_j = 0, \forall_j$

The first part of the model (3) with b_0 and b_j represents the long-run relationship; whereas the second part with $c_{0,i}$, $c_{j,lj}$ to d_j represents the short-run dynamics of the models, Δ Indicates differencing of variables, while ϵ_t is the error term (white noise), and (t – i) is for the lagged period.

Bounds test evaluates the null hypothesis, which indicates the non-existence of the long-run relationship. When the null hypothesis of no cointegration is rejected, the alternative hypothesis suggests the presence of a long-term relationship.

For decision-making criteria about (H_0 or H_1), Pesaran et al. (2001) proposed the following procedure:

a. If F-statistic > upper bound of critical value, the existence of cointegration is confirmed
b. If F-statistic < lower bound of critical value, it is confirmed that variables are not cointegrated
c. If F-statistic between upper bound and lower bound of critical value then the conclusive decision may not reach about variables cointegration.

The optional lag length of variables was automatically selected based on Akaike Information Criteria (AIC) using the software (Eviews 13).

Table 1: Unit root test table (PP)

Include in test equation	Variables	Brent	WOP	USD-Euro	Oecdst	Oecdgdpg	GPRT	GPRA	Chngdpg
At level									
With constant	T-statistic	−2.2572	−1.0739	−1.9021	−2.3546	−12.2985	−4.4239	−5.2466	−13.3275
	P	0.1880	0.7234	0.3301	0.1574	0.0001	0.0005	0.0000	0.0001
		n0	n0	n0	n0	***	***	***	***
With constant and trend	T-statistic	−2.2500	−2.7992	−1.7321	−3.0763	−12.2282	−4.7023	−5.3806	−16.4582
	P	0.4566	0.2013	0.7293	0.1180	0.0000	0.0013	0.0001	0.0000
		n0	n0	n0	n0	***	***	***	***
Without constant and trend	T-statistic	−0.4057	1.8898	−0.0625	0.4529	−10.8593	−1.7370	−0.8650	−7.0910
	P	0.5350	0.9856	0.6594	0.8103	0.0000	0.0781	0.3387	0.0000
		n0	n0	n0	n0	***	*	n0	***
Include in test equation	**Variables**	**D (brent)**	**D (wop)**	**D (USD-EUR)**	**D (oecdst)**	**D (oecdgdpg)**	**D (gprt)**	**D (gpra)**	**D (chngdpg)**
At first difference									
With constant	T-statistic	−7.1310	−7.6409	−6.3355	−8.4107	−87.0648	−16.1945	−25.6598	−84.3075
	P	0.0000***	0.0000***	0.0000***	0.0000***	0.0001***	0.0001***	0.0001***	0.0001***
With constant and trend	T-statistic	−7.0895	−7.5909	−6.4584	−8.3125	−88.4884	−16.2443	−25.9871	−86.5037
	P	0.0000***	0.0000***	0.0000***	0.0000***	0.0001***	0.0000***	0.0001***	0.0001***
Without constant and trend	T-statistic	−7.1706	−7.4436	−6.3772	−8.4222	−87.1910	−16.8514	−23.8213	−83.4825
	P	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***

*Significant at the 10%, **Significant at the 5%, ***Significant at the 1%, and (no) not significant. Source: Authors' estimation

5. EMPIRICAL RESULTS AND DISCUSSION

In this section, we shall elaborate on the results of the employed econometrical models designed in the previous part and discussion and how the variables were selected, which influence the crude oil prices. However, the main objective of this paper is to investigate the short-run/long-run relationship between oil price fluctuation and selected variables among the geopolitical events as well as the geopolitical threats and acts.

5.1. ARDL Approach to Cointegration

We assume that all selected independent variables have a negative or positive effect on world oil prices. The main goal of our study is to measure the effect of geopolitical events on world oil prices. However, the geopolitical events should have to directly raise the crude oil prices as the threat of investors in the oil market from interruption of oil supply and indirectly, when the geopolitical act leads to cut the oil production and supply and then results in an imbalance between oil supply and demand, which means higher demand than supply and the end leads to higher crude oil prices. In model number (3) we incorporated two variables, which would explain the influence of the geopolitical factor on the movement of oil prices in the selected period. The first variable is an index of geopolitical threats (GPRT) and the second variable is an index of geopolitical acts (GPRA) (Dario and Iacoviello, 2018; 2024). Caldara and Iacoviello defined geopolitical risk as the threat, realization, and escalation of adverse events associated with wars, terrorism, and any tensions among states and political factors that affect the peaceful course of international relations.

The results of the Phillips-Perron (PP) unit root test confirm that 4 variables are stationary at level (with constant and with constant and trend), 2 variables of them (without constant and and trend), and 4 other variables are stationary after the first difference (Table 1). This implies that the variables (*chngdpg, oecdst, gprt and gpra*) are integrated at level *I(0)*, and others (*brent, wop, oecdgdpg and USD-EUR*) are integrated of order one *I(1)*. The results of these tests support the choice of an ARDL estimation technique.

After ensuring that among variables used in the model are not integrated into order two I(2), we proceed to run the ARDL model. Before that, using the VAR estimation we specified the lag structure of our model and the results are in Table 2.

The legs length of the ARDL model developed by Pesaran et al. (2001) are to be estimated using Akaike Information Criterion (AIC) have been automatically selected by the software (Eviews 13). We employed the ARDL model with no constant and no trend to enter the cointegration relationship.

After determining a long-run relationship between variables, we proceed to estimate an unrestricted ARDL model as well as ARDL Long-run from or Bounds test with no constant and no trend, to determine the long-run dynamics of the model.

The test above uses the F-statistic and the critical bounds values for testing the null hypothesis of no levels relationship. The guideline for decision is that if the computed F-statistic value is less than the critical value for the I(0) regressors, we have to accept the null hypothesis of no levels relationship, but if the value is greater than the critical value for the I(1) regressors we have to reject the null hypothesis of existence the long run relationship (Igberi et al., 2020).

The results of the bound test presented in Table 3 show that the calculated F-statistic of 3.82 was found to be greater than the critical value for the *I*(1) regressors of 3.18 of the Pesaran et al (2001) upper bound values at 5% level. Thus, the null hypotheses

Table 2: VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	−1716.530	NA	14517306	39.19386	39.41907	39.28459
1	−1201.475	924.7581	515.6008	28.94261	30.96952*	29.75920*
2	−1126.640	120.7568	416.8273	28.69635	32.52497	30.23881
3	−1072.747	77.16370	573.4279	28.92608	34.55639	31.19439
4	−1025.003	59.68063	992.4376	29.29552	36.72753	32.28969
5	−924.1917	107.6848	589.1367	28.45890	37.69261	32.17893
6	−809.3269	101.8119*	311.7283	27.30289	38.33829	31.74877
7	−703.2262	74.75277	276.2677	26.34605	39.18316	31.51780
8	−551.8889	79.10815	148.3335*	24.36111*	38.99992	30.25872

*Indicates lag order selected by the criterion. LR: Sequential modified LR test statistic (each test at 5% level). FPE: Final prediction error, AIC: Akaike information criterion, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

Table 3: Autoregressive distributed lagged estimates, autoregressive distributed lagged (1, 5, 1, 3, 0, 7, 6, 2) based on Akaike info criterion dependent variable: Brent (89 observations)

Variable	Coefficient	SE	T-statistic	P*
BRENT(−1)	0.868003	0.067811	12.80031	0.0000
WOP	−0.148911	1.011034	−0.147286	0.8834
WOP(−1)	−1.479295	1.511098	−0.978954	0.3317
WOP(−2)	2.965408	1.423424	2.083292	0.0417
WOP(−3)	−2.565426	1.259535	−2.036803	0.0463
WOP(−4)	3.471275	1.149721	3.019234	0.0038
WOP(−5)	−2.395142	0.828195	−2.892001	0.0054
USD_EUR	135.4212	18.23407	7.426822	0.0000
USD_EUR(−1)	−109.7784	21.25949	−5.163735	0.0000
OECDST	31.93858	18.92545	1.687599	0.0970
OECDST(−1)	−85.92641	24.95897	−3.442707	0.0011
OECDST(−2)	2.587980	24.58993	0.105246	0.9166
OECDST(−3)	49.79917	14.98710	3.322802	0.0016
OECDGDPG	5.128521	1.166929	4.394886	0.0000
GPRT	−0.001811	0.019627	−0.092289	0.9268
GPRT(−1)	−0.008423	0.021380	−0.393981	0.6951
GPRT(−2)	0.021571	0.021433	1.006405	0.3185
GPRT(−3)	−0.030638	0.021913	−1.398139	0.1675
GPRT(−4)	0.007872	0.021486	0.366370	0.7154
GPRT(−5)	0.013308	0.023032	0.577826	0.5657
GPRT(−6)	−0.093059	0.023652	−3.934478	0.0002
GPRT(−7)	0.034565	0.017854	1.935999	0.0578
GPRA	0.036721	0.033939	1.081968	0.2838
GPRA(−1)	0.019697	0.033174	0.593756	0.5550
GPRA(−2)	−0.083598	0.033673	−2.482687	0.0160
GPRA(−3)	0.075163	0.031490	2.386865	0.0203
GPRA(−4)	−0.054575	0.030023	−1.817793	0.0744
GPRA(−5)	−0.021942	0.030410	−0.721555	0.4735
GPRA(−6)	0.072101	0.027861	2.587936	0.0122
CHNGDPG	−0.647329	0.555391	−1.165538	0.2487
CHNGDPG(−1)	−2.395352	0.979000	−2.446734	0.0175
CHNGDPG(−2)	0.984694	0.708205	1.390408	0.1698

Source: Authors' estimation. SE: Standard error

of no cointegration are rejected this confirms that the *brent, wop, oecdgdpg, chngdpg, oecdst, USD-EUR, gprt* and *gpra* are cointegrated and confirms the existence of a long-run relationship among the variables using the bounds testing method of Pesaran et al. (2001).

According to our estimates, all independent variables have a strong effect for the long-run form on the independent variable (*brent* – one of the worlds three most important benchmarks of crude oil), which are statistically significant, though some of them has an effect with some lags. While the negative sign of *chngdpg* on the first lag can argued that China has relatively large oil stocks, with which it can cover the demand for oil for some time.

While the cointegration relationship exist as it is clear above, it is important to study the speed of convergence to equilibrium by estimating the Error correction model.

The error correction term, ECt-1, has a significant effect on the error rate of 1% and has a negative sign. So, there is enough evidence of a cointegration relationship or a long-term relationship between independent and dependent variables. The error correction term coefficient of (−0.131997) implies that following a shock, the variables will return to their long-run equilibrium at a rate of approximately 13% per quarter (Table 4). In addition, the significance of ECT variables also means that the empirical models used in the study have valid model specifications. Moreover, it is evident by the large value of *T*-statistic, namely (−5.858513), that the coefficient is high statistically significant.

It is necessary indeed to find whether the residuals from the used model are serially uncorrelated and homoscedastic. The following output from residual diagnostics.

The standard diagnostic tests of residuals (the residuals follow a normal distribution, and the calculated Jarque–Bera of normality test is insignificant, which confirms the normal distribution. The Breusch–Pagan– Godfrey test was used to check the heteroscedasticity; the results are insignificant which nullifies the null hypothesis. It means that the residuals are homoscedastic. Breuch-Godfrey serial-correlation LM test was used to check whether there is or no serial correlation. The results of residual diagnostic are desirable (Table 5).

According to the diagnostic test results, we can confirm the stability of the parameters with the Cumulative Sum and the Square of the Cumulative Sum tests for recursive residuals. This shows that coefficients statistics remain within the bounds at a 5% significance level, so it can be said that coefficients are stable (Figures 6 and 7). All these results are desirable and indicate that the model conforms to standard statistical properties.

After several tests, we concluded that the model was chosen appropriately and the results are from the viewpoint of the economic theory interpretable and explanatory. From the results

Table 4: Estimated coefficients error correction model dependent variable: D (brent), method: Autoregressive distributed lagged

Variable	Coefficient	SE	T-statistic	P
COINTEQ*	−0.131997	0.022531	−5.858513	0.0000
D (WOP)	−0.148911	0.806742	−0.184583	0.8541
D (WOP(−1))	−1.476115	0.820353	−1.799365	0.0767
D (WOP(−2))	1.489293	0.732619	2.032833	0.0462
D (WOP(−3))	−1.076133	0.667467	−1.612264	0.1118
D (WOP(−4))	2.395142	0.656091	3.650623	0.0005
D (USD_EUR)	135.4212	15.51936	8.725948	0.0000
D (OECDST)	31.93858	15.07966	2.117990	0.0381
D (OECDST(−1))	−52.38715	14.71862	−3.559243	0.0007
D (OECDST(−2))	−49.79917	13.31840	−3.739125	0.0004
D (GPRT)	−0.001811	0.017190	−0.105371	0.9164
D (GPRT(−1))	0.046380	0.017867	2.595832	0.0117
D (GPRT(−2))	0.067950	0.018295	3.714220	0.0004
D (GPRT(−3))	0.037313	0.016858	2.213428	0.0304
D (GPRT(−4))	0.045185	0.016974	2.661955	0.0098
D (GPRT(−5))	0.058493	0.017783	3.289352	0.0016
D (GPRT(−6))	−0.034565	0.015230	−2.269492	0.0266
D (GPRA)	0.036721	0.028447	1.290867	0.2014
D (GPRA(−1))	0.012852	0.029375	0.437525	0.6632
D (GPRA(−2))	−0.070746	0.026243	−2.695772	0.0090
D (GPRA(−3))	0.004416	0.025764	0.171414	0.8644
D (GPRA(−4))	−0.050159	0.024340	−2.060796	0.0434
D (GPRA(−5))	−0.072101	0.023887	−3.018446	0.0036
D (CHNGDPG)	−0.647329	0.402425	−1.608568	0.1126
D (CHNGDPG (−1))	−0.984694	0.467696	−2.105415	0.0392

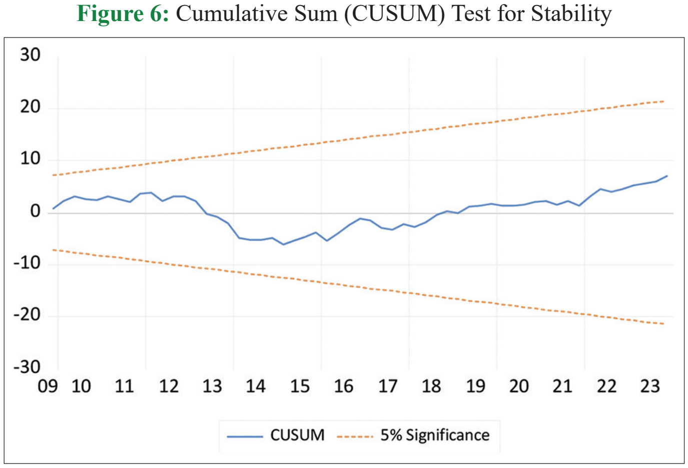
Source: Authors' estimation. P values are incompatible with t-Bounds distribution.
SE: Standard error

Table 5: The results of residual diagnostics

Jarque-bera of normality test			
Jarque-Bera	5.774584		
Probability	0.55727		
Breusch-godfrey serial correlation LM test			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	0.791255	Probability F (2.55)	0.4584
Obs*R^2	2.489169	Probability χ^2 (2)	0.2881
Heteroskedasticity test: Breusch-pagan-godfrey			
Null hypothesis: Homoskedasticity			
F-statistic	1.076987	Probability F (32.56)	0.3956
Obs*R^2	33.90601	Probability χ^2 (32)	0.3757
Scaled explained SS	21.42032	Probability χ2 (32)	0.9220

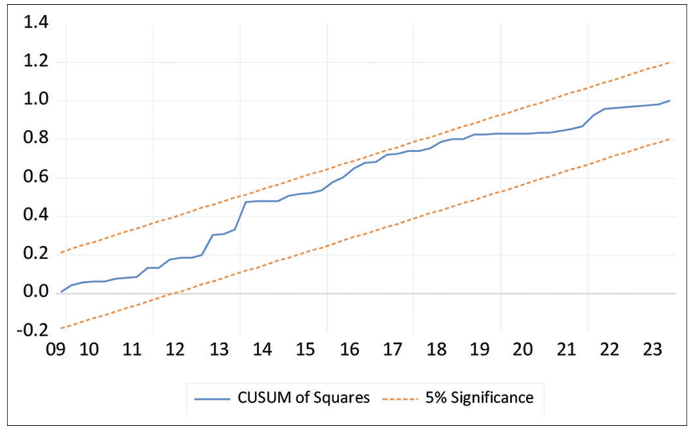
Source: Authors' estimatio

Figure 6: Cumulative Sum (CUSUM) Test for Stability



Source: Authors' illustration

Figure 7: Cumulative sum of square (CUSUMQ) test for stability



Source: Authors' illustration

of our ARDL model (3), it is clear that the geopolitical factor (represented in the model, in particular (*GPRT and GPRA*), are strong statistically significant, which explicate the important role it played, in the observed period, in the movements of crude oil prices.

6. CONCLUSION

Oil prices are determined by several factors. These are, for example, market factors (demand and supply, economic growth in the giant economies), the value of the US dollar, speculation in the futures market, and non-market, resp. unpredictable factors (geopolitical factor - political unrest, geopolitical threats, acts, terrorist attacks, civil and international wars, and natural disasters - hurricanes, floods, and earthquakes). As a matter of fact, high real prices hamper consumption and encourage and motivate the search for competitive substitutes from huge marginal oil sources, the production of which is currently uneconomical, but also other energy sources. However, persistently low oil prices are shown to have the opposite effect. Advances in technology exploration and production are likely to reduce prices as additional oil resources become part of the reserve base.

Thus, the main objective of this paper was to explore the relationship between geopolitical events, together with market factors, and crude oil prices for the period 2000Q1-2023Q4. In other words, the endeavour was to examine the effect of geopolitical events on crude oil prices in the crude oil markets in the above-mentioned period.

From the history of oil prices, it can be stated that the movement of oil prices has always been influenced by several of the above factors, regardless of the dominance of influence in a given time horizon, which mutually influences and causes the rise or fall of oil prices on world markets. For example, the main factor and trigger of the first and second oil shocks was the geopolitical factor, which influenced market factors and resulted in rising oil prices. On the other hand, the sharp rise in oil prices in 2008 and 2014 and their subsequent sharp decline were caused simultaneously by two factors - market factors and speculation (respectively), although many analysts state that they were mainly caused by market speculation.

During previous years (January 2000-December 2023), oil prices were highly volatile and a period of price volatility can be expected in the future as well due to unpredictable political and economic circumstances. For example, it is very understandable that tensions in the Middle East can result in a major disruption to oil production and trade. Finally, the results of the ARDL model clearly show that the geopolitical factor as well as geopolitical threats and acts significantly affected world crude oil prices during the period under research. Put differently, geopolitical threats and geopolitical acts have a strong relationship with world crude oil prices in long-run and short-run terms. On the other hand, market forces, which are included in our ARDL model, also play an important role in restoring long-term equilibrium.

Our findings from the employed ARDL model confirm that the brent as crude oil benchmark, market factors (world oil production, OECD oil stocks, OECD GDP growth, Chinese GDP growth) and non-market factors (geopolitical factors -index of geopolitical threats and acts) are cointegrated and confirms the existence of a long-run relationship among the variables using the bounds testing approach. Our estimates suggest that all independent variables have a strong effect on the dependent variable crude oil price (*brent)*. The negative effect of Chinese GDP growth can argue that China has relatively large oil stocks, with which it can cover the demand for oil for some time. The hypothesized positive effect of the GDP growth of China on the global oil prices in the short run is rejected, but it is not entirely unexpected. As the giant economy among emerging and developed countries, and registered high economic growth in the selected period, we assume that should have reflected on the growth of oil consumption and demand, and thus would lead to rising oil prices on world markets.

We can conclude that, the results of our model (see the previous section) show that there is highly evidence of a cointegration relationship or a long-term relationship between dependent and independent variables. These confirm our hypothesis that geopolitical events affect crude oil price in the world oil markets. Indeed, our econometric analysis distinguishes between the geopolitical threats, which positively affected oil prices in the short-run horizon and the geopolitical acts, which positively affected oil prices in the long-run rather than in the short-run horizon.

It should be noted that our model has a limitation for including other factors (like a factor of speculation etc.) due to the lack of data, which plays an important role in the volatility of oil prices on world markets and causes considerable problems for both exporters and importers of this commodity.

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