Hungarian University of Agriculture and Life Sciences

Analysing of the Impacts of the Fluctuation of Crude Oil Price on Certain Economic Indicators

PhD Dissertation

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1. INTRODUCTION

1.1. The importance of the topic

In this time of global market uncertainty the world requires energy in increasing quantities. Energy, which is required in all aspects of life, is critical to a country's development. Countries must use energy efficiently in order to compete on a global scale and ensure long-term development. Energy-efficient countries are successful economically and lead the competition field. Over the last few centuries, the availability of energy has changed the course of humanity. New sources of energy – fossil fuels first, followed by nuclear diversification and hydro power, and renewable technologies have been unlocked.

Supplies should also be reliable at a properly set price to pave the path for economic growth. The overall strategy in terms of energy sources of a country should be based on meeting the needs and further developing the energy sector. However, development should also consider the efficiency of use and utilisation it in the long run. Sustainability here should be understood to include not only the natural resources but also technological and social aspects and priority should be given to long-term objectives over the short-term ones.

Energy is regarded as the primary source and driver of economic growth and its existence is undebatable for a modern economy. Economic growth in the future is predominantly tied with the availability of accessible and green, environmentally friendly energy sources in the long run.

Supplies should also be reliable at a properly set price to pave the path for economic growth. The overall strategy in terms of energy sources of a country should be based on meeting the needs and further developing the energy sector. However, development should also consider the efficiency of use and utilisation it in the long run. Sustainability here should be understood to include not only the natural resources but also technological and social aspects and priority should be given to long-term objectives over the short-term ones.

According to the International Energy Outlook there would be a significant rise in the demand for energy between 2012 and 2040, i.e. from 549 quadrillion British thermal units (Btu) in 2012 to 629 quadrillion Btu in 2020 and to 815 quadrillion Btu in 2040—a 48% increase from 2012 to 2040 EIA (2016).

The developing non-OECD nations seem to demand more energy which is resulted from economic growth and expanding population so energy demand will rise by 71% between 2012 and 2040. However, in the OECD member countries total energy use will go up by only 18% between 2012 and 2040 EIA (2016).

Energy consumption tends to rise. Nonetheless, the issues of energy security and the effects of non-renewable (fossil fuel) emissions on the environment coupled by high oil prices encourage the use of no fossil renewable energy and nuclear power, as well as natural gas. Governments also support no fossil energy sources, which are termed as the world's fastest-growing source of energy with an average rate of 2.6%/year, while that of nuclear energy is 2.3%/year and natural gas hardly reaches 1.9%/year. The slowest growing form include coal with its 0.6%/ year (2016). Rapid development in the energy market is of vital importance for fast economic growth to be achieved by any country. As energy resources might run out in the long term as fossil fuels stocks on which a country's energy supply is based are limited.

According to the IEA fossil fuels seem still to be the most important energy source in 2040, as liquid fuels, natural gas, and coal make up 78% of total world energy consumption. Petroleum with other liquid fuels still has the largest energy share although their share of total global marketed energy consumption slightly shrinks from 33% in 2012 to 30% in 2040. Liquid fuels are mostly consumed in transportation and industry. The residential and power sectors seem to use less as a result of rising world oil prices, so substituting liquids with other alternative fuels is becoming common. We have to note, however, that despite of the rising global oil price, more and more liquid fuels are used in the transportation and industrial sectors. The ratio grows by 1.1%/year in transportation sector, and by 1.0%/year in the industry between 2012 and 2040 EIA (2016).

Energy is of great significance for life and also for development as it plays a role in reducing poverty, increasing productivity and improving the quality of life. It also affects sustainable social development and economic growth.

Energy is not evenly consumed all over the world: while some consume large amounts, the others lack modern energy forms. Volatile and fluctuating oil prices do harm to stable energy supply and security. The distribution of crude oil is not even worldwide. Countries with the most oil reserves include the countries in the Middle East, such as Iran, Iraq, Kuwait, Saudi Arabia and the United Arab Emirates (UAE), while natural gas can be found mainly in Russia and other Former Soviet Union (FSU) countries, Iran, Qatar and Saudi Arabia.

Currently, almost all aspects of life depend on oil extraction. The present world is centred on oil, which has been the driver of world economy for many years and, at present, it cannot entirely be replaced. Crude oil is also considered as a commodity asset, whose price is a case of concern for many investors, which transforms this physical asset into a sophisticated financial product.

When we have oil in mind, we tend to consider the fuel for our cars, trucks and planes, as well as heating oil. However, there are hundreds of ways to use crude oil, which has an impact on our lives. Depending on the composition of the crude oil, refineries manufacture different proportions of petroleum products. The largest share is termed as "energy carriers", i.e. various grades of fuel, oil and gasoline. These fuels incorporate or can be mixed to yield gasoline, jet fuel, diesel fuel, heating oil, and heavier fuel oils. Heavier (less volatile) fractions are utilized to produce asphalt, tar, paraffin wax, lubricating and other heavy oils.

Refineries also manufacture other chemicals in complex processes that finally yield plastics and other useful materials. This is how oil is used in the most common way. There is plastic almost in everything one can find in a store. Petroleum is added to make clothing non-flammable and colourful by the production of rayon, nylon, polyester, and even artificial furs. Cushions for couches are often filled with durable, lightweight polyurethane foam. In vehicles high-performance plastics have substituted heavier materials– from the interior to the engine block – and it resulted in reducing weight and enhancing fuel economy as well as safety. Plastic is also utilized for manufacturing computer cases, shoes, car bumpers, kids' toys, and thousands of other household items. Crude oil also comes handy in manufacturing car hoses, wiring and many fluids (antifreeze, brake fluid, transmission fluid, motor oil, and lubricating grease).

Crude oil also plays a role in producing food. In addition, fertilizers rely on petroleum. Due to the fact that petroleum frequently consists of a few percent of sulphur-containing molecules, elemental sulphur is also produced under the term of petroleum product. Carbon, in the form of petroleum coke, and hydrogen may also be produced that are also counted to the category of petroleum products. The hydrogen produced in the meantime is most often used as an intermediate product for other processes of oil refinery. A case in point is hydrocracking and hydrodesulphurization. To sum up, oil is regarded to play an important part in the production and transportation of many of our everyday items. A lot of sectors of the economy will negatively be affected by the increase of oil prices, or boosted in the reverse situation.

Crude oil prices, like most other commodities in the market, have routinely experienced wild price swings alternating between periods of great scarcity, high demand, and high prices and periods of oversupply, low demand, and depressed prices. These so-called crude oil “Price Cycles” can last several years, depending on factors such as oil demand, the volume of oil drilled, processed, and sold by the major producers, and so on. These price swings have been triggered by economic and political events, technological advancements and changes within the petroleum industry, and continue to influence prices in the present day.

When examining oil prices the last decade saw some of the most spectacular price explosions in oil history. In 2003, the United States invaded Iraq, causing supply disruptions. This was exacerbated by Asia's and China's massive demand growth. As a result, prices have risen from $28.38 per barrel in July 2000 to $146.02 in July 2008. Oil prices are likely to have risen as a result of both increased demand and fears of supply disruptions. Global demand for oil was rising, outpacing any increases in production and excess capacity. One major reason is that developing countries, particularly China and India, have been rapidly growing. These economies have become more industrialized and urbanized, contributing to an increase in global demand for oil. Furthermore, concerns about supply disruptions have been fuelled by unrest in oil-producing countries such as Nigeria, Venezuela, Iraq, and Iran. The breathtakingly sharp rise in the price of oil in the latter half of 2007 and the first half of 2008 has led many to argue that increased speculation in commodity markets played a role, and there is evidence of increased activity in these markets. However, whether speculation is a factor in high oil prices is debatable. It is also important to remember that both demand for and supply of oil react slowly to price changes in the short run, so very large price changes may be required to restore equilibrium if demand moves even slightly out of line with supply. Prices fell as a result of the 2008 global financial crisis before staging a comeback. The Arab Spring of 2011 caused supply shortages, pushing prices up to $126.48 per barrel. Recent technological advancements have significantly altered the global oil landscape. Hydraulic fracturing has pushed the United States back to the top of the pack, reducing OPEC's influence and depressing prices. The flood of US shale oil into the market has resulted in a sharp drop in global oil prices, from $114.84 per barrel in June 2014 to $28.47 in January 2016. OPEC has attempted to alleviate the glut by collaborating with non-OPEC nations such as Russia to implement production cuts. As a result, prices have recovered somewhat but have never returned to levels seen in the previous decade. With the United States now serving as the new "swing producer," OPEC's influence and ability to control prices is likely to remain limited. The ongoing trade war between the United States and China, as well as geopolitical uncertainty in Iran, Syria, and other countries, has pushed oil prices up from their 2016 lows of less than $30 per barrel to $54.70 in October 2019. However, with shale production remaining high and the global economy weakening, prices are expected to remain low. Currently, a coexistence of forces – price disagreements between Russia and Saudi Arabia, as well as the Corona-Virus pandemic – has had a significant impact on the oil market, resulting in a sharp drop in the oil price. The drop in oil prices in March-April 2020 has pushed oil to its lowest level in many years. WTI oil prices fell to negative territory for a brief period in April 2020.

A drop in oil prices should result in lower transportation and fuel costs for businesses. Consumers will also benefit from lower transportation and fuel prices. Lowering oil prices will effectively increase their disposable income, allowing them to spend more on other goods. Because oil is the most traded commodity and has a significant impact on global transportation costs, it should cause inflation and may result in higher rates of economic growth.

However, oil prices can fall when there is a fear of an economic downturn. In this case, falling oil prices are insufficient to boost economic growth because other factors are holding it back. Furthermore, if oil prices fall sufficiently, some oil companies may go out of business, resulting in an increase in bad debts. The drop in oil prices in 2020 is a sign of an impending economic downturn, and prices have fallen so far that many oil companies will be forced out of business, resulting in job losses and reduced investment.

Lowering the cost of living is aided by lower oil prices. Particularly if a household owns a car or uses other forms of oil-powered transportation. To a lesser extent, lower transportation costs should result in lower prices for all goods.

This decrease in the cost of living is especially important when real wage growth is low, as it has been in recent years. A drop in oil prices is essentially a free tax cut. In theory, a drop in oil prices could lead to increased spending on other goods and services, increasing real GDP.

A decrease in demand for oil was expected with lower global GDP. If the oil price fall is long-lasting, the economy will be affected more strongly because consumers react more strongly to permanently lower prices. However, the impacts on global economy do not only depend on the temporary or long-lasting nature of low prices but also on what causes oil prices to fall. It can be reduced demand for oil or an increased supply of oil. The volume of impacts also depends on to what extent countries are able to adjust their fiscal and monetary policies as a cure for price decreases.

A significant increase in oil prices will contribute to higher inflation. This is due to rising transportation costs, which will result in higher prices for many goods. This is cost-push inflation, as opposed to inflation caused by rising aggregate demand/excess growth.

Consumers' discretionary income will be reduced. They face higher transportation costs but do not benefit from rising incomes. Higher oil prices can slow economic growth, which is especially problematic if consumer spending is low.

2. OBJECTIVES TO ACHIEVE

The study of economics is divided into two parts: macroeconomics and microeconomics. Macroeconomics, as the name implies, examines the economy's overall, big-picture scenario. Simply put, it focuses on how the economy as a whole performs and then analyses how different sectors of the economy interact with one another to understand how the aggregate functions. This includes factors such as unemployment, GDP, and inflation. Macroeconomists create models that explain the relationships between these variables. These macroeconomic models, and the forecasts they generate, are used by government entities to aid in the development and evaluation of economic, monetary, and fiscal policy; by businesses to set strategy in domestic and global markets; and by investors to forecast and plan for movements in various asset classes.

Given the enormous size of government budgets and the impact of economic policy on consumers and businesses, macroeconomics clearly addresses important issues. Economic theories, when applied correctly, can provide illuminating insights into how economies work and the long-term consequences of specific policies and decisions. Macroeconomic theory can also assist individual businesses and investors in making better decisions by providing a more comprehensive understanding of the effects of broad economic trends and policies on their respective industries.

It is also critical to recognize the limitations of economic theory. Theories are frequently developed in a vacuum and lack real-world details such as taxation, regulation, and transaction costs. The real world is also quite complicated, with issues of social preference and conscience that do not lend themselves to mathematical analysis. Even with economic theory's limitations, it is important and worthwhile to monitor major macroeconomic indicators such as GDP, inflation, and unemployment. The performance of companies, and thus their stocks, is heavily influenced by the economic conditions in which they operate, and studying macroeconomic statistics can assist an investor in making better decisions and identifying turning points.

Similarly, understanding which theories are popular and influencing a particular government administration can be extremely beneficial. A government's underlying economic principles will reveal a lot about how that government will approach taxation, regulation, government spending, and other policies. Investors can gain a better understanding of economics and the implications of economic decisions by better understanding economics and the ramifications of economic decisions.

The effect of oil prices has remained an empirical question in the economic literature since the unprecedented oil shock of the 1970s. As a result, numerous studies have been conducted on the oil price and macroeconomic variables such as output, exchange rate, inflation, interest rates, and so on.

2.1. Problems to solve and the research questions

The empirical question of how the oil price (volatility) affects growth indicators has continued to elicit contradictory responses from economists. On the one hand, some argue that fluctuations in oil prices boost output, thereby driving growth; on the other hand, others argue that price fluctuations will reduce output, thereby impeding growth.

According to AMUZEGER (1998) and AKPAN (2009), an increase (decrease) in the price of oil, which represents a positive (negative) shock, will increase (decrease) the revenue base of oil-rich countries because it will mean higher (lower) export (foreign exchange) earnings. The increased (decreased) export earnings translate into increased (decreased) economic growth. There is, however, a counter narrative for oil-importing countries. According to HAMILTON (1983), VAN DE VEN, and FORQUET (2017), an increase in oil prices inhibits growth. Higher oil prices increase energy expenditure, resulting in higher production costs. This is equivalent to rising general prices, resulting in a decrease in aggregate demand and, in this case, real GDP growth performs poorly. There is essentially a wealth transfer effect between oil importers and oil exporters that are imposed by oil price fluctuations, which necessitate policy responses, particularly in the economies that have been harmed

Increases in oil prices are generally thought to increase inflation and slow economic growth. In terms of inflation, oil prices have a direct impact on the prices of goods manufactured with petroleum products. As previously stated, oil prices have an indirect impact on costs such as transportation, manufacturing, and heating. Increases in these costs can have an impact on the prices of a wide range of goods and services, as producers may pass on production costs to consumers. The extent to which increases in oil prices lead to increases in consumption prices is determined by how important oil is for the production of a given type of good or service.

Increases in oil prices can also stifle economic growth by influencing supply and demand for goods other than oil. Increases in oil prices can reduce the supply of other goods by raising the costs of production. High oil prices, in economic terms, can shift up the supply curve for the goods and services that use oil as an input.

High oil prices can also reduce demand for other goods by reducing wealth and instilling uncertainty about the future (SILL 2007). One way to consider the effects of higher oil prices is to consider them a tax on consumers FERNALD and TREHAN (2005).

Despite these effects on supply and demand, the relationship between rising oil prices and economic downturns is not perfect. Not every significant increase in oil prices has been followed by a recession.

Low growth, high unemployment, and high inflation characterized the two large oil shocks of the 1970s. It's no surprise that changes in oil prices have been identified as a significant source of economic volatility.

However, research over the last decade has called into question this conventional wisdom about the relationship between oil prices and the economy. According to BLANCHARD and GALI (2007), the late 1990s and early 2000s saw large fluctuations in oil prices comparable to the oil shocks of the 1970s. These later oil shocks, however, did not cause significant fluctuations in inflation, real GDP growth, or the unemployment rate.

Simply observing the movements of inflation and growth in the aftermath of oil shocks may be misleading. Oil shocks have frequently coincided with other economic shocks. Commodity prices rose dramatically in the 1970s, exacerbating the effects on inflation and growth. On the other hand, the early 2000s were a period of rapid productivity growth, which helped to offset the impact of rising oil prices on inflation and growth. To determine whether the relationship between oil prices and other variables has changed over time, we must look beyond casual observations and use econometric analysis.

Formal studies uncover evidence that the relationship between oil prices and the macroeconomy has deteriorated over time. HOOKER (2002), for example, contends that the structural break in the relationship between inflation and oil prices occurred at the end of the 1980s. BLANCHARD and GALI (2007) investigated how prices, wage inflation, output, and employment respond to oil shocks. They discovered that since the mid-1980s, the responses of all these variables to oil shocks have become muffled.

Despite the large amount of papers on oil prices and macroeconomic indicators, the majority of the literature has been devoted to the study of the dynamics in oil-importing industrially developed economies. One of the reasons I have chosen this topic for my dissertation is because there is only a small number of studies which have been devoted to developing countries and oil exporting countries in relation to inflation, unemployment, household consumption, CO2 emission and GDP growth.

The second reason I have decided to write about this problem, because I wanted to verify or reject former studies indicating that the link between oil price and key macroeconomic has been weakening.

Based on the above reasons I have formulated my research questions as follows:

1. What is the relationship between oil price and inflation rate in oil exporting countries, OPEC countries and major EU countries?

2. What is the relationship between oil price and unemployment rate in oil exporting countries, OPEC countries and major EU countries?

3. What is the relationship between oil price and household final consumption expenditure in oil exporting countries, OPEC countries and major EU countries?

4. What is the relationship between oil price and CO2 emission in oil exporting countries, OPEC countries and major EU countries?

5. What is the relationship between oil price and GDP growth in oil exporting countries, OPEC countries and major EU countries?

6. Do oil price fluctuations have a different impact on the economy of oil exporting and oil importing countries?

Based on my hypotheses I wanted to answer this question with supported data analysis

7. Did the link between oil prices and key macroeconomic indicators deteriorate over the last decade?

Based on my own analysis I was curious whether my results would support scientific literature on the weakening link.

The objective of the dissertation is to answer those research questions and examine oil price changes and their effect on economic development in the world. It will analyse the relationship between oil prices changes and inflation, unemployment, household final consumption expenditure, CO2 emission and GDP growth in different country groups. It is assumed that oil prices strongly influence the economy of net oil exporting countries while little or no influence can be detected on the economy of net oil importing countries. In order I could answer my research questions I have defined my hypotheses as follows:

2.2. The hypotheses

In order I would be able to answer my research questions I have defined my hypotheses. Under each hypothesis I give a brief explanation on the reasons and the background of my assumptions.

Hypothesis1: There is a positive linear relationship between oil price and inflation rate. Falling oil prices decrease inflation rate in oil exporting countries, OPEC countries and major EU countries.

According to many studies, the price of oil has a significant impact on determining consumer price inflation because oil is a direct input for many consumer products and is used as a direct input in almost every consumer product. During the oil price shocks of the 1970s and 1990s, the impact of oil prices on inflation was especially strong. According to historical data, the price of oil rose from $3 per barrel before 1973 to close to $40 per barrel in 1979. Petroleum price has also risen dramatically, from $15 a barrel in 1998 to nearly $140 a barrel in 2008 EIA (2016).

Lower oil prices dampen inflation directly when oil-related product prices decrease and indirectly when production costs for other goods go down.

Lower oil prices may generate lower global inflation. According to the WORLD BANK (2015), global inflation would fall by 0.4–0.9 percentage points in 2015 due to a 30 percent fall in oil prices. However, impacts differ depending on the share of oil products from the CPI basket, the impacts of oil prices on wages and other prices, the exchange rates as well as the structure of oil-related taxes and subsidies.

Decreasing oil prices can have a more significant impact on inflation in countries where oil-related products make up a large part of the CPI basket. The volume of these impacts also differs in countries. Oil-related taxes also influence consumer prices.

The impacts decreasing oil prices have will be greater if lower prices are permanent, because companies and consumers adjust their behaviour in contrast with the case when price reduction was only temporary.

The strong correlation between oil prices and inflation, may vary over time. Such a strong bond vanished in the mid-1980s. EVANS and FISHER (2011) discovered no evidence of an oil price pass-through effect on core inflation (inflation excluding food and energy prices) since the mid-1980s. Using the data from 1985 to 2011, CHEN and WEN (2011) found the same results as reported in EVANS and FISHER (2011) and they concluded that oil price shocks has no impact on the trend inflation but the effect is transitory through core inflation. HOOKER (2002), on the other hand, investigated the relationship between oil prices and inflation over the sample years 1962–1980 and 1981–2000. The findings revealed that the price of oil had a significant impact on inflation in the first sample period but not in the second. Again, the findings imply the strong relationship between oil price and inflation that existed in the early 1970s vanished by the mid-1980s. Many studies reported disparate results. KIPTUI (2009), MISATI et al. (2013), KARGI (2014), and ABOUNOORI et al. (2014) are among the studies that report significant effects of oil price on inflation (2014). CHOU and TSENG (2011), on the other hand, conducted analyses on the pass-through effect of oil prices on CPI inflation in a group of countries in emerging Asia. They discovered evidence of oil's long-run pass-through effect on CPI inflation in the majority of the countries, but the findings were insignificant in the short term.

The dissertation will focus on investigating the correlation between oil prices and inflation in both net oil exporting and net oil importing countries between 2008 and 2019.

Hypothesis 2/A/: There is a negative linear relationship between oil price and unemployment rate in oil exporting and OPEC countries.

Hypothesis 2 /B/: There is a positive linear relationship between oil price and unemployment rate in major EU countries.

If the oil price increase is long-lasting, production structure may be altered, which has a deeper impact on unemployment. Indeed, oil price rises adversely affect oil-intensive sectors, which results in implementing new production methods that generate capital and labour reallocations and have an impact on unemployment. In the long term LOUNGANI (1986 et al.) analysed the relationship between oil price movements and the labour market. DAVIS-HALTIWANGER (2001) focused on the influence of oil prices on unemployment. The effects t oil prices make on the labour market can vary. KEANE-PRASAD (1996) concluded that oil price increases generally reduce employment in the short term but increase it in the long term due to the complementarities in the different segments of the labour market.

The dissertation will focus on investigating the correlation between oil prices and unemployment in both net oil exporting and net oil importing countries between 2008 and 2019.

Hypothesis 3: There is a negative linear relationship between oil price and the final consumption expenditure of households in oil exporting, OPEC and EU countries.

An oil price increase can adversely affect consumption, investment and unemployment. Consumption is positively related to disposable income, and investment by raising firms' costs and, possibly, by increasing uncertainty, which leads to a postponement of investment decisions FERDERER (1996).

While there has been a significant amount of literature on the relationship between international oil prices and their effect on economic growth, the impact of international oil prices on consumption has only recently become a focus of study. As a result, only a few papers that are directly related to this effect have been published. PETERSEN and MEHRA (2005) were among the first to conduct research on the subject. Mork's works served as inspiration. In terms of oil price increases, their article reported empirical evidence indicating that oil prices shocks have a negative impact on consumption. Furthermore, they discovered that oil price increases that occur after a period of price stability matter more than oil price increases that reverse earlier declines, and that oil price increases that occur after a period of price stability matter more than oil price increases that occur before a period of price stability. BROADSTOCK and ZHANG (2014) used a similar method to Mehra and Petersen to study several Asian economies and discovered empirical evidence indicating the existence of a nonlinear asymmetric correlation between oil prices and consumption. WANG (2013) arrived at this conclusion while researching the OECD's top economies. However, in contrast to previous authors, he examined this relationship using a logistic smooth transition model.

The dissertation will focus on investigating the correlation between oil prices and household final consumption expenditure in both net oil exporting and net oil importing countries between 2008 and 2019.

Hypothesis 4: There is a negative linear relationship between oil price and CO2 emission in oil exporting, OPEC and major EU countries.

Transport accounts for more than one-fifth of global anthropogenic CO2 emissions and more than a quarter of total emissions. Many researchers have concluded that higher fuel prices or trip costs can reduce fuel consumption and thus CO_2 emissions via a variety of transmission mechanisms (HAN and HAYASHI, 2008; LI, et al. 2011; LINDSEY, et al. 2011; MILES et al. 1992).

According to ACAR (2017), the abundance (and dependence) on oil resources contributes significantly to sustainability challenges in oil resource abundant (and dependent) economies. It is surprising, however, that few existing studies have considered the causal influence of crude oil price on energy consumption and CO_2 emissions in oil-resource-rich economies where oil export receipts are a critical source of fiscal spending that generates economic activity BJERKHOLT and NICULESCU (2004); VILLAFUERTE et al.(2009).

Air pollution can be the result of our production and consumption pattern. In the case there is an increase in oil prices, it may lead to a reduction in energy consumption resulting carbon dioxide emission decrease.

The dissertation will focus on investigating the correlation between oil prices and CO_2 emission in both net oil exporting and net oil importing countries between 2008 and 2019.

Hypothesis 5/A/: There is a positive linear relationship between oil prices and the GDP growth of oil exporting and OPEC countries.

Hypothesis 5/B/: There is a negative linear relationship between oil prices and the GDP growth of major EU countries

In general, reduced oil prices are caused by an increased supply of oil, and will positively affect the development of global economy. However, these impacts differ for each country depending on whether they are *net importers* or *net exporters* of oil. Most countries belong to net importers.

The relationship between oil prices and GDP can be explained by the supply-side effect. According to this theory, rising oil prices refer to reduced availability of a basic input to production, which leads to a reduction of potential output BARRO (1984); BROWN-YÜCEL (1999); ABEL-BERNANKE (2001). This way, an increase in production cost results in slowing down output and productivity. According to BROWN-YÜCEL (2002) and HAMILTON (2005) oil price increases negatively affect output while this impact weakens in time, especially since the late 1990's. One of the possible answers can be the two major global oil shocks despite of which GDP growth and inflation remained quite stable in the majority of developed countries. BLANCHARD-GALI (2007) concluded that the effects of oil price increases are similar in different periods but often coincided with large shocks, large commodity price increases in the 1970's, and higher productivity as well as a greater world demand for oil in the 2000's.

According to one of my hypotheses in oil-importing countries falling oil prices have a positive impact on GDP growth. Consumption increases while production and transportation costs decrease, resulting in higher profits, investments and new recruitments. In the net exporters like Saudi Arabia or Russia, GDP growth is dampening as export revenues are falling. Producing and exporting more can compensate for the reduced prices not to lose much export revenue. Oil-exporters tend to depend on oil price to a greater extent than oil importers. Oil-exporting countries should take these negative impacts into consideration.

The dissertation will focus on investigating the correlation between oil prices and GDP growth in both net oil exporting and net oil importing countries between 2008 and 2019.

3. LITERATURE OVERVIEW

3.1. The formation an history of petroleum

There are clashes of opinions of scientists as far as the formation of petroleum is concerned. The theories emerged can be divided into two categories: the abiogenic and the biogenic theory KENNEY et al, (2001), (2002). According to the abiogenic theory, inorganic substances served as the source material. Although these explanations can be traced down as far as the 1860's, more recent researches tend to be in favour of the nonorganic origin (GOLD-SOTER (1980), (1982), (1986); GOLD (1984), (1985); OSBORNE (1986); LEMLEY (2006).

The theory of abiogenic petroleum origin suggests that carbon exist naturally in large amounts on the Earth, some of which take the form of hydrocarbons. Hydrogen atoms and carbon atoms, which are to form hydrocarbon molecules, make up petroleum. Every section of the above-mentioned hydrocarbons is supposed to be a chain link. When only a few hydrocarbons are grouped together, a very light petroleum product, such as methane and propane gases, is formed. In the opposite case, dozens of hydrocarbon links form heavier materials such as lubricating or heavy fuel oil. In contrast with aqueous pore fluids, hydrocarbons are less dense, and move upward in deep fracture networks. The biomarkers found in petroleum are partly caused by thermophilic, rock-dwelling microbial life formations. However, still not many things are disclosed about their role in the formation, alteration, or contamination of the various hydrocarbon deposits. According to thermodynamic calculations and various experiments n-alkanes do not spontaneously evolve from methane at pressures which are typically found in sedimentary basins, so the theory of an abiogenic origin of hydrocarbons suggests deep generation below 200 km under surface (SPEIGHT 2014). One of the most interesting proofs suggested to support the theory is the recently observed existence of the natural gas methane in Titan, a moon of the planet Saturn, where it could not have been formed through biological processes (GLASBY (2006). Abiogenic theory would change the fundamentals of future oil supply if it were true.
In this paper I will still consider the abiogenic oil hypothesis false, and regard crude oil as a fossil fuel whose exhaustion is a cause of concern.

In contrast with abiogenic theory a majority of geologists favour the biogenic theory of petroleum formation. The chemistry of the transformation of the organic material into petroleum is not clearly understood and contains considerable speculations. TISSOT-WEITE (1978); SNOWDON-POWELL (1982); BROOKS-WEITE (1984); SPEIGHT (2007) According to this theory oil is derived from the remains of marine flora and fauna which existed several million years ago. The bacterial decomposition of the plants and animals caused the majority of the oxygen, nitrogen, phosphorus and sulphur to leave the matter by leaving behind a sludge that is composed of carbon and hydrogen. As the oxygen was removed from the detritus, decomposition took place at a lower speed. With the passage of time the remains were covered by layers of sand and silt. As the depth of the sediment exceeded 3000 meters, pressure and heat changed the remaining compounds into the hydrocarbons and other organic compounds that form crude oil and natural gas HELMENSTINE (2017).

The kind of petroleum formed by the plankton layer especially depended on how much pressure and heat were applied. In the case of low temperatures a thick material, such as asphalt, was formed while higher temperatures resulted in a lighter petroleum. This process, termed as diagenesis, modifies the chemical composition into a waxy compound called kerogen first and then, with increased heat, into a liquid through a process called catagenesis CALIFET-OUDIN (1966); BARKER-WANG, (1988); SPEIGHT (2007). Ongoing heat could produce gas but if the temperature exceeds 260°C, the organic matter is destroyed and neither oil nor gas is produced HELMENSTINE (2017).

The compounds of the precursors affected the composition of petroleum to a great extent and the relative amounts of these precursors (depending on the local flora and fauna) that could be found in the source material resulted in another variable adding to the composition of the produced oil. This way, it is not surprising that the composition of crude oil composition is relative to the site (location) and age of the oil field. Additionally, variations can be traced down as the depth of the well changes. Even two adjacent wells can yield crude oil with totally different features, though SPEIGHT (2014).

Hydrocarbons are said to be the most important component of crude oil, but their composition can greatly differ even to 50%-97% depend on how it is extracted. The organic compounds such as nitrogen, oxygen, and sulphur typically make up about 6%-10% of crude oil while metals such as copper, nickel, and iron account for less than 1% of the total composition EDITORIAL DEPARTMENT OIL PRICE (2009).

Various biomarkers found in the samples of all the oil to date can present some arguments against the abiotic theory. One of the above-mentioned chemicals in crude oil is porphyrin which has been identified in a large number of sediments and crude oils to establish a wide distribution of the geochemical fossils TISSOT-WEITE (1978). Porphyrins are organic molecules similar to both chlorophyll in plants and haemoglobin in animal blood regarding their structure MCQUEEN (1986). They are classified as tetra pyrrole compounds and often contain metals such as nickel and vanadium TISSOT-WEITE (1978). Porphyrins are readily destroyed by oxidizing conditions (oxygen) and by heat RUSSEL (1960). Hence, geologists reckon that the porphyrins found in crude oils can serve as a proof that the petroleum source rocks were deposited under reducing conditions. The origin of petroleum is linked with an anaerobic, reducing environment. The presence of porphyrins in some petroleum means that anaerobic conditions developed early in the life of such petroleum, for chlorophyll derivatives, such as porphyrins, are easily oxidized and decomposed under aerobic conditions LEVORSEN (1967).

Based on the view of geologists and petroleum engineers outlined above this evidence provides irrefutable proof that the oil and gas accumulations found to date are of a biologic origin.

The word *petroleum* derives from the Latin word *petra* and *oleum* literally meaning *rock oil.* The term also refers to hydrocarbons that can be found in large amounts in the sedimentary rocks in the shape of gases, liquids, semisolids, or solids. From the point of view of chemistry petroleum is a complex mixture of hydrocarbon compounds, usually with minor amounts of nitrogen-, oxygen-, and sulphur-containing compounds, as well as varying amounts of metal-containing compounds SPEIGHT (2007). Petroleum technology has crucial importance until other alternative forms of energy are securely available BOYLE (1996); RAMAGE (1997). The use of petroleum has a long history that goes back many thousand years in time HENRY (1873); ABRAHAM (1945); FORBES (1958a), (1958b); JAMES-THORPE (1994); KRISHNAN-RAJAGOPAL (2003). However, the use of petroleum and the development of related technology is not as modern as one would believe although the petroleum industry is basically a 20th century industry. In order to understand the evolution of the industry, it is imperative to have a short and complex understanding of the first uses of petroleum SPEIGHT (2014).

The first evidence for oil product usage was from 70,000 years ago. Natural bitumen has been found on stone tools from Neanderthal sites in Syria BOEDA et al (2008).

The Tigris-Euphrates valley, which is now situated in Iraq, has been inhabited since 4000 BC by the Sumerians whom one of the first civilised cultures is due to. As their culture became more developed, bitumen or asphalt was often made use of either in construction or as ornaments THOMPSON (1936); MOOREY (1994); SPEIGHT (2014).

Ancient Persian tablets suggest that petroleum was used for medical and lighting purposes mostly by the higher levels of society. In ancient Egypt bitumen was essential for mummies. It is rarely known that the word 'mummy' is derived from the Arab word mūmiyyah, which means bitumen. However, according to CLARK et al (2016) no balms created prior to the New Kingdom contained bitumen as the custom could rather have been introduced in the Third Intermediate (ca 1064-525 BC) and Late (ca 525-332 BC) periods and became a frequently used practice after 332, during the Ptolemaic and Roman periods. With the help of ancient words one can trace down the use of petroleum and its derivatives even in ancient texts. The preparation of petroleum derivatives called for expertise as alchemy (early chemistry) was thought to cover four sub-routines: dissolving, melting, combining, and distilling COBB-GOLDWHITE (1995).

The earliest known drilled oil wells were found in East Asia (China) dating back to 347 CE or earlier TOTTEN (2007).

References to petroleum and its derivatives were even made in the Holy Bible but it is important to note, however, that h by the time the books of the Bible had been written, petroleum and bitumen as well as their derivatives were widely used and traded SPEIGHT (2014).

Bitumen reached Europe during the Middle Ages (BAUER, (1546), (1556).We can also find the detailed description of the properties of bituminous products. After thorough further investigations the sources and use of this material was understood and consequently, modern petroleum industry was born SPEIGHT (2014).

There are several other references of petroleum usage up to the beginning of the modern petroleum industry COOK-DESPARD (1927); MALLOWAN- ROSE (1935); NELLENSTEYN- BRAND (1936); MALLOWAN (1954); FORBES (1958a), (1958b), (1959), (1964); MARSCHNER *et al* (1978). In 1849 Abraham Gesner from Canada, the "father of the petroleum industry", distilled kerosene from cannel coal and bituminous shale. Kerosene is easy to produce in addition to the fact that it is cheaper and smells better than animal-based fuels when burnt. Kerosene substituted for whale oil and, as a result, a new market for crude oil was opened up. In 1857 Michael Dietz invented a clean-burning lamp that was especially designed for the new fuel oil, kerosene. The roots of modern petroleum industry go back to the late 1850s when it was discovered in 1857 and commercialized in Pennsylvania in 1859 BELL (1945). Drilling for oil for commercial use did not occur till Edwin L. Drake opened the first oil well in the United States. Before his first drilled well in Titusville it was common practice for people to gather oil around "seeps" for centuries. However, the new way of collecting oil posed new challenges, e.g. even the most productive areas failed to produce large amounts of oil. In the 1850s new machinery raised the demand for oil for lubrication but the main petroleum sources such as whaling and collecting oil from seeps could not keep pace with rising demand. It was necessary to find a way to extract the oil from the ground MCNAMARA (2017). The Drake Well is 21 meter tall located on the edge of the town of Titusville. Oil is shipped in 42-gallon barrels. Drake Well marks the beginnings of an international search for petroleum TOTTEN (2007). The modern era of refineries started in 1862 when the first commercial unit for petroleum distillation appeared SPEIGHT, (2007).

The two-cycle spark ignition engine was invented by Karl Benz in Germany in 1878 followed by the four-cycle engine. Years later in 1886 Benz patented the first "carriage with a gasoline engine."

Prior to that time, gasoline was considered as an unwanted composition of petroleum having caused a lot of house fires as it tended to explode in kerosene lamps.

Soon afterwards, oil stood for t other fuels in transport. The automobile industry was given an impetus at the end of the 19th century and oil was used as fuel. . Gasoline engines were necessary for airplanes. Ships operated by oil could go twice as fast as their coal powered counterparts. However, it was not until after World War II that welding techniques, pipe rolling and metallurgical advances made it possible to produce reliable long distance pipelines, which resulted in a natural gas industry boom. At the same time, the petrochemical industry and its newly developed plastic materials resulted in increasing production. As the price of crude oil increased, access to oil sources has become economically viable DEVOLD (2009).

To sum up, we can state that petroleum and related materials have been in use for nearly 6,000 years. With the passage of time the use of petroleum has developed from the relatively simple use of asphalt to contemporary complex refining techniques with a wide range of products and petrochemicals SPEIGHT (2007).

3.2. The significance of OPEC

OPEC stands for Organization of the Petroleum Exporting Countries. It was established in Baghdad, Iraq, when five countries (the Islamic Republic of Iran, Iraq, Kuwait, Saudi Arabia and Venezuela) signed an agreement in September 1960. These five countries are termed as Founder Members of the Organization. Afterwards, OPEC was accessed by Qatar (1961), Indonesia (1962), Libya (1962), the United Arab Emirates (1967), Algeria (1969), Nigeria (1971), Ecuador (1973), Gabon (1975), Angola (2007) and Equatorial Guinea (2017). Ecuador suspended membership in OPEC in December 1992 but later in October 2007 it became a member again. Indonesia withdrew from OPEC in January 2009 but some years later membership was reactivated in January 2016, but finally it suspended its membership at the 171st Meeting of the OPEC Conference in November 2016. Gabon terminated membership in January 1995 but joined again in July 2016. To date, OPEC has 14 members but it is interesting to note, however, that some of the biggest oil producing countries such as Canada, China, Mexico, Norway, Russia, and the United States are not members of OPEC. Republic of Congo joined OPEC in 2018 and Qatar left OPEC in January, 2019. Ecuador also left OPEC on 1 January 2020. Another oddity is that although not a single European nation is an OPEC member, the headquarters of the organisation are seated in Vienna, Austria.

OPEC was established with the purpose of co-ordinating and unifying petroleum policies within the member countries to set fair and stable prices for petroleum producers as well as ensuring an efficient, economic and regular supply of petroleum and a fair return on capital for the investors of the industry.

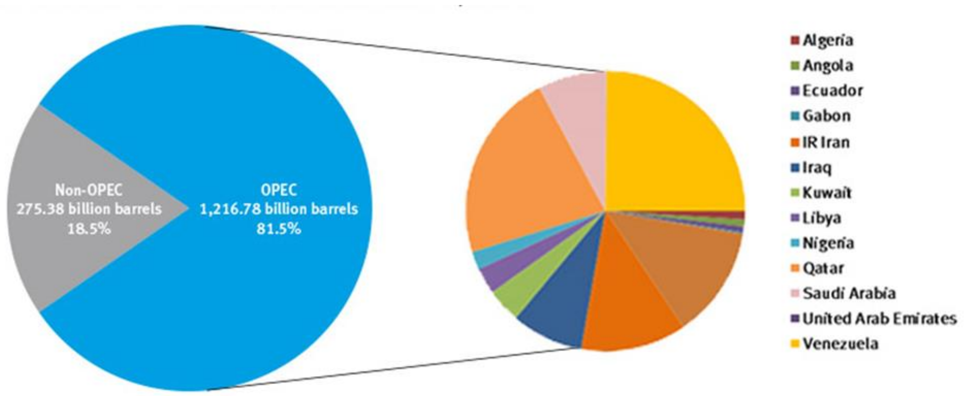
OPEC was established when the international politics and economy went through a transitionary period and new states were born in the developing world. The global oil market was governed by the "Seven Sisters"[1], i.e. the multinational companies listed in the footnote. It became independent of the former Soviet Union and in contrast with centrally planned economies the market of oil was regulated by the laws of the free market economy. OPEC drafted its objectives with the institutional system first in Geneva and then, in 1965, in Vienna. It also adopted a statement on

[1] 1.Anglo-Iranian Oil Company (now BP),.Gulf Oil (later part of Chevron),Royal Dutch Shell, Standard Oil Company of California (SoCal, now Chevron), Standard Oil Company of New Jersey (Esso, later Exxon), Standard Oil Company of New York (Socony, later Mobil, now part of ExxonMobil), Texaco (later merged into Chevron)

petroleum policy for its member states in 1968, which provided them with the inalienable right of sovereignty over their national natural resources.

OPEC stepped onto the international stage in the 1970’s due to the fact that the member countries were given the right to control their domestic petroleum industries and thus, they could play a great role in setting the price of crude oil on the global markets. However, it did happen twice that oil prices increased e dramatically in a volatile market, which was attributed to the Arab oil embargo posed in 1973 as well as the outbreak of the revolution in Iran the early 1980’s prices started to soar before their decline of 1986 in response to a big oil glut and the fact that consumers tended to abandon the use of hydrocarbon. OPEC’s share of the contracting started a dramatic decline and the total petroleum revenue fell to one-third of its former one, which resulted economic difficulties for many member countries of the organisation. Oil prices fluctuated heavily by the end of the decade but they could still reach half of their former levels Nevertheless, OPEC’s share of the global output started to recover. Consequently, OPEC introduced group production ceiling for its member states and also a Reference Basket for pricing, which are considered to be the collateral for market stability and reasonably set prices. In the 1990’s prices levelled off and remained relatively stable as of the 1970’s and 1980’s. However, volatility and price weakness dominated the market, and due to the South-East Asian economic downturn and the mild Northern Hemisphere winter of 1998–99 prices fell back to their 1986 levels. This downturn was followed by recovery in line with globalisation and ICT revolution. The OPEC oil price assisted in consolidating and stabilising crude prices at the beginning of the 2000’s. However, in 2004 several market factors and speculation caused prices to go up and crude oil market to become volatile. Prices reached a record high in mid-2008 before collapsing at the dawn of the economic crisis. OPEC started to play a prominent role in the oil sector to tackle the economic crisis. The globalisation in the economy posed a great risk to the oil market and uncertainties in the financial system also added to the economies. Social unrest in several parts of the Earth had an impact on supply and demand alike. However, the market remained stable with between 2011 and mid-2014 but afterwards, due to speculation and oversupply prices decreased in 2014. As far as trade patterns are concerned, demand was growing further in Asian countries and in contrast, shrinking in the OECD OPEC (2017).

Currently, 81.5% of the world's crude oil reserves are located in OPEC member countries, especially in the Middle East, with its 65.5% of the total (Figure 1). Recently, OPEC member states have significantly increased their oil reserves by adopting best practices, realizing explorations, recoveries and innovations. Consequently, OPEC's current oil reserves are estimated to be 1,216.78 billion barrels OPEC (2017).



OPEC proven crude oil reserves , at end 2016 *(billion barrels, OPEC share)*

Venezuela	302.25	24.8%	Kuwait	101.50	8.3%	Qatar	25.24	2.1%	Gabon	2.00	0.2%
Saudi Arabia	266.21	21.9%	United Arab Emirates	97.80	8.0%	Algeria	12.20	1.0%			
IR Iran	157.20	12.9%	Libya	48.36	4.0%	Angola	9.52	0.8%			
Iraq	148.77	12.2%	Nigeria	37.45	3.1%	Ecuador	8.27	0.7%			

Figure 1: OPEC share of world crude oil reserves, 2018
Source: OPEC ANNUAL STATISTICAL BULLETIN (2019)

3.3. The theory of oil prices

Resources can be divided into two categories: renewable and can be depleted such as petroleum. This affects its pricing strategies. However, it is also important to remark that the projections of running out of oil are based on geology and not price SPEIGHT (2014).

The economic theory on exhaustible resources is expanding such as the principle idea of HOTELLING (1931) has been explained and added by others, such as SOLOW and WAN (1976) on extraction costs, PINDYCK (1978) on exploration, and SLADE (1982) on technological progress.

HORSNELL and MABRO (1993), BACON and TORDO (2004), CAROLLO (2011) and AMADEO (2017) have also dealt with Hotelling's main idea. Market power has also been studied. A case in point is STIGLITZ (1976), SALANT (1976), and GILBERT (1978). KRAUTKRAEMER (1998), and more recently GAUDET (2007) summarised literature. The theory of market price bubbles has been examined by BRUNNERMEIER (2008) and HULL (2003). BORENSTEIN (2008) analysed the oil exchange in detail while HAMILTON (2008) and MITCHELL (2006) tried to find an explanation for the recent high prices on the market.

Oil and gas possess special features that differentiate them from other commodities. These characteristics include

- The high uncertainty of resource development and the specificity of investment from production to consumption,
- The features of a natural resource,
- The finiteness of the resource,
- The existence of two decision makers: the manufacturing company and the resource owner.
- Demand for energy is often inelastic, and

- Markets are imperfect if we take externalities into consideration.

Energy markets can best be described by

- Imperfect competition
- Externalities and
- Public goods

Lack of information may lead to price distortions, against which governments are introducing transparency measures. As energy is non-recyclable, the burning of fossil fuels results in a great amount of CO2 as a greenhouse gas. Energy supplies-especially electricity, oil and gas are classified as public goods whose internalisation is addressed by Pigouvian taxes. It is a tax normally levied on any t activity resulting in negative externalities, i.e. costs not internalized in the market price. The tax is to correct an inefficient market outcome, and set equal to the social cost of the negative externalities. When negative externalities exist, the social cost is not covered by the private cost of the activity. In such situation, the market outcome is not efficient and may cause the over-consumption of the product SANDMO (2008). The most widely used example of such an externality is environmental pollution BAUMOL (1972).

In general, crude oil prices are determined by the cost of finding and bringing oil reserves to market in the long term, and, in the short term, by the supply/demand 12 balance and the tightness of the market regarding its ability to supply crude and feedstock of different grades to meet product demand FATTOUH (2011).

Harold HOTELLING was the first to describe the evolution of pricing non-renewable resources. Hotelling defines the net price path as a function of time when economic rent is maximised with the extraction of a non-renewable natural resource. The maximum rent is also termed as Hotelling rent or scarcity rent that stands for the maximum rent if the stock resource is emptied. If a non-renewable resource is efficiently exploited, the change in net-price per unit of time (%) should be equal with the discount rate.

Hotelling rule can be expressed by the equilibrium situation which is termed as the optimal solution.

$$\frac{P'(t)}{P(t)} = \delta,$$

where $P(t)$ is the unit profit at time t and δ is the discount rate.

The economic rent or resource rent reflects a situation where the resource owner has open access to the resource for free.

To conclude, according to HOTELLING the price of a finite resource must rise at a rate equal to the discount rate As a consequence, all else equal, the price of crude oil must rise and continue to rise in the future. The price path following Hotelling’s theory is presented by Figure 2.

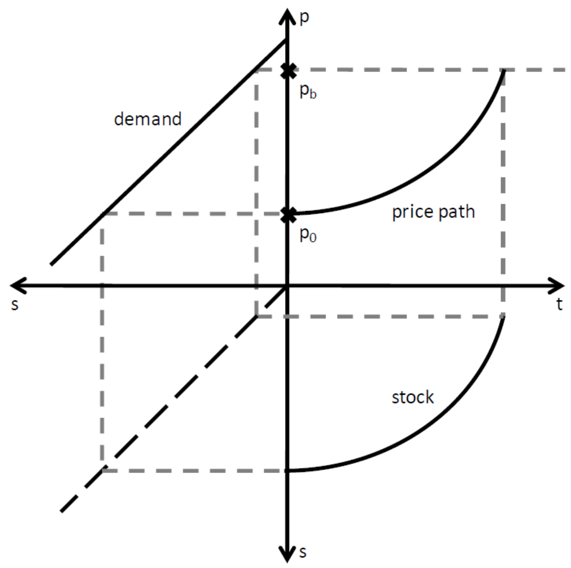


Figure 2: Hotelling's price
Source: HOTELLING (1998)

As time goes by, the resource is exploited, its stock decreases, and its price increases at a rate similar to the rate of interest till the backstop price pb is reached. The backstop price expresses the price of a substitute, i.e. the cost per energy unit of electric cars running on nuclear power. After the backstop price is reached, production stops as it ot economical to extract leftover resources anymore as the substitute is cheaper.

Figure 3 represents the price path in different cases. In the first figure we can see how a higher interest rate results in exhausting the stock of resources within a short time. The starting level for the price is lower as the backstop price would be reached "too soon".

The second figure details a case when a new discovery is made after production has already started. It modifies the price path on the total remaining stock and the interest rate. In this case extraction takes longer but more new discoveries would lead to a saw-like shape. New discoveries as well as technological progress may serve as an explanation why oil prices in real have not always been rising.

The third figure illustrates technological change that pushes costs downward and causes a U-shaped price path as SLADE (1982) suggests. The last case presents a price path of extraction with degradation costs. The price never reaches the backstop because the last units are getting more and more expensive to extract. Supply is so low that it causes consumption to shift to satisfy demand. If costs increase linearly, the price path will be concave. We have to add, though, that these situations are extreme simplifications but they serve as a good basis to analyse real life price paths.

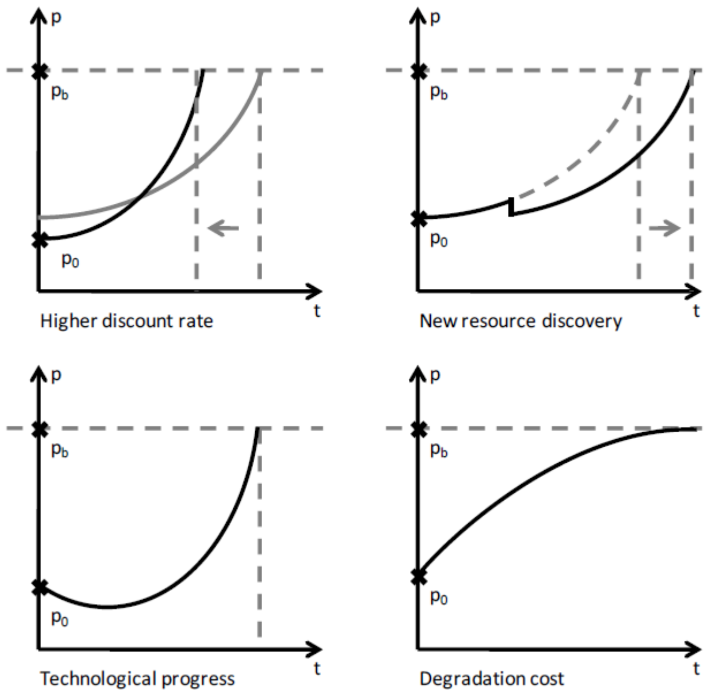


Figure 3: Hotelling's price in different cases
Source: HOTELLIN (1998)

As written above, Hotelling's assumptions are simplifications of the real world as perfect competition and fully known stocks are assumed. It is also assumed that the resource extracted is used completely with no waste and there are no externalities or market failures. Finally, the cost of extraction is thought to be constant and that there are no alternatives or substitutes for the resource.

Hotelling's model has later been extended by many others. According to KRAUTKRAEMER (1998) Hotelling's model does not follow empirical studies of non-renewable resource prices, as there has not been a persistent increase in prices over the last 125 years. He assumes that technological progress has played a greater role than finite availability in the pricing process of non-renewable resources. He also proved empirically that non-renewable resources generally have residuals from production, which must be calculated in the total price. KRAUTKRAEMER also examined the impacts of backstop technology on the price of non-renewable resources. As finite resources increase in price, other alternative resources, backstops, will become cheaper.

Recently, greater attention has been paid to the climate policy in the Hotelling model. KOLSTAD and TOMAN (2001) assume that crude oil prices should consider climate issues by taking into account increased greenhouse gas emissions that reduce welfare over time. Nevertheless, Hotelling's model has provided a deeper insight into how prices of non-renewable resources are formed.

3.4. The development of oil prices

As previously mentioned, the first commercial oil was extracted in 1859 in Titusville, Pennsylvania, at 49 cents/bbl nominal price first quoted in 1861. Figure 4 describes the changes in oil price between 1861 and 2016 by making use of 2016 inflation adjusted prices. In the 1860's the price of oil fluctuated when it peaked at s 120 USD/bbl. This high could be due to large-scale investments of oil producers. The high prices made new players come to the stage to have a share of prosperity (NORENG 2000). Nonetheless, in the 1870's prices gradually decreased to 20 USD/bbl presumably caused by oversupply. During the 1870's the oil price stabilised for nearly a century by averaging at 18 USD. Positive price movements were rare but if so, it could be attributed to shortage in oil supply. The first occurred in the severe winter of 1919-20, followed by the 1929 Wall Street crash, and the consumption boom in 1947. All this resulted in sharply falling supply behind the demand triggering an increase in the oil price MITCHELL et al (2001).

In general, demand for oil increased after World War II but after 1947 prices levelled off for the next 25 years at 14 USD/bbl. The reason for stable prices was the constant increase in the supply as production doubled after WWII. After WWII several economic and political events changed the global market for crude oil. First, the Organisation of Petroleum Exporting Countries (OPEC) was established in the 1960's resulting in a power union providing more than half of global oil reserves. In 1971, The Texas Railroad Commission lifted the output limits of the U.S. oil producers as U.S. producers had no more spare capacity and tool of imposing upper limit on the prices. This marked a remarkable r shift in controlling oil prices from the U.S. to OPEC (WTRG ECONOMICS 2011).

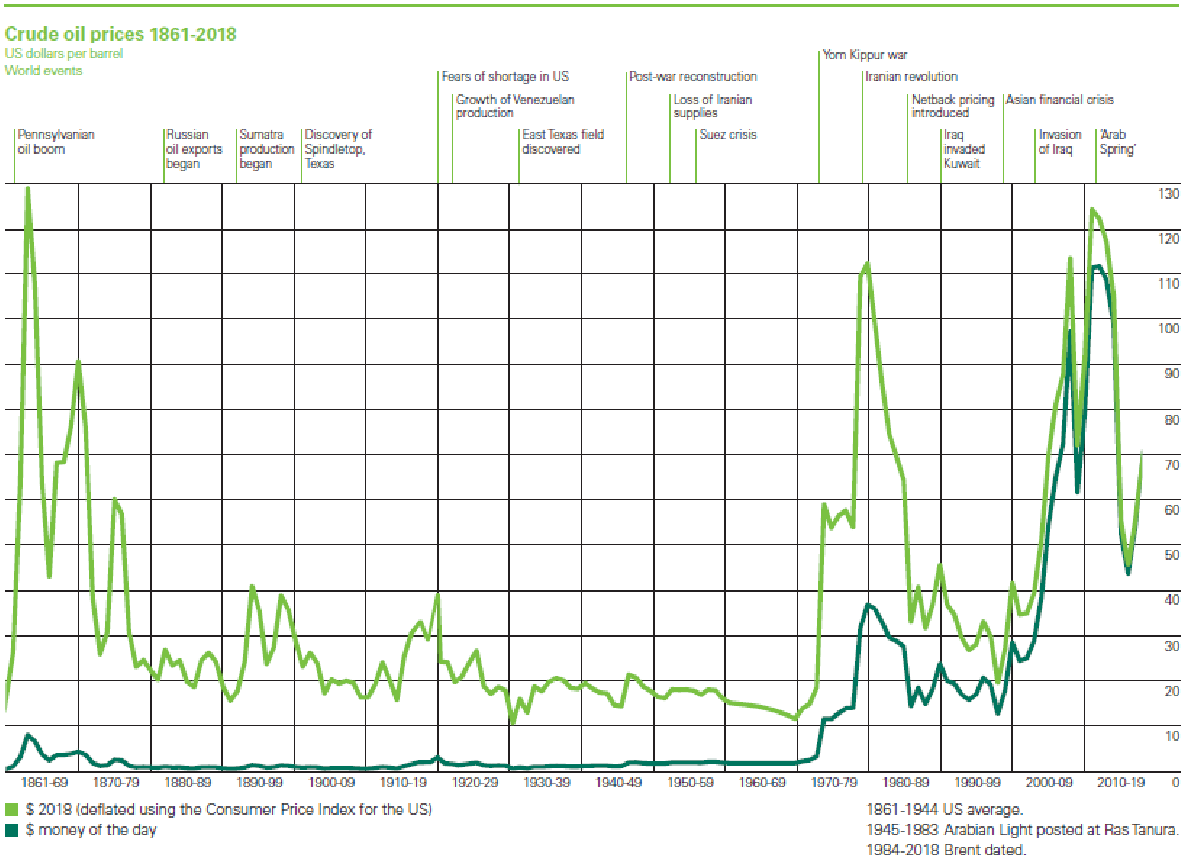


Figure 4: Crude oil prices, 1861-2018
Source: BP STATISTICAL REVIEW (2019)

The first major oil crisis took place in 1973/4, when the price of a barrel increased from 15.48 USD/bbl in 1973 to 48.92 USD/bbl in 1974, which marks an increase of four times. This crisis resulted from an embargo by OPEC on the western countries for their support of Israel in the Yom Kipur War. During that period the oil supply decreased by 4 million barrels per day (MMBPD), which amounted to seven percent of global production at the time. In 1974, OPEC stopped the embargo against the United States, but it still existed on the Netherlands, Portugal, South Africa and Rhodesia for some months.

The aggregated effect of the Arab embargo on oil prices was profound as the price was never able to reach the pre-embargo level again. It also showed the world the power of OPEC in influencing oil prices. Several projects and funds were initiated to tackle the post crisis situation such as "Project Independence" by the U.S. government with the objective of making the U.S. self-sufficient in energy. Another example includes the "Oil Facility" fund set up by the International Monetary Fund (IMF) that provided loans to nations affected by the crisis.

The International Energy Agency (IEA) was founded by the Organisation for Economic Co-operation and Development (OECD) in 1974 to prevent disruptions in oil supply and also disclose information for statistical purposes on international oil market and other energy sectors. The U.S. government also imposed price controls on domestically produced oil to minimise the effects of high 1973/4 oil prices. Consequently, U.S. oil consumers received much cheaper oil than the rest of the world while the producers could not get the world market price. The price controls were efficient in moderating the U.S. recession in the short term but also they had some long-term impacts on future capacities. It is assumed that the high prices would have led to lower consumption and the development of more fuel-efficient cars and heating devices.

The second major oil crisis occurred in January 1979 when world oil price soared (to 93 USD/bbl). The increase was attributed to a dramatic fall in oil supply as a result of a political unrest between Iran and Iraq. The 1979 Iranian revolution incurred a loss of 2.5 MMBPD. As a consequence of the Iraqi invasion the production of both countries was dramatically diminished by 6.5 MMBPD and also global production dropped by ten percent as of the previous year. The second oil crisis had a very devastating impact on international economy. The price of a barrel increased by 211 percent from 1978 to 1980 from which OPEC members, other than Iran and Iraq, benefitted.

This marked the beginning of deregulating oil prices in the US and also price controls were abandoned. Gas rationing was imposed in certain states and energy saving became a major public issue. Other energy sources such as solar and gas power came into the centre of attention. The European reaction also was energy saving and better isolation was used for homes. As far as car manufacturers both in Europe and in the U.S. are concerned, they were committed to manufacturing more fuel-efficient cars. Non--OPEC producing countries began extraction in Alaska, Mexico and the North Sea. Between 1980 and 1986 the non-OPEC production was increased by 10 MMBPD (EIA, 2007).

The 1979 Iran – Iraq crisis resulted in some serious issues. The production capacity of Iran has never recovered and the current production level still only reaches two thirds of the former, pre-revolution production. Iraq's production made a better recovery although it is still lagging 1.5 MMBPD behind its high prior to the war. The high oil prices reduced the demand for oil, which resulted in the oil prices going down. The price of a barrel of oil had dropped from 93 USD in 1980 to 27.33 USD in 1986. OPEC tried to impose low production quotas but prices plunged to 27 USD and stayed relatively stable during the 1980's EIA (2007).

As a consequence of a political unrest of the Iraqi invasion of Kuwait in 1990, oil prices went up again. Saddam Hussein's declaration of damaging oil fields also made prices instable. As Kuwait was to be liberated, oil prices steadily declined although for a short period of time. Due to the strong U.S economy and the booming Asian Pacific region prices increased again and global oil consumption increased by 6.2 MMBPD, where the Asian consumption accounted for 5.9 MMBPD. The decline of the Russian production also affected prices whose increase ended in 1997-1998 hit by the Asian economic crisis. At the same time, however, OPEC increased the production quota by 2.5 MMBPD (which marks a 10-percent increase) MITCHELL et al., (2001). Reduced Asian consumption and increased OPEC's production made prices plunge to 16.60 USD/bbl, the lowest price since 1973. In 1999 prices recovered to nearly 25 USD/bbl as OPEC drastically reduced production by 3MMBPD. Throughout 2000, the growing U.S and world economy made prices increase. However, this trend was interrupted by the increased production of Russia and the terrorist attack on the World Trade Centre on September 11, 2001. These events had their profound effect felt on oil prices, i. e. a 35-percent decrease in the spot price for WTI WTRG (2011).

In 2002 oil price stood at approximately 30 USD/bbl when OPEC decided to cut production quotas by 1.5 MMBPD in agreement with Russia and Mexico. In February, Iraq refused UN arms inspectors to return to Iraq, which, together with production cuts by OPEC and non-OPEC producers, put a pressure on the price. By mid-autumn prices went up again as the EIA. In mid-December the price of WTI on NYMEX was traded at approximately 32 USD/bbl, which was resulted from the general strike in Venezuela and the geopolitical situation in the Middle East EIA (2007).

–In 2002 prices reached record levels. First, the price went up to 32.5 USD/bbl in late December 2002 – early January 2003, and in 2004 price exceeded 40 USD/bbl standing at 57.90 USD/bbl in the early 2005. In August 2005 prices went over 60 USD, and then even exceed 75 USD in mid-2006. The price then went back to 60 USD/bbl by the beginning of 2007 before soaring again to as high as 99.29 USD/bbl by the end of that year. In the course of 2008 oil price was extremely volatile. In the first half the price peaked reaching its all-time high of 147.02 USD/bbl on July 11th. From there the price plummeted to below 70 USD/bbl by October 19th.

According to some experts the surge in oil prices prior to 2008 was partly due to speculation in the futures markets (WALLACE 2008). However, although speculation can raise prices in the short term, in the long term it is market conditions that determine oil price. As the storage of oil is expensive, most speculators must sell their oil purchase within a few months.

The May 29, 2008 report of the U.S. Commodity Futures Trading Commission (CFTC) makes notice of "Multiple Energy Market Initiatives" launched with the United Kingdom Financial Services Authority and ICE Futures Europe with the objective of surveillance and providing information on futures contracts. Part 1 is "Expanded International Surveillance Information for Crude Oil Trading" CFTC (2008). This section received wide coverage in the financial press about the speculation on oil futures price manipulation (MUFSON 2008).

The Interagency Task Force interim report concluded that speculation had not made profound changes to oil prices, rather, it is fundamental supply and demand factors that serve with the best explanation for oil price increases. One of the reasons for price increases was the global economy's fast expansion for decades resulting in increasing demand for oil, while production grew sluggishly accompanied by production shortfalls. The report concluded that, as a result of the imbalance and low price elasticity, substantial price increases occurred as the market tried to make a balance between scarce supply and t growing demand. According to the report this imbalance would exist in the future, making a pressure on oil prices to go up.

In May, 2010 the oil price fell from $88 to $70 within two weeks owing to concerns over how European countries would curb their budget deficits. If the economy in Europe slowed down, there would be less demand for crude oil. Similarly, if the European crisis could spread to the American economy, demand would be further reduced LAZZARO (2010). The strong dollar and high inventories also contributed to the situation. Political events in Egypt, Libya, Yemen, and Bahrain caused oil prices to $95/barrel in February 2011 while a few days prior, oil prices on the NYMEX closed at $86. Oil prices reached their high at $103 on 24 February where oil production was affected by the political upheaval in Libya ROONEY (2011).

In December 2014, the price of both Brent and WTI reached their low at US$ 62.75 a barrel. Futures for West Texas Intermediate (WTI) for January slid to $58.80 a barrel on the New York

Mercantile Exchange (NYME). Despite of this, the global oil industry continued to produce massive amounts of oil and in 2012 it grew by 600,000 barrels every year till 2016. By 2012 Canadian oil production was also surging ALBERTA OIL (2012).

In June 2014 crude oil prices were reduced by about a third as U.S. production rose and China and Europe's demand for oil decreased. In spite of the global oversupply, in November 2014 in Vienna, Saudi Oil Minister Ali al-Naimi rejected the production cuts appeal of the poorer OPEC member states. Brent, plunged to US$71.25, a four-year low but Al-Naimi argued that the market would correct itself. OPEC had a "long-standing policy of defending prices" and was ready to let the Brent oil price fall to $60 LAWLER (2014). Although by the end of 2014, the demand for l oil consumption in the world continued to decline, the rapid oil output growth in 'light, tight' oil production in North Dakota and Texas rejuvenated economic growth in refining, petrochemical and transportation industries in the U.S., which destabilized international oil markets MOHR (2014).

In January 2016, WTI crude hit another eleven-year low by falling to 32.53 a barrel for the first time since 2009.

Brent crude sunk to $27.10 on January 20, the lowest since November 2003. Oil increased again before falling on January 25 with Brent crude at $30.86 and U.S. oil at $30.68, respectively. OPEC encouraged to decrease production, which, accompanied by interest rate increases, resulted in U.S. oil's making gains to finish January at $33.62.

On February 11, U.S. crude was at $26.21 after standing at $26.05, its lowest price since May 2003 JOHNSON (2016). The next day oil jumped 12.3 percent to $29.44, in one day since February 2009. OPEC was "ready to cooperate" on lower production RILEY (2016).

In January 2017 despite promises of lower output, no changes were seen. U.S. output was higher and China suffered from economic problems. Brent fell 3 percent to $55.45 and WTI to $52.37, respectively, marking a nearly 3 percent loss. From January to August WTI went up from $45 to $50 in 2017.

To combat the coronavirus pandemic, many governments began restricting travel and closing businesses in January 2020. Oil demand began to fall. Oil consumption averaged 94.4 million barrels per day (b/d) in the first quarter of 2020, a 5.6 million b/d decrease from the previous year EIA (2021).

3.5. Factors that affect crude oil price

Factors that affect crude oil prices is a subject of several studies. Now three groups of factors that have an impact on crude oil prices are detailed, which are most frequently referred to in literature. This classification is based on FAN - XU (2011) but these factors are analysed by many authors. According to FAN-XU (2011) the main drivers of crude oil price include

- Supply-demand, or the commodity attribute of crude oil
- Speculation, or the financial attribute of crude oil
- Extreme events, or the political attribute of crude oil.

The significance of these factors was changing over time. There are still debates on the specific input of each factor. For example, MASTERS (2008), CIFARELLI-PALADINO (2009) and some others regard that speculation played a crucial role in crude oil price development since 2000. HAMILTON (2008) states that price increases resulted from strong global demand and mere speculation cannot explain the rapid growth of oil prices. KAUFMANN (2011) analysed supply side changes.

Either way, a single factor can hardly explain price development and high volatility. The reasons are more complex and different factors are responsible for long-term trends and short-term price speculations. Now let us have a closer look at each of these factor groups.

Some experts state that it was the supply-demand relationship which served as the driver of oil volatility in the 20th century. After the Gulf War ended in 1991, prices stabilised for some time, at around 20$ per barrel. A small decline occurred in 1997-1999 after the Asian economic crisis but after the consolidation of the US economy from 9/11, prices started to skyrocket, which was also due to other factors like OPEC production cuts and a rise in demand. Global demand was steadily growing in both developed and developing countries. China showed a growth in oil demand of 15% in 2004. KAUFMANN (2011) points out that although the volume of production was not changing to a great extent, the price increase might still be caused by supply side fundamentals. Non-OPEC nations are often regarded as price takers in oil production while OPEC nations express some form of strategic behaviour so a sudden change in the market share of OPEC producers could generate a supply shock. KAUFMANN (2011) suggests that a similar thing could have happened in 2004when steady growth in non-OPEC production was compensated by growth in OPEC production.

3.5.1. Non-OPEC supply and OPEC supply

Oil production from non-OPEC countries like North America, regions of the former Soviet Union, and the North Sea make up approximately 60 percent of world oil production. Figure 5 reflects that there were slight increases in non-OPEC production between 2005 and 2008.

In contrast with OPEC oil production, non-OPEC producers make independent decisions on producing oil. In OPEC, production is realised by national oil companies (NOCs) while international or investor-owned oil companies (IOCs) carry out production activities in non-OPEC countries. While some NOCs operate similarly to IOCs, they might have other objectives such as employment, infrastructure, or revenue.

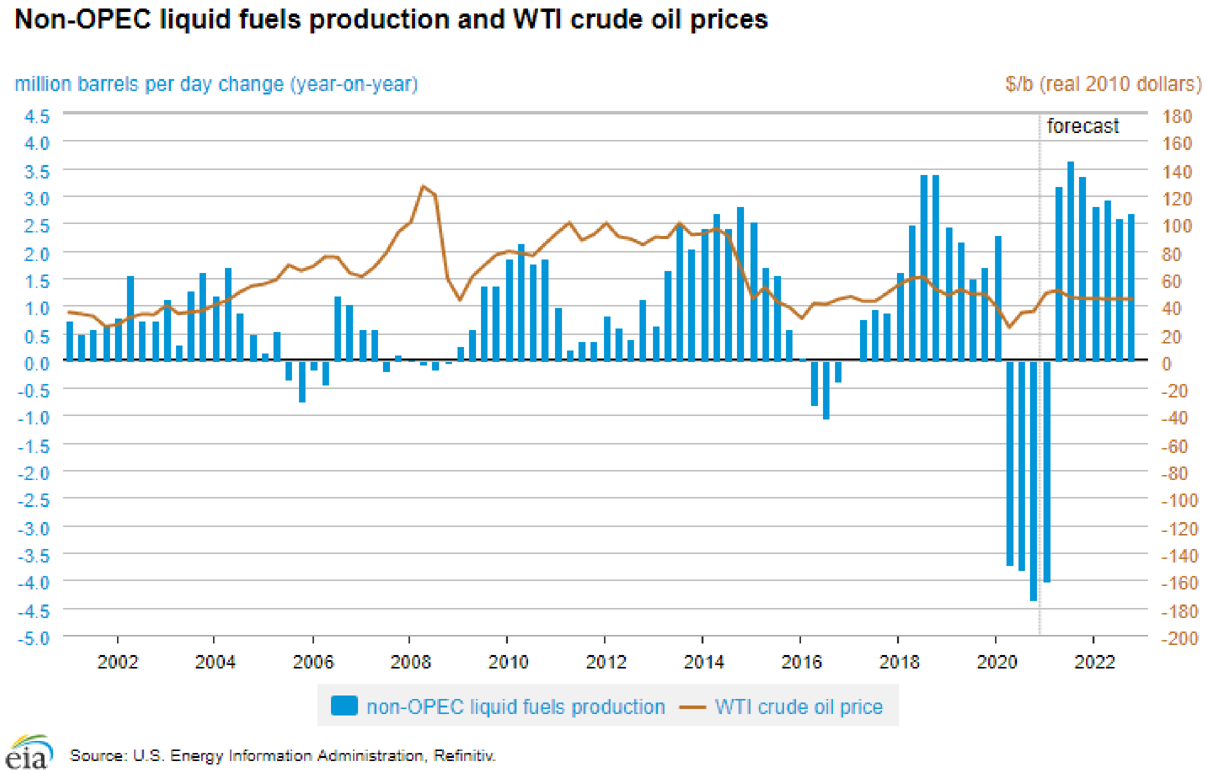


Figure 5: Non-OPEC liquid fuels production and WTI crude oil prices
Source: EIA (2021)

As was mentioned before producers in non-OPEC countries tend to be seen as price takers, i.e. they respond to market prices rather than influence prices by production. Consequently, non-OPEC producers produce at or near full capacity and spare capacity is little. Lower non-OPEC supply makes prices go up by decreasing total global supply and increasing the "call on OPEC." The greater the call, the more likely it is able to influence prices.

Figure 6 presents WTI price levels with global GDP growth rates (that indicate global oil demand growth) and changes in world capacity quarterly , defined as OPEC capacity as well as non-OPEC production (that indicates global oil supply growth). Between 2005 and 2008, there was a significant economic growth while oil production capacity even declined in some quarters. The market conditions put an upward pressure on oil prices.

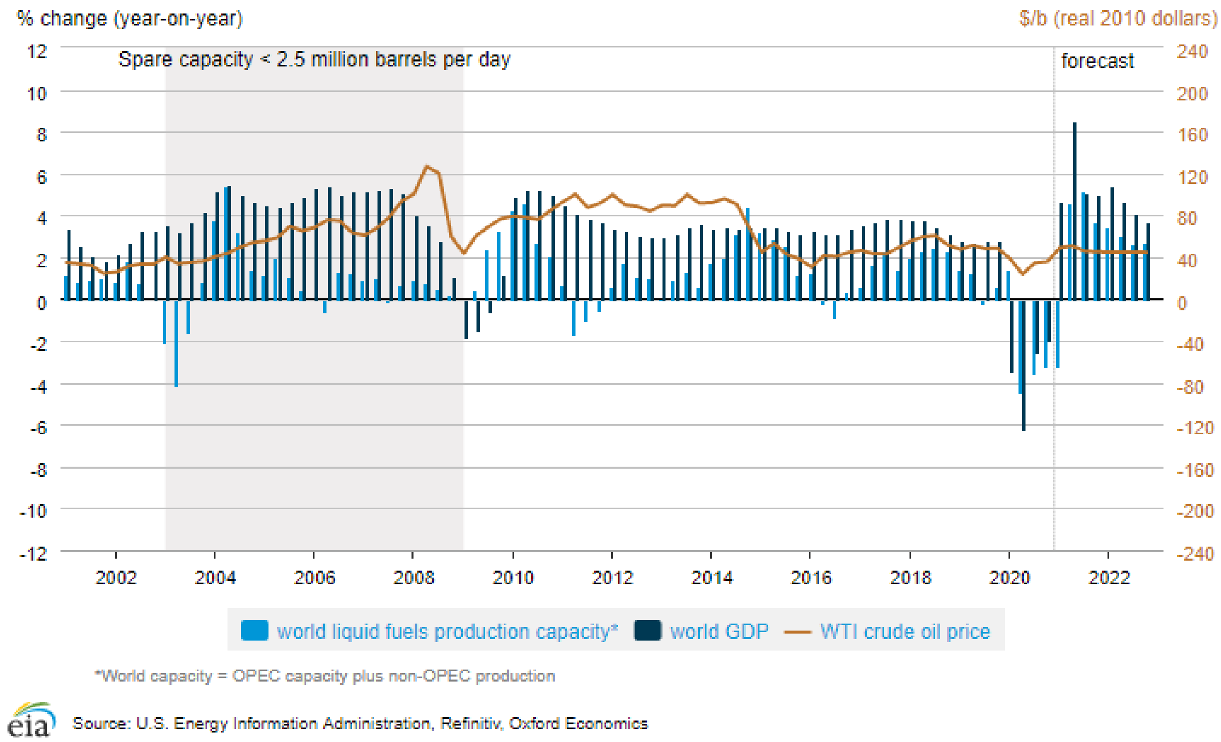


Figure 6: Changes in world liquid fuels production capacity and GDP, price of WTI crude oil
Source: EIA (2021)

Non-OPEC production is realised in areas with high finding and production costs while lower cost resources are situated in OPEC member countries. Non-OPEC producers have researched e.g. the deep-water offshore and looked for non-traditional sources such as oil sands. As a consequence, non-OPEC production incurs a cost disadvantage if compared to OPEC production.

Non-OPEC producers have taken a leading role in developing new production technology often of higher-cost supplies, but costs are reduced with the advances of technology, which can put a downward pressure on prices.

OPEC's crude oil production can significantly affect oil prices. The organization strives to manage oil production in its member countries as it sets production targets. Historically, crude oil prices increase in times when OPEC production targets are decreased.

OPEC member countries are responsible for approximately 40 percent of the world's crude oil and their exports represent about 60 percent of the total petroleum traded internationally. Due to its large market share OPEC can influence international oil prices. Saudi Arabia, OPEC's largest producer, has a great impact on oil prices. Figure 7 reflects how projected changes in Saudi Arabia crude oil production affects WTI crude oil prices.

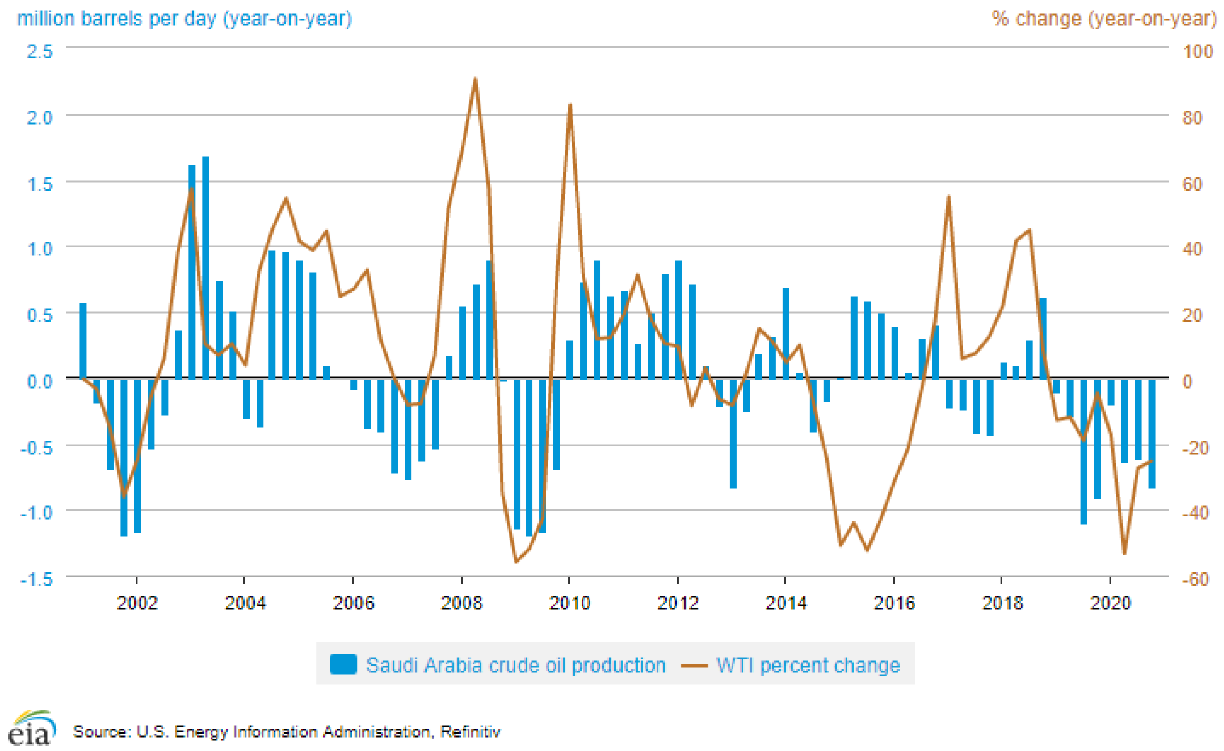


Figure 7: Changes in Saudi Arabia crude oil production can affect oil prices
Source: EIA (2021)

The extent of OPEC members' utilizing their production capacity often serves as an indicator of tight global oil markets, and how OPEC exerts an upward influence on prices. Spare capacity is the volume that can be brought on within 30 days and sustained for at least 90 days (EIA). Saudi Arabia, the largest oil producer and exporter, historically has had the greatest spare capacity of more than 1.5 - 2 million barrels per day on hand.

OPEC spare capacity (Figure 8) indicates world oil market's ability to respond to crises that would reduce supplies. From 2003 to 2008, OPEC's total spare capacity stood at near or below 2 million barrels per day (i.e. less than 3 percent of global supply), which allowed for very little cushion for fluctuations in supply while demand was rising rapidly. Moreover, markets are influenced by geopolitical events within and between OPEC countries. Events that entail potential losses of oil supplies can strongly influence oil prices.

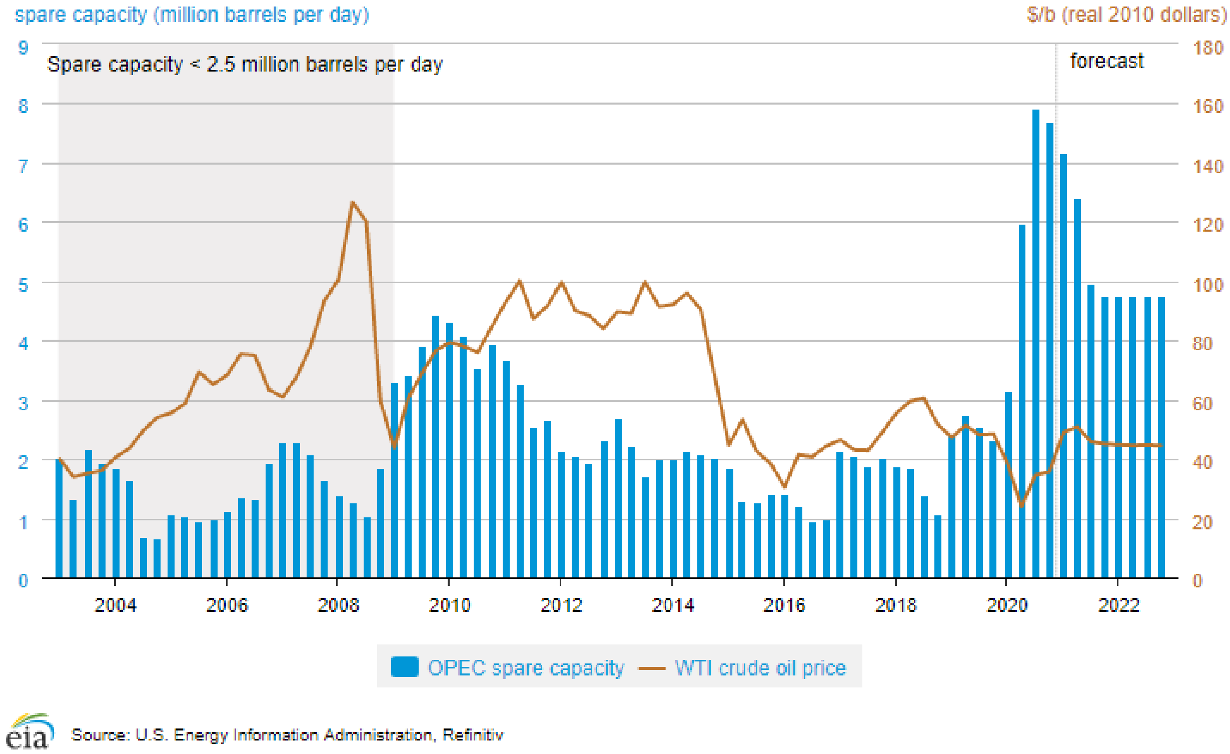


Figure 8: OPEC spare production
Source: EIA (2021)

3.5.2. Non-OECD demand and OECD demand

Oil consumption in non-OECD developing countries has grown dramatically in recent years. The oil consumption within the OECD countries declined between 2000 and 2010, while non-OECD oil consumption increased more than 40 percent. China, India, and Saudi Arabia presented the biggest growth in oil consumption among the non-OECD countries. Figure 9 presents a strong relationship between GDP growth rates and growth in oil consumption in non-OECD countries. Since 2001 non-OECD consumption went down only in the fourth quarter of 2008 and the first quarter of 2009. Increased demand pressure overtook any downward pressure on oil consumption as a consequence of higher prices.

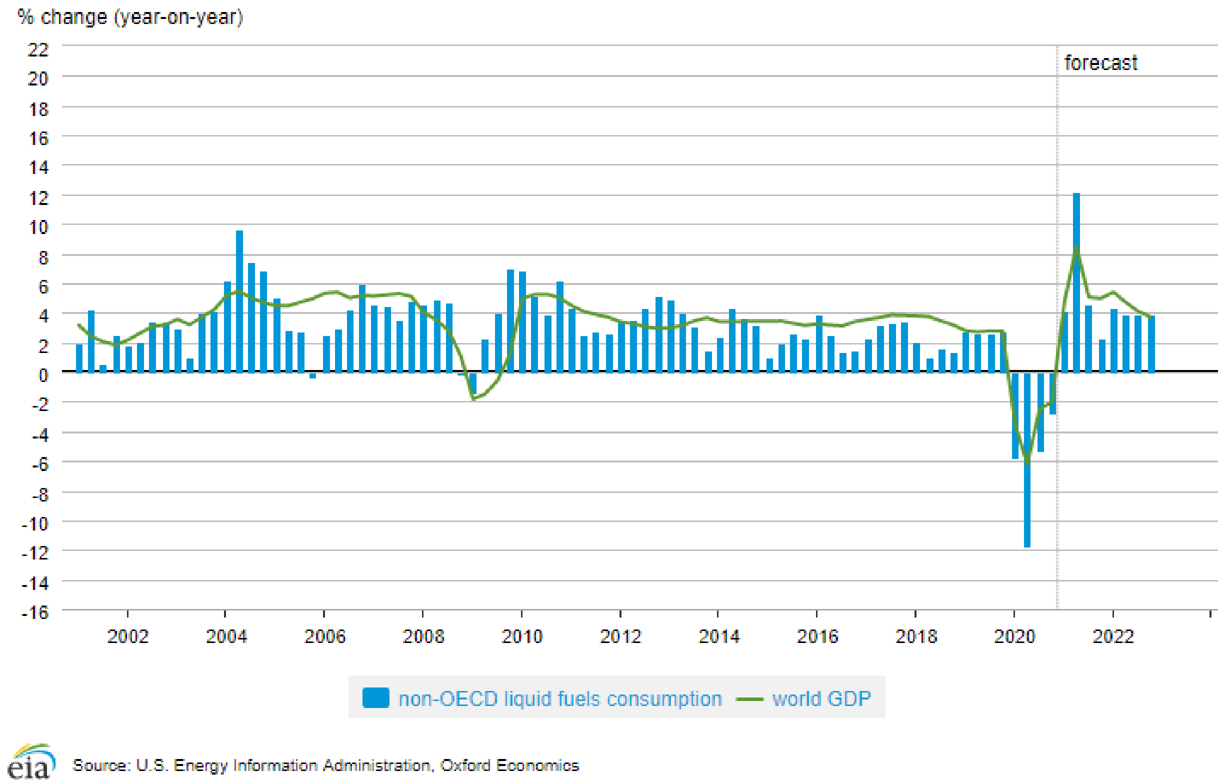


Figure 9: Economic growth and oil consumption
Source: EIA (2021)

Rising oil consumption results in rapid economic growth that can influence global oil demand and oil prices to a great extent. Transportation, in particular, requires large amounts of oil and related to economic conditions. Oil is also consumed as fuel or feedstock, and in some non-OECD countries, it is used for power generation. Consequently, oil prices tend to rise when economic activity and oil demand is growing strongly. The rapid population growth in non-OECD countries is an additional factor that supports oil consumption growth. Figure 10 illustrates WTI price levels with changes in world GDP growth rates (it indicates underlying oil demand growth) and world oil consumption. Rising oil prices prevented global oil consumption from growth between 2005 and 2008 despite the strong economic growth.

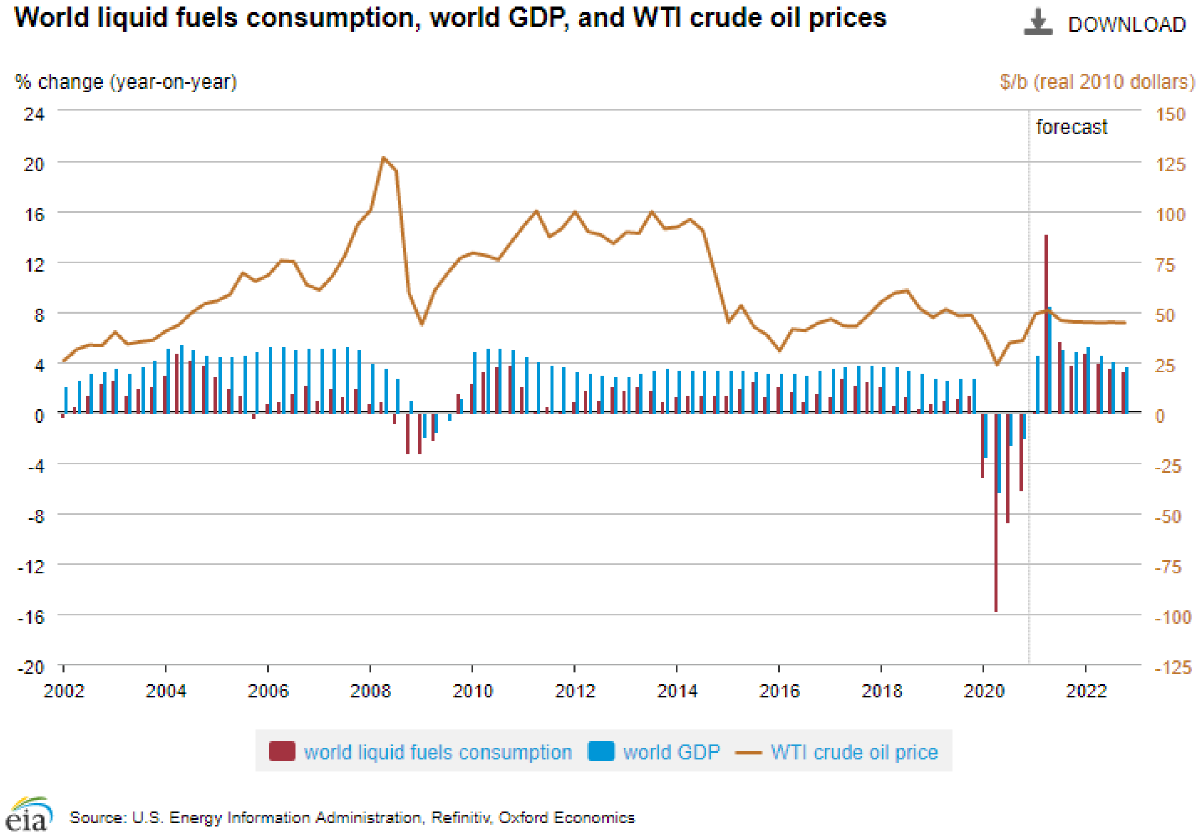


Figure 10: World liquid fuels consumption with GDP and oil prices
Source: EIA (2021)

Structural conditions also influence oil prices and economic growth. Developing countries tend to have stronger manufacturing industries, which are more energy intensive than service industries. Although transportation oil use is usually a smaller share of the total in non-OECD countries, this increases rapidly as expanding economies have an increased need to move goods and people. Vehicle ownership per capita is also highly resulting from rising incomes. China's strong economic growth made it become the largest energy consumer and the second largest oil consumer in the world.. According to EIA all the net increase in oil consumption in the next 25 years will derive from non-OECD countries.

In addition to economic activity, energy policies also affect oil use. Many developing countries, for example, control end-use prices, which prevents consumers from responding to price changes. This reduced demand response makes economic growth as a key driver of non-OECD demand more important.

The Organization of Economic Cooperation and Development (OECD) held 53 percent of world oil consumption in 2010. Oil consumption in the OECD fell between 2000 and 2010 whereas non-OECD consumption went up 40 percent during the same period. The impact of prices on OECD consumption has been more evident than for non-OECD countries due to the slower economic growth.

Structural conditions affect oil prices, economic growth and oil consumption. Developed countries normally have higher vehicle ownership per capita so oil use within the OECD transportation sector has a larger share of total oil consumption than in non-OECD countries. Economic conditions and policies on transportation have a significant impact on the total oil consumption of OECD countries which have higher fuel taxes and policies to improve new vehicles and encourage the use of biofuels. Furthermore, the economies in OECD countries have larger service sectors than manufacturing. As a result, the economic growth in these countries might not have the same effect on oil consumption as it would in non-OECD countries.

OECD countries have fewer subsidies on end-use prices so changes in prices are reflected in the prices faced by consumers. But, it is also a question of time for people to adjust their transportation and for the vehicles become more energy-efficient in response to price changes.

Changes in expected future oil prices can also have an effect on consumers' decisions on the modes of transportation and vehicle purchases. If prices are to be high or increase in the future, more consumers may decide to purchase more fuel efficient vehicles or, alternatively, use public transportation.

3.5.3. The equilibrium

Inventories serve as the balancing point between supply and demand. When production exceeds consumption, crude oil and petroleum can be stored. In contrast, when consumption exceeds current production, supplies can be drawn on inventories. As both supply and demand are uncertain, petroleum inventories often serve as a precaution. Figure 11 represents the price of the next (prompt) month's oil futures contract subtracted from the price of the oil futures contract 12 months ahead. This difference is compared to the change in OECD petroleum inventories. The more positive the spread between the near term and longer term contracts, the more likely it is to build inventories. If inventories decline, near term prices relative to prices further into the future will increase.

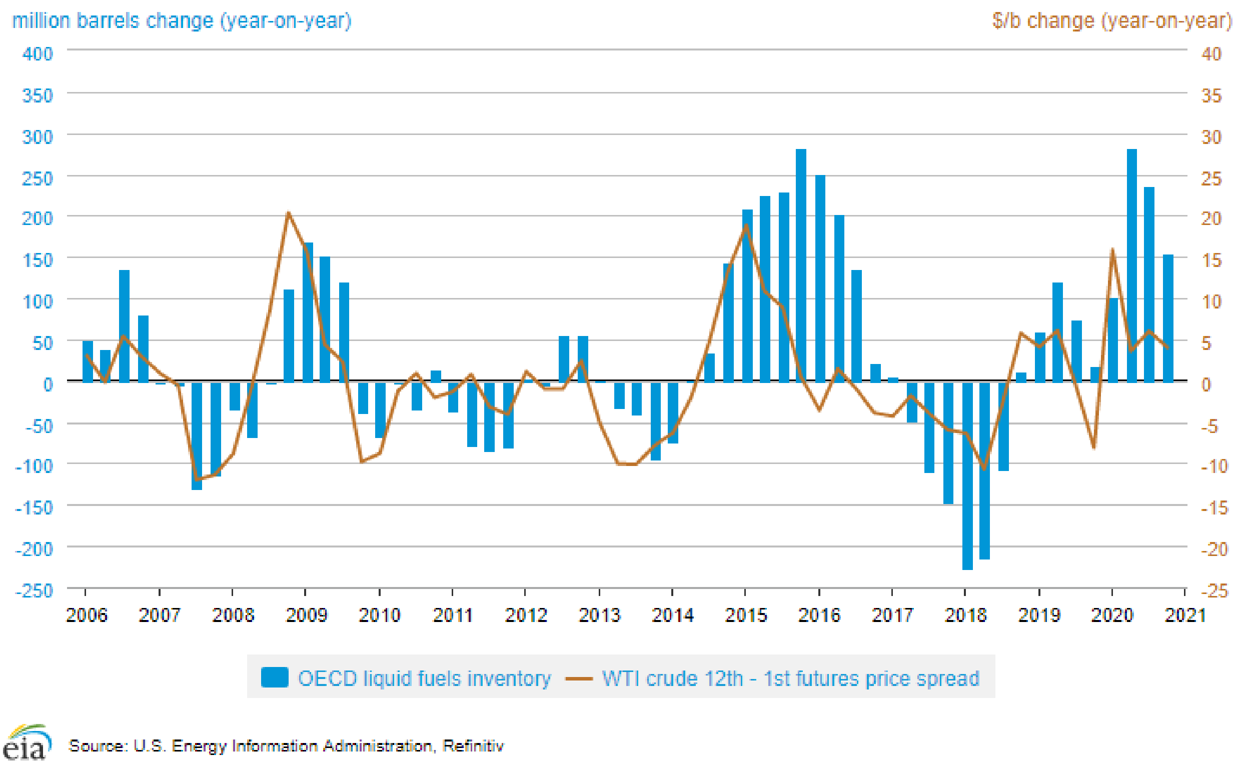


Figure 11: OECD liquid fuels inventories
Source: EIA (2021)

Refineries and other terminals can store crude oil and/or finished products (motor gasoline, heating oil, and diesel) to prepare for fluctuations, maintenance or unexpected weather. Some petroleum products like heating oil and gasoline have their inventories rise when consumption is lower and are down when consumption increases. That is why inventory levels can be very usefully assessed. Inventories are able to meet both current and future demand, so their level greatly depends on the relationship between current oil price and expected prices in the future. If chances are for a stronger future demand or a weaker future supply, prices for the futures contracts are likely to increase and inventory will pile up to meet the future balance. On the contrary, a large loss in current production or an unexpected rise in current consumption send spot prices as of futures prices upwards and inventory drawdowns are encouraged to satisfy the present demand.

Prices and inventories are strongly related. If futures prices increase compared to the current spot level, a larger amount of oil is expected to be stored and later on to be sold at the higher expected price. In the opposite case, , if an increase in crude oil storage is expected , it refers to the fact that current production surpasses current consumption at the current price. The balance between current and future prices as well as supply and demand by means of inventories reflects one of the most significant connections between financial market participants and trading companies interested in oil, who deal with futures trading.

The U.S. ENERGY INFORMATION ADMINISTRATION (2017) publishes crude oil statistics on inventories weekly, monthly, and annually. Industrialized OECD countries also publish their inventory statistics regularly. However, we have to note that the inventory data for other countries is available on a less timely basis or even not accessible at all. What is more, oil is often stored on ships at sea so we lack complete information on inventories which adds to the uncertainty of oil markets, and thus contributes to shaping oil prices.

Finally, the United States and several other countries also maintain some strategic oil reserves such as the U.S. Strategic Petroleum Reserve by the Department of Energy, with its more than 700 million barrels in case of a supply disruption. Members of the International Energy Agency also possess about 1.6 billion barrels of petroleum stocks in case of emergency.

At certain times the increase in oil prices may be so rapid and long-lasting that there are some additional factors involved by experts to explain these dramatic changes. Nowadays attention has gradually been shifted to the financial component of crude oil price.

3.5.4. Speculation

Market participants not only buy and sell oil at present but also trade for the future delivery so one of the roles of the futures markets is price projections. As a conclusion, these market players also play a great role in setting oil prices.

Oil market has several participants with different motivations. For instance, oil producers are greatly exposed to changes in oil and petroleum prices so they have the intention of hedging the risk by buying and selling energy derivatives so futures or options might be bought by transportation companies to prevent future fuel costs from rising above a certain level, while producers tend to sell futures to lock in their price for future output.

Banks and other financial managers-with no interest in trading physical oil-also try to make a profit from price changes. Recently investors have added energy and other commodities to equity and bond investments to diversify or offset inflation risks. Sometimes the desired "long" buyer and "short" seller positions of the oil market do not necessarily equal. Banks and other "non-commercial" investors provide liquidity to futures and derivative markets. However, there are concerns that non-commercial commodity trading and investment may "use up" liquidity and generate price movements. .

Activity in commodity exchange has been increasing in recent years. One of the measures of activity in futures markets is open interest, i.e. the number of contracts not settled or closed. Open interest on crude oil futures contracts rose to a great extent in the past decade. Both commercial participants (directly interested in physical oil production, consumption, or trade) and non-commercial investors (financial managers and funds interested in only trading contracts) have become more active in trading. In addition to futures contracts, another to invest in crude oil is options contracts. Options make possible an insurance-like instrument against negative commodity price movements.

Between 2003 and 2007 the average world growth rate of almost 5% (IMF) generated excess global liquidity and prosperity on financial markets. Derivatives and a great number of speculative funds were invested into crude oil futures. New players were attracted and took long positions on futures contracts to benefit from price fluctuations. The role of extrapolative expectations in oil price rise was analysed by MASTERS (2008) and confirmed by CIFARELLI-PALADINO (2009). Crude oil markets are evolving new features, as they are interconnected with other financial markets such as the exchange rate market, stock market and futures market FAN-XU (2011). Oil is traded in US dollars worldwide although BHAR-MALLIARIS (2011) argue that the depreciation of the US dollar is just one of the factors that can cause increasing oil prices.

FAN - XU (2011) describes a “Bubble accumulation" period from March 2004 to June 2008, when a significant number of global hedge funds started to pump money into the energy futures market, which formed commodity price bubbles, especially in oil futures market. Despite this still fragile balance, the supply and demand fundamentals are not considered to be important drivers that could influence crude oil price changes. KAUFMANN-ULLMAN (2009) also assumed that the oil market might have been subject to structural changes in September 2004.

As affected by the 2008 financial crisis and liquidity shortage worldwide, investors started to withdraw from oil futures markets, so the price of crude oil plummeted. At that time speculation stopped to be a driving force in crude oil prices and role of economic fundamentals was re-established.

The global financial crisis of 2008-2009 generated a dramatic increase in the connection between crude oil and other commodities due to the decreasing demand for raw materials. A growing number of investors invested in index funds-market instruments that granted them exposure to baskets of commodities. These index funds are made up by shares of various energy and other commodities to ensure diversification of commodities. Exchange traded funds (ETFs) can also be regarded popular with investors to gain exposure to commodities.

Nevertheless, the relationship between crude oil and other financial markets is rather complex as influences between crude oil price changes and values of other assets are still dubious. Another cause for concern is that these relationships and their strength fluctuate over time. There is a tendency of the prices of crude oil and other commodities to move together in recent years. The darker colours of Figure 12 denote higher correlations (co-movements) between the daily price changes of crude oil futures and other commodities futures for each quarter. It is an important observation that the historically strong correlation between oil and natural gas prices has recently stopped to move together in North America as natural gas prices have been pushed down by shale gas.

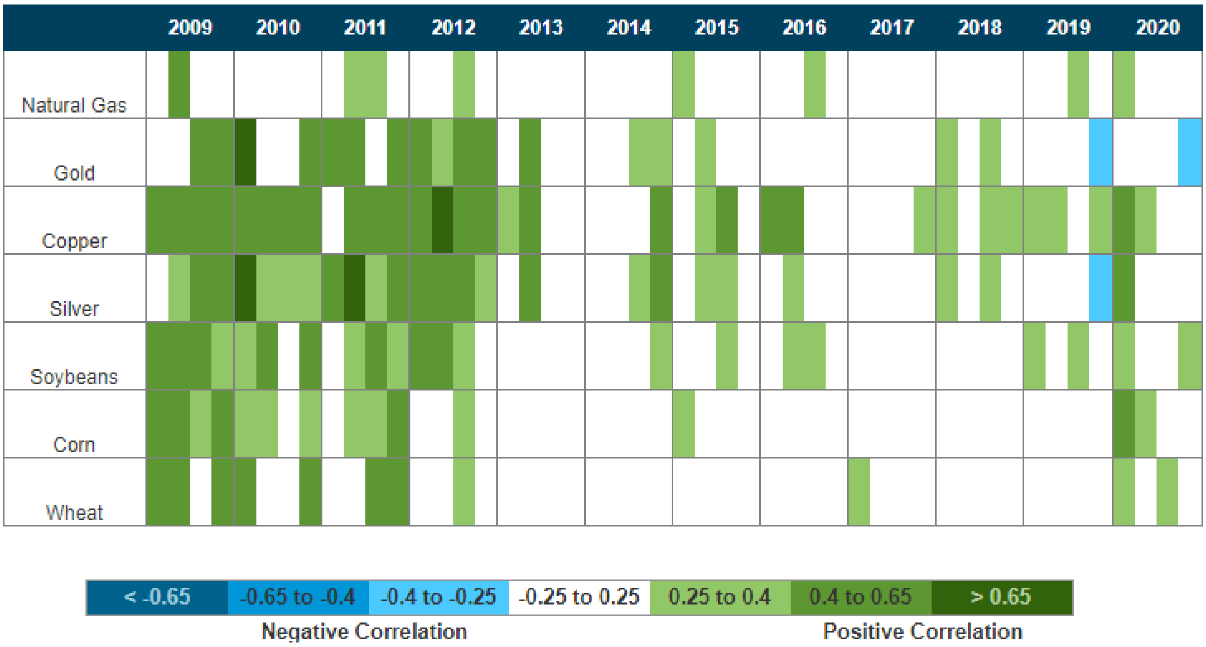
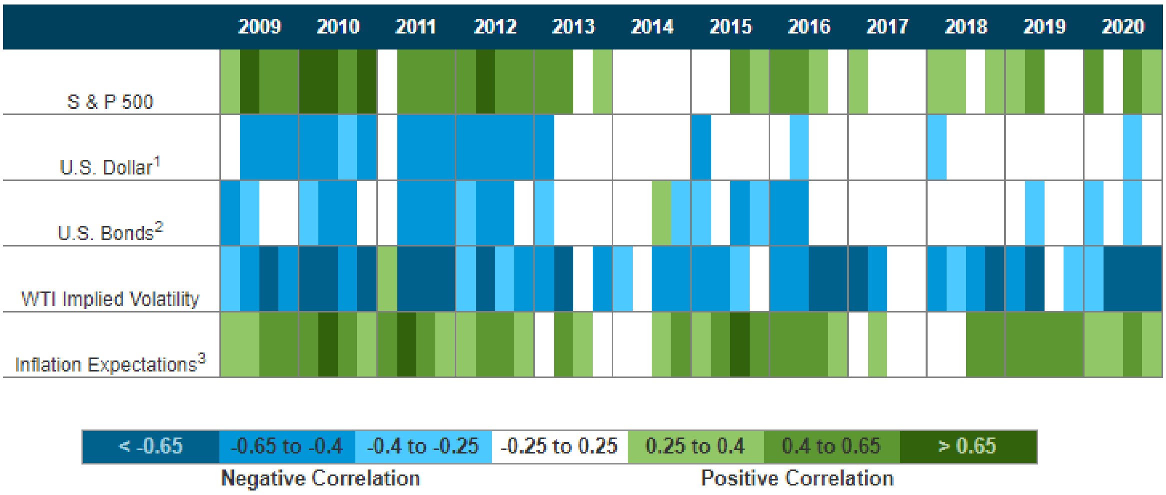


Figure 12: Correlations between daily futures price changes of crude oil
Source: EIA (2021)

Before 2007 stocks, bonds, and exchange rates showed only infrequent connection with oil futures prices while the price of crude oil was positively correlated with 2008-2010 stock and negatively correlated with the U.S. dollar during 2007 to date, and showed occasional negative correlations with bond prices between 2008 and 2010.

There are financial, physical, and common underlying economic factors-to be considered in the case of each asset such as the economic slowdown and recovery-. Financial factors to be counted with are e.g. the growing interest in crude oil as a form of investment. Physical crude oil markets can also be affected by external factors. Exchange rates and economic factors also influence crude oil production and consumption.

Figure 13 reveals some of the correlations (co-movements) between oil futures prices and other financial markets on a daily basis. Oil prices and the S&P 500 tend to move together while oil prices move in the opposite direction of the dollar exchange rate and Treasury bonds.



[1] U.S. Dollar Index (DXY), which is a weighted index of a basket of currencies, per U.S. dollar. As the dollar strengthens against other currencies, the value of the index rises.

[2] U.S. bonds is based on the negative of the change in yield on 30-year U.S. government bonds because as yields rise, bond prices fall.

[3] Inflation Expectations are based on daily changes in the 5 year Treasury - TIPS (Treasury Inflation Protected Securities) spread.

Figure 13: Correlations between daily returns on crude oil futures
Source: EIA (2021) Stocks

Traditionally, stocks have been the largest part of the investment market. Economic conditions can influence stock and commodity prices such as that of oil to move together. With the improvement or worsening of macroeconomic conditions earnings for companies increase or decrease and demand for commodities rise (or fall). Economic expectations can partially explain why there was a positive correlation from 2008 to2010 between the S&P 500, a benchmark for stock markets, and crude oil, one of the most popular traded commodities.

There were also significant changes in the level of risk during 2008-2010 and crude oil has expressed similar risk/return characteristics to stocks. As a conclusion, when risks rise significantly (during the financial crisis) and then abate (during recovery), stocks and prices for crude oil and other commodities tend to move together in the same direction.

3.5.5. Bonds, currencies and extreme events

As economic conditions improve (or worsen), interest rates on government bonds rise (or fall) but bond prices and interest rates move in opposite directions, As it is so, the U.S. Treasury bond prices and crude oil prices would also move in opposite directions when economic conditions significantly change.

Bonds, the second-largest type of investment, are often regarded as investments with lower risks than stocks, although their average returns are also lower. Bonds are generally less volatile. U.S. Treasury bonds, in particular, are usually termed a riskless type of investment.

Several examinations have been carried out to support the inverse relationship between the dollar exchange rate to other currencies and crude oil prices. The first hypothesis is that as oil benchmarks are normally priced in U.S. dollars, a depreciation of the dollar decreases the oil price outside the United States, which can increase demand for oil and has upward pressure on prices.

Second, the U.S. dollar depreciation decreases the profits of non-U.S. producers. To offset this, these countries target higher dollar prices of oil to maintain real revenue, budget levels, and purchasing power in world markets. Dollar depreciation also reduces the returns converted into foreign currencies. Commodity investment is also attractive to U.S. investors as a hedge against inflation if dollar depreciation increases the expectations of greater inflation.

Last, oil price rises also add to the U.S. trade imbalance, which can make additional downward pressures on the dollar, thus yielding a negative correlation in the reverse direction.

Despite these possible explanations, the current correlation between oil prices and exchange rates has not been stable over time, and was close to zero for more than half of the last decade.

According to ZHANG et al. (2009) extreme events have serious impacts on crude oil markets that last several years. Examples include the Gulf War of 1990-1991 and the recent economic crisis. Irregular events make important but short-term effects on crude oil prices such as the geopolitical events of Figure 14. As illustrated by the figure and confirmed by many authors, extreme and irregular events can be the driving forces of crude oil price fluctuations in both long-term and short-term.

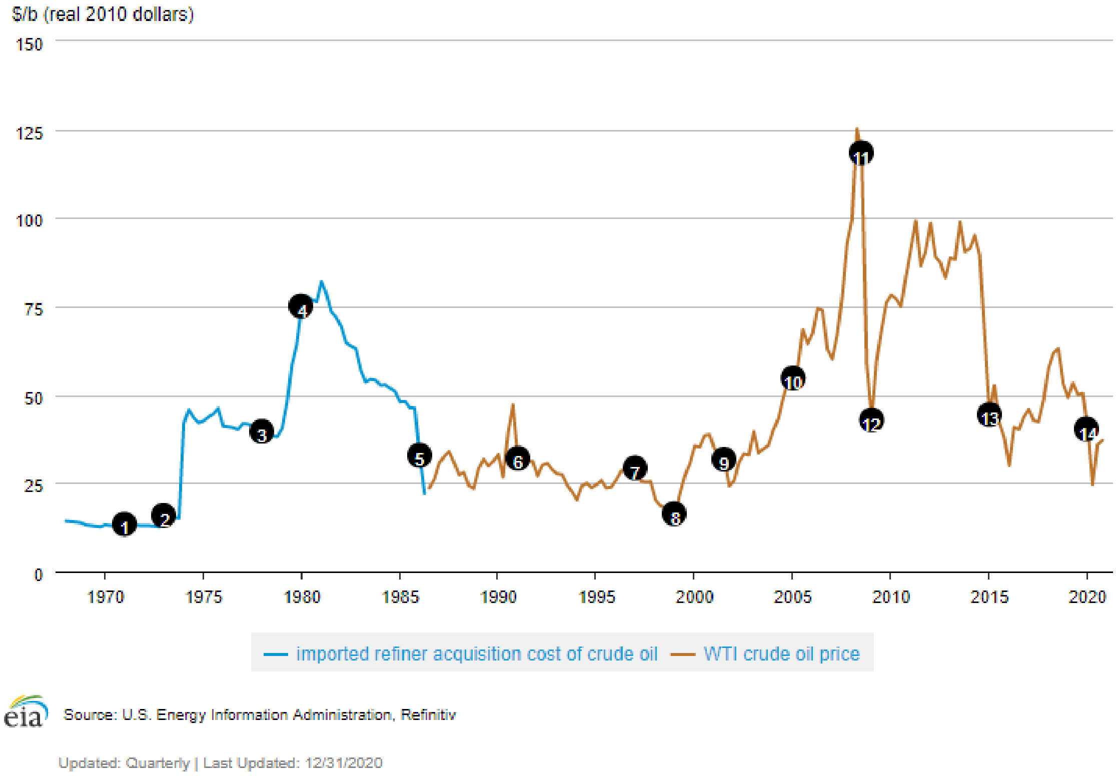
Much crude oil can be found d in regions exposed to political upheaval, or disrupted oil production due to political events. Several oil price shocks take place as supply disruptions are triggered by political events such as the Arab Oil Embargo in 1973-74, the Iranian revolution and Iran-Iraq war in the 1970's -1980's, and the Persian Gulf War in 1990. More recently, supply disruptions (or curbs on resources) resulting from political events have been seen in Nigeria, Venezuela, Iraq, Iran, and Libya EIA (2017).

As a result of oil supply disruptions emanating from political events, market participants always count with the chances of future disruptions and their potential effects. The availability of crude stocks and the ability of other producers to offset supply loss are also considered. For example, if the market has much spare production capacity to offset a possible disruption, prices would be slightly affected than if production capacity were much lower. When chances are for a disruption when spare capacity and inventories are not sufficient to offset the loss in supply, prices may be above the level expected as forward-looking behaviour adds a "risk premium."

Weather can also have a significant role in oil supply. For example, the 2005 hurricanes decreased both oil and natural gas production so petroleum product prices increased sharply as supplies decreased. In cold weather producers try to supply enough heating oil within a short time resulting in higher prices. Other events like refinery or pipeline problems can restrict the flow of oil and products, causing prices to rise.

However, the influence of these factors on oil prices is relatively short lived. Once the problem is rectified and oil and product flows return to normal, prices usually return to previous levels EIA (2017).

ZHANG et al. (2009) also assumed that the impact of extreme and irregular events is bigger on high crude oil price volatility recently,



1: US spare capacity exhausted
2: Arab Oil Embargo
3: Iranian Revolution
4: Iran-Iraq War
5: Saudis abandon swing producer role
6: Iraq invades Kuwait
7: Asian financial crisis
8: OPEC cuts production targets 1.7 mmbpd
9: 9-11 attacks
10: Low spare capacity
11: Global financial collapse
12: OPEC cuts production targets 4.2 mmbpd
13: OPEC production quota unchanged
14: Global pandemic reduces oil demand

Figure 14: Crude oil prices and special events
Source: EIA (2021)

3.6. Former researches on the relationship between oil prices and key macroeconomic variables

Oil price fluctuations are regarded as one of the causes for business cycle fluctuations. There have been some attempts made to find out whether oil price shocks and fluctuations can make an impact on macroeconomy and economic growth JONES-LEIBY (1996); JONES *et al*., (1997), (2002), (2004); and BROWN-YÜCEL, (2002). Moreover, the way oil prices influence the economy and the magnitudes of their effects may have evolved through time. Indeed, the mechanisms have changed a lot and are evolving in time. The 2000's was characterized by a large amount of oil price increases that had a weak effect on oil-importing countries while in the 1970's countries were depending on oil. Some papers were aimed at investigating the correlation of oil prices and macroeconomic activity and exploring the impacts of oil shocks from the demand side. A decrease in crude oil price was regarded as an inflationary shock PIERCE-ENZLER (1974) or a transfer of wealth from importing to exporting countries, resulting in changing trade patterns HICKMAN et al (1987), which depends on energy-import intensity. The bigger the intensity, the bigger the impact on macroeconomy. Thus, the consequences include a decrease in domestic demand (leading to lower GDP and higher unemployment) and inflation (consequence tighter monetary policy). An oil price increase also influences supply RASCHE-TATOM, (1977a, b, c) as energy serves as one of the basic inputs in production. So, an energy cost rise can imply a reduced access to a basic input that can increase the cost of production and consequently, a decrease in productivity. The Real Business Cycle theory of the 1980's identified oil shocks as supply shocks so oil price increase can be seen as an inflationary shock. In this way an oil price increase generates a rise in the consumer price index (CPI), the extent of which is dependent on the share of oil products in the consumption basket. However, there are some second-round effects, as well, such as the decline of purchasing power. Companies tend to pass the oil price increase on to selling prices, which feeds a wage-price spiral resulting in inflation expectations. The effects of an oil price increase on inflation could clearly be identified in the 2000's with three possible explanations. First, at that time the central banks was weaker in fighting against inflation as to date most central banks have inflation targets in addition to output targets, and now they are mostly independent. Second, wages are no longer indexed on prices, second-round effects are hardly observable Third, as international competition is becoming more intense, and firms cannot pass the oil price increase on to selling prices. To sum up, the impact of an oil price increase is weaker nowadays.

An oil price increase can also adversely affect consumption, investment and employment. First consumption weakens with diminishing disposable income and investment due to the increase of the firms' costs. As far as households are concerned, an oil price increase raises domestic fuel prices which reduces purchasing power. If the oil price rises are considered to be temporary, consumers try to save less or borrow more, which pushes real interest rates up. On the contrary, if long-lasting oil price rise is expected, it can modify production structure and affects unemployment. The return of oil-intensive sectors shrinks so new production methods must be adopted by firms that are less intensive in oil inputs. This will generate capital and labour reallocations in sectors that may have an impact on unemployment LOUNGANI (1986). Depending on such reallocations, the effect of an oil price rise on unemployment should be insignificant in the long term KEANE-PRASAD (1996).

Nonetheless, there are different transmission channels through which oil prices may have an impact on the economy, for example the oil price-GDP relationship. DARBY (1982) and HAMILTON (1983) assumed that several economic recessions were preceded by sharp oil price rises. However, empirical studies of the 1980's concluded that oil prices had much lesser impact on economic output. Most studies mainly pay attention to output, inflation and unemployment. HAMILTON (1983) and BURBIDGE-HARRISON (1984) identified a Granger-causal relationship between oil price changes and variations in some macroeconomic indicators such as GNP (negative correlation) and unemployment rate (positive correlation) in the US.

Granger causality (1969) has been acknowledged and accepted which assumes that by taking two variables X and Y, X causes Y if the current value of Y can be better predicted by using past values of X.

GISSER-GOODWIN (1986) concluded on their empirical data collected between 1961 and 1982 that oil prices could still be used as predictors of GNP growth.

While most studies assumed a symmetric specification from oil prices to GDP, asymmetric specification was detected by MORK (1989) and HAMILTON (1996).

HOOKER (1996) identified causality between oil prices and GDP and HAMILTON (1996) detected a stable statistical relationship between oil price changes and GDP. The oil price-GDP relationship interaction and transmission channels helped understand how oil prices may influence a macroeconomic aggregate such as GDP.

ROTEMBERG-WOODFORD (1996) expressed their doubt whether a stable, long-term relationship between oil prices and other macro- economic variables existed. They estimated that a 10% increase in oil price contracts output by 2.5%, 5 or 6 quarters later. According to FINN's (2000) model an oil price shock decreases energy use.

HOOKER (1999) analysed the oil price- GDP relationship from 1954 to 1995. He concluded that oil prices had a direct effect on output before 1980 but afterwards, other indirect channels emerged. BACKUS-CRUCINI (2000) found that changing terms of trade is subject to increased oil price volatility, as opposed to fluctuations in exchange rates.

A MORK et al. (1994), JIMENEZ-RODRIGUEZ and SANCHEZ (2005) confirmed that the results for the US could also be applicable to Japan, Germany, France, Canada, the United Kingdom and Norway (with a positive effect of oil price changes on output for this last country). PAPAPETROU (2001) examined the effect of the consumer price index of petroleum products on the Greek economy and also detected causal relationships between oil prices and industrial production, employment and share prices.

BERCEMENT et al. (2009) analysed the relationship between oil prices and output growth Findings are that oil price increase have a significant and positive impact on the output of Algeria, Iran, Iraq, Kuwait, Libya, Oman, Qatar, Syria and the UAE while oil prices do not seem to have a significant impact on the output of Bahrain, Djibouti, Egypt, Israel, Jordan, Morocco and Tunisia.

RASCHE and TATOM (1977b, 1981) examined the long-term interactions between oil prices and economic activity and found that the Cobb- Douglas production functions evaluated the effect of energy prices on the output for Canada, France, Germany, Japan, the UK and the US. CARUTH, HOOKER and OSWALD (1998) and HOOKER (2002) analysed relationship between unemployment, real interest rate and real oil prices while LARDIC - MIGNON (2006) pointed out an asymmetric integration between oil prices and GDP in the US and Europe.

ALIYU (2009) followed oil price effects on real macroeconomic activity in Nigeria and concluded that oil price shocks affect real GDP growth.

FUHRER (1995); HOOKER (2002) and LEBLANC-CHINN (2004) carried out empirical studies on oil effects on macroeconomic variables and also analysed the relationship between unemployment and oil price shocks similarly to LOUNGANI (1986); DARBY (1982) and GISSER-GOODWIN (1986).

According to BOUCHAOUR-AL-ZEAUD (2012) the oil price fluctuation in oil exporting countries influence five macroeconomic variables (namely, real GDP, unemployment, inflation, money supply, real exchange rate) as it turns out from their data collected from 1980 to 2001 As a conclusion, oil prices had no important impact on most variables in the short term although they had a positive effect on inflation and a negative effect on real effective exchange rate. IWAYEMI-FOWOWE (2011) examined Nigeria and concluded that oil price shocks did not significantly affect most macroeconomic variables in Nigeria between 1985 and 2007.

Most results showed that linear and positive oil shocks have not caused output; government expenditure; inflation; and the real exchange rate. ITO (2008) also examined oil prices effects on inflation, real effective exchange rate and real GDP for Russia from 1995 to 2009 and it concluded that oil prices fluctuations are related to the growth (decline) in real GDP in the long term while in the short term (four quarters) rising oil prices do not only result in inflation and economic growth negatively or positively but also induce real effective exchange rate appreciation.

4. MATERIALS AND METHODS

4.1. The methodology of the research

Before analysing the hypotheses of my research and the representing the results, I would like describe the methodology of my research, the applied methods and the statistical indicators that I used to prepare the dissertation.

In order to analyse the relationship between oil price and various macroeconomic variables I have decided to apply for secondary research method. The reason I have chosen this type of research method is by doing this I assumed I would gain insights into methods and findings from previous researches which would help me define my own research process. Secondary research also helps to identify knowledge gaps that can serve as the name of my own research. Secondary research is a common method of conducting a systematic investigation in which the researcher relies solely on existing data during the research process. This research design includes organizing, collating, and analysing data samples in order to reach valid research conclusions. Secondary research is also referred to as desk research because it entails synthesizing existing data from the internet, peer-reviewed journals, textbooks, government archives, and libraries. The secondary researcher examines previously established patterns in previous studies and applies this information to the specific research context. Secondary research entails assimilating data from various sources, that is, using existing research materials rather than creating a new pool of data using primary research methods. Secondary research methods commonly used include data collection via the internet, libraries, archives, schools, and organizational reports. For my analysis I have decided to work with online data. Online data is information obtained through the use of the internet. IOT (Internet of Things) technology, for instance, can be leveraged to gain granular visibility into different sets of data SHARMA (2019). The reason I have applied for this research method is because the internet provides a large pool of research resources that can be accessed effectively. While this method simplifies data collection, I must have taken care to only collect information from legitimate sites. Because secondary research relies on previously collected data, extra precautions must be made to ensure that authentic data samples are used in the dissertation. False data can have a negative impact on research results. Secondary sources must always be evaluated carefully to ensure that it not only fulfils the researcher's requirements but also meets the criteria of sound scientific practices HOX-BOEJIE (2005). A careful evaluation of collected data and sources ensures that the data can be used as the basis for further research. For instance, available data may have been collected for a different specific purpose, which may result in deliberate or unintentional bias STEWART-KAMINS (1993). Such data could prove to be detrimental to a research data recency is another factor that must be considered since the recency of data can affect research outcomes.

According to GODDARD-MELVILLE (2001), research entails more than just gathering information; it also entails answering unanswered questions as part of discovering and/or creating new knowledge. And, in order for this newly discovered or created knowledge to be recognized or noticed, you must demonstrate its validity. In research, methodology is defined as the systematic method of resolving a research problem by gathering data using various techniques, providing an interpretation of the data gathered, and drawing conclusions about the research data. A research methodology is essentially the blueprint for a research or study (MURTHY-BHOJANNA (2009). In the context of research, methods and methodology refer to two related but distinct concepts: method is the technique used to collect evidence; methodology, on the other hand, "is the underlying theory and analysis of how a research does or should proceed" KIRSCH-SULLIVAN, (1992). MILLS-BIRKS (2011), define methodology as "a set of principles and ideas that inform the design of a research study." Methods, on the other hand, are "practical procedures used to generate and analyse data" MILLS-BIRKS (2011).

Academic researchers have traditionally approached research studies through two distinct paradigms, namely positivistic and phenomenological COLLIS-HUSSEY (2013). Positive and phenomenological approaches, also known as qualitative and quantitative approaches DUMAY, (2008), play an important role in determining data collection process, particularly the methods used in the research.

This approach is frequently used by researchers who adhere to the scientific paradigm HAQ (2014). This method attempts to quantify and generalize data from a sample of a target population MACDONALD et al., (2008). It employs a structured data collection procedure, with numerical data output. Quantitative research also employs objective analysis through the use of statistical methods MACDONALD et al. (2008).

In contrast to the quantitative approach, which seeks to count things in order to explain what is observed, the qualitative research method seeks to create a complete and detailed description of your observations as a researcher MACDONALD et al. (2008). Rather than offering predictions and/or causal explanations, the qualitative method provides contextualization and interpretation of the collected data. This research method is subjective and necessitates a smaller sample size of carefully selected respondents.

The combination of traditional quantitative and qualitative approaches resulted in a modern method. According to BRANNEN-MOSS (2012), the existence of the mixed methods approach stems from its potential to help researchers view social relations and their complexities more clearly by fusing quantitative and qualitative research methods while recognizing the limitations of both at the same time. In social research, mixed methods are also known for the concept of triangulation. According to HAQ (2014) triangulation allows researchers to present multiple findings about a single phenomenon by combining quantitative and qualitative approaches in one study.

As my research topic completely data-oriented I have selected quantitative secondary research method for my analysis.

In the dissertation I primarily sought answers to my hypotheses and targeted the 5 hypotheses by analysing them with different statistical indicators. The data used in the research were collected from several international statistical public databases. BRITISH PETROL (2019) publishes the Statistical Review of World Energy for the previous period each year, and I used the 2019 issue. Another large group of data collection was made from the World Development Indicators (WDI) database. This database is the premier compilation of the WORLD BANK (2019). The database contains 1,600 time series indicators for 217 economies and more than 40 country groups, with data for many indicators going back more than 50 years, it is the most accepted database because it works with various indicators requested from countries. This information is public and can be queried in many ways. Some sections contain ready-made statistical indicators, while others collect data from 1968 onwards. The database also uses graphical representations, which were also used to test some hypotheses. As both publications and sources are based on internationally accepted and secured data, I have fulfilled the requirement of reliability of the research. The WDI database is based on the conversion to the 2010 US dollar, so my research also met the criteria of objectivity.

4.2. Geographical factors in the analysis

When selecting the countries to be included in the research, my goal was to include countries that are well representative of the given groups and find data for each hypothesis. To answer the questions in the hypotheses I selected 27 countries and categorized them into 3 country groups.

Country group 1. /selected oil exporters/

I selected the largest oil exporting countries in my research that are not members of the other two groups of countries. Significant factor was to choose not only developed but also developing countries, preferably from different continents. It was important that the proportion of the population should also be heterogeneous. I used GDP per capita values.

Country group1 includes:

Brazil, Canada, China, People's Republic, Colombia, India, Mexico, Norway, Russia, United States

Country group 2. /selected OPEC countries/

The Organization of the Petroleum Exporting Countries (OPEC) is a group of 13 major oil-exporting countries. OPEC was established in 1960 to coordinate its members' petroleum policies and to provide technical and economic assistance to its members.

Country group 2 includes:

Algeria, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar Saudi Arabia, United Arab Emirates

Country group 3. /selected EU countries/

The third group that I have involved in the research is the EU countries. I chose these countries because I compared population and GDP values from the other countries involved in the research. It was also important to select EU countries that were preferably founding countries or joined earlier, as this would ensure that the data could be found in the WDI database for each country. The development of the former Eastern countries and its dynamism differ from that of the founding countries and thus I examined more stable countries.

Country group 3 includes:

Belgium, Denmark, France, Germany, Ireland, Italy, Luxemburg, Netherlands, United Kingdom

4.3. Description of the statistical methods used in the analysis

Fixed and chain base index numbers

A significant portion of my research hypotheses concerned what changes and correlations I could show between two time-determined factors. For example, the evolution of the GDP of each group of countries over time. This is aided by the analysis of chain ratios and their graphical display. I used base ratios when I analysed constant variables such as determining values relative to the 2010 dollar exchange rate. Trends could also be identified in relation to them.

Distributions

A sample of data will form a distribution. The distribution provides a parameterized mathematical function that can be used to calculate the probability for any single observation in the sample space. The first step in turning data into information is to create a distribution. Before doing the analyses I presented distribution in tables and in the form of graphs as well.

Mean

To describe the location of a distribution, I used a typical value from the distribution. There are a number of different ways to find the typical value, but by far the most used is the arithmetic mean. The arithmetic mean of a list of numbers, is the sum of all of the numbers divided by the number of numbers.

Standard deviation

I also calculated standard deviation. The standard deviation is a measure of the amount of variation or dispersion in a set of values. A low standard deviation indicates that the values of the set tend to be close to the mean, whereas a high standard deviation indicates that the values are spread out over a larger range.

The standard deviation formula weighs unevenly spread out samples more than evenly spread samples. A higher standard deviation tells that the distribution is not only more spread out, but also more unevenly spread out. This means it gives a better idea of data's variability than simpler measures, such as the mean absolute deviation.

Trend analysis

Trend analysis involves the collection of information from multiple time periods and plotting the information on a horizontal line for further review. I used linear trend estimation. Linear trend estimation is a statistical technique used to aid in data interpretation. When a series of measurements of a process is treated as, a time series, trend estimation can be used to make and justify statements about data tendencies by relating the measurements to the times at which they occurred. This model can then be used to describe the observed data's behaviour without explaining it. Linear trend estimation, in this case, expresses data as a linear function of time and can also be used to determine the significance of differences in a set of data linked by a categorical factor.

Variance

In a number of cases variance was also calculated. Variance is the expectation of the squared deviation of a random variable from its mean. It measures how far a set of numbers is spread out from their average value. The variance is the square of the standard deviation, the second central moment of a distribution, and the covariance of the random variable with itself.

Correlation

Correlation refers to any statistical relationship, whether causal or not, between two random variables or bivariate data. Correlation, in the broadest sense, refers to any statistical association, though it is most commonly used to refer to the degree to which two variables are linearly related. Correlation coefficients are used to assess the strength of a relationship between two variables. Pearson's correlation coefficient is the most common type of correlation coefficient. Pearson's correlation (also known as Pearson's R) is a correlation coefficient that is frequently used in linear regression. I used Pearson's correlation coefficient in my analysis. For the calculation the following formula was used:

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2]}}$$

Linear regression

In some cases linear regression calculations were used. By fitting a linear equation to observed data, linear regression attempts to model the relationship between two variables. One variable is regarded as an explanatory variable, while the other is regarded as a dependent variable.

The research was carried out according to the conditions of scientific research. My research met the criteria for measurement. I strived for validity, reliability and objectivity and adhered to ethical standards.

Displaying data

I used several methods to display the research data. Using the Boxplot method, I was able to display the amount of time-independent data for each country, as well as the average between the minimum and maximum data.

The Scatterplot graphs represents the examined data in a coordinate system, which in this case I used to display the regression values.

For the research and analysis of data, I primarily used IBM SPSS version 22 and converted the resulting data into Microsoft Excel 2016 version for graphical presentation

I mostly used the graphs displayed in MS Excel to display the trends and data, because the IBM SPSS diagrams are not so aesthetic and more difficult to shape.

5. RESULTS AND THEIR DISCUSSION

5.1. The analysis of the relationship between oil price and inflation rate

H1: There is a positive linear relationship between oil price and inflation rate. Falling oil prices decrease inflation rate in oil exporting countries, OPEC countries and major EU countries.

5.1.1. Analysing oil exporting countries

In Hypothesis 1 I was researching the connection between oil price and inflation. According to my hypothesis falling oil prices decrease inflation resulting growth in the economy of both oil exporting and oil importing countries.

Firstly I examined how oil price changed in the examined period from 2009-2019.The data clearly show that oil prices are not stable and proportionate, but fluctuate widely. We used the data provided by BP to determine the price of oil. The price is based on the Dubai $ / bbl, published in the 2020 BP Statistical Review of World Energy. During the 10-year period under review, we can see that there was a slow rise in the price from 2009 after the invasion of Iraq. The price peaked in 2012 at 109, 08 Dubai USD. As a result of the Arab Spring, we continue to see a steady decline in price movements until 2016. That time oil price fell to the price level of 2005 for a while, after that it began to rise again slowly. Currently its price is close to the 2009 price. The change in prices is shown in Figure 15 in which the trend line is also shown. The trend line clearly shows that oil prices are falling.

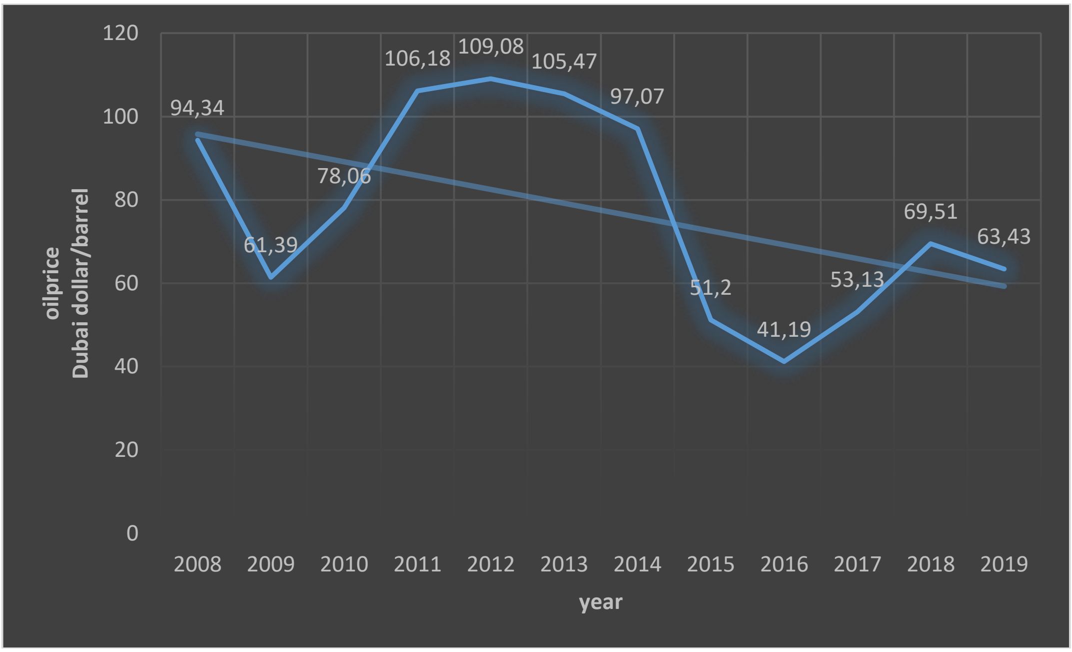


Figure 15: Oil price change from 2008 to 2019

Source: BP Statistical Review (2020)

After examining changes in the price of crude oil, we need to look at how inflation has changed in each country. Firstly I examined the major oil exporting countries. Based on the existing data, I examined 9 countries, how their inflation rate developed during the period under review.

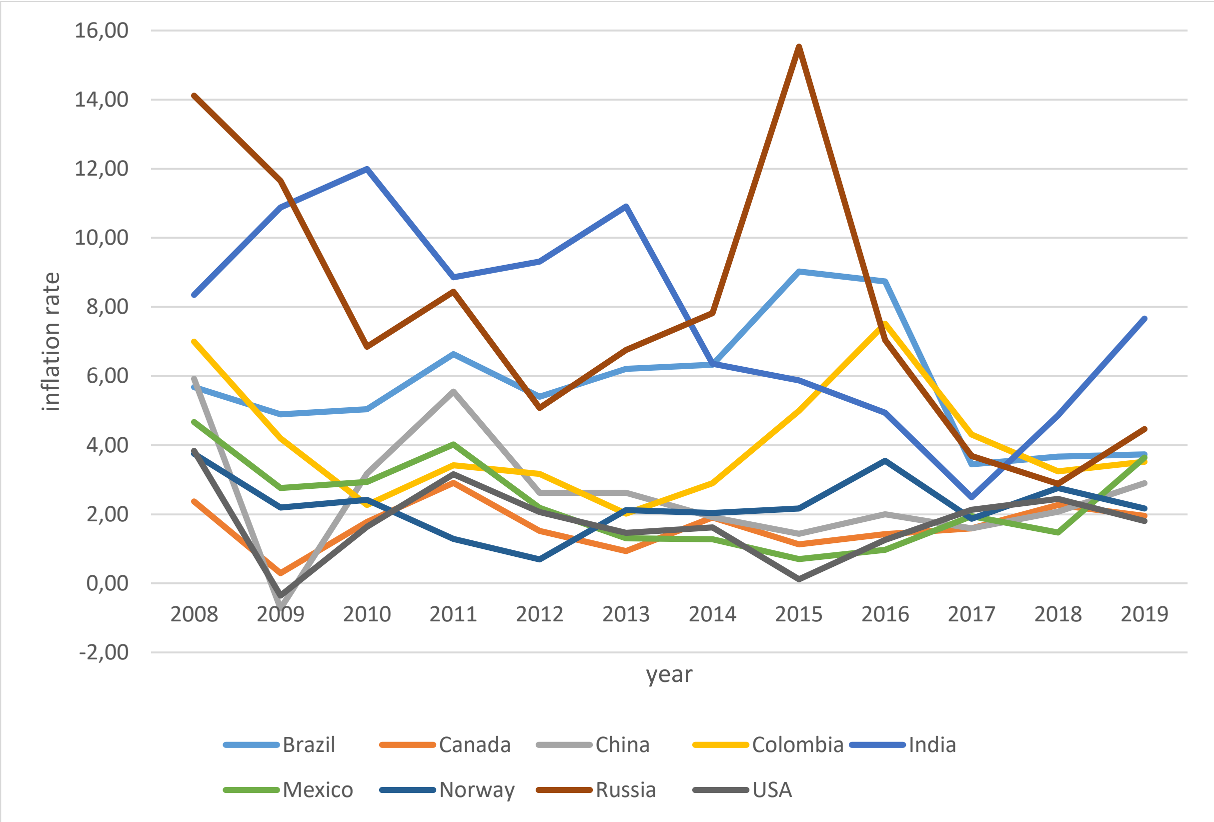


Figure 16: Annual inflation rate in the oil exporting countries from 2009 to 2019

Source: Author's own editing based on WDI

Inflation in these countries fluctuated widely over the period examined. If we look at Figure 16, we can see that inflation in each country is different. The U.S. and China reached negative inflation in 2009. By 2019, the large discrepancies had leveled off and the data for the 9 countries showed inflation rates ranging from 2 to 8.

As I was not able to show definite trend, I further examined the data obtained to see how the annual inflation rate developed on average in each country.

As Figure 17 shows, the average inflation rate in all countries is steadily declining and was highest in 2008 at 6.19 and lowest at 2.56 in 2017. After that it began to rise in 2019 reaching 3.54 which was the same as in 2012, 2014. I also plotted the trend line, which showed a steady decline from 5.14 to 3.2.

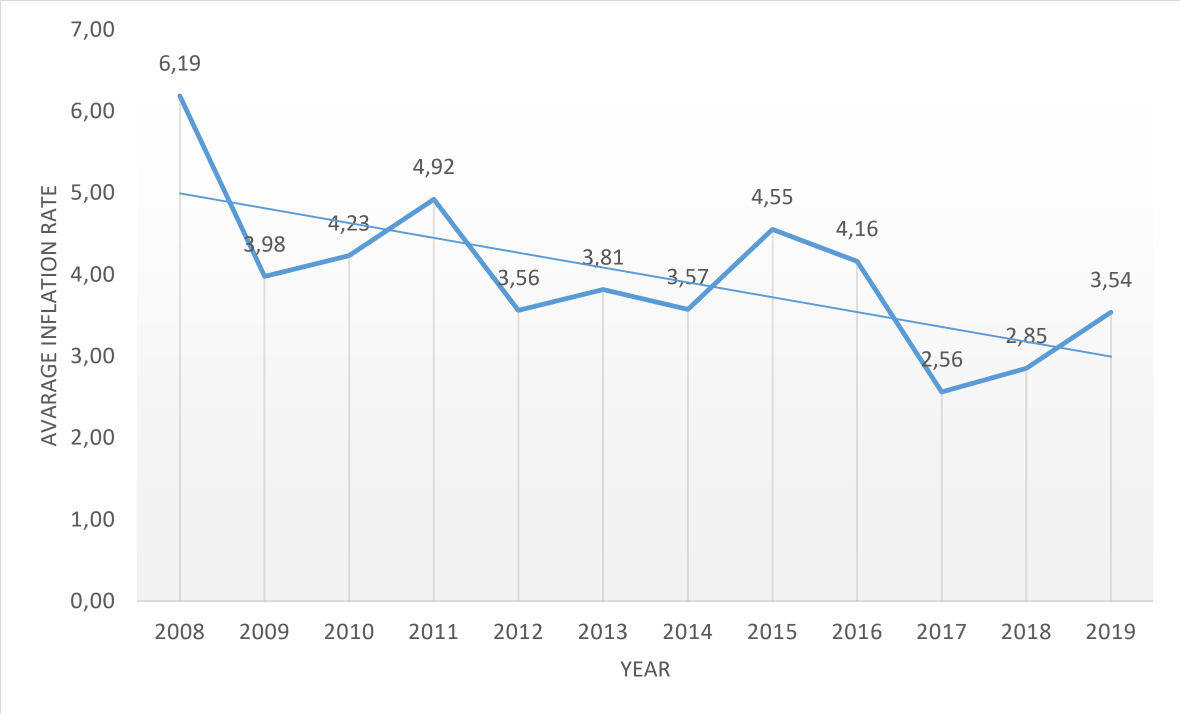


Figure 17: The average inflation rate for each year

Source: Author's own editing based on WDI

In the next phase of the research I compared the average inflation rate of oil exporting countries with the oil price. Figure 18 shows that inflation rate loosely follows the movement of oil prices. The average inflation rate in each country reacts loosely and inversely to oil prices. This phenomenon is detectable in the period of 2009-2016. After 2016 we can see a more linear relationship. The trend in both cases is decreasing and parallel to each other.

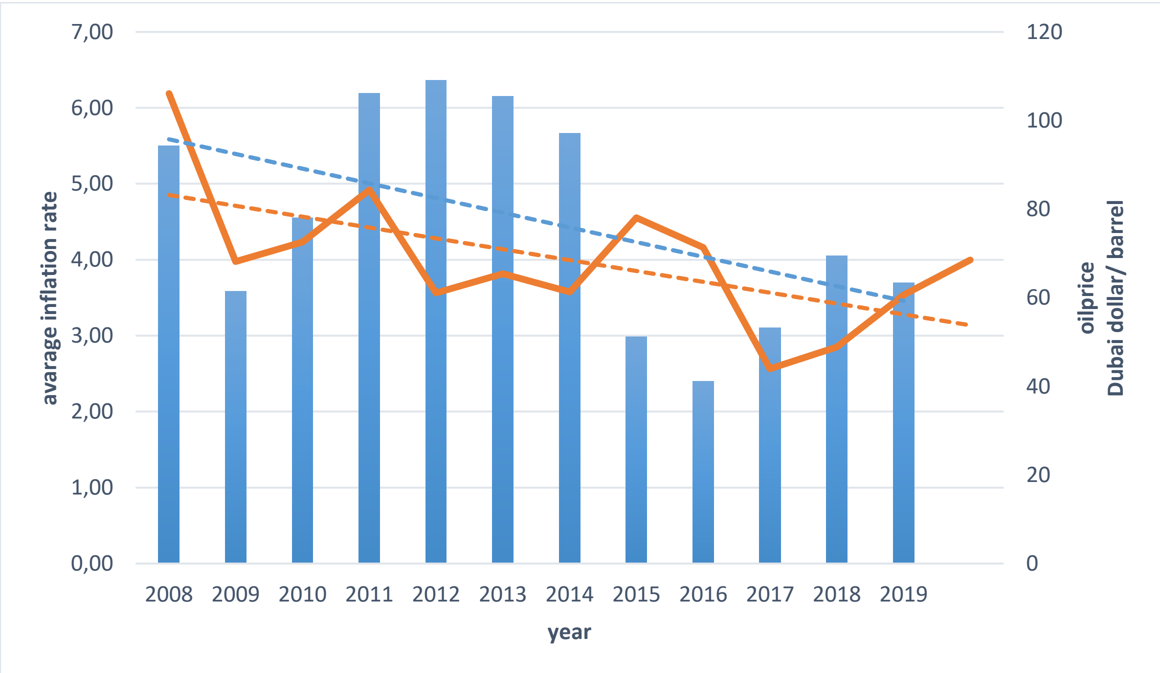


Figure 18: Changes in the price of oil (orange) and changes in average inflation (blue bars) of oil exporting countries from 2008 to 2019 with the corresponding trends

Source: Author's own editing based on WDI

5.1.2. Analysing OPEC countries

I examined 9 countries that are members of OPEC. These are Algeria, United Arab Emirates, Iran, Iraq, Kuwait, Libya, Nigeria and Saudi Arabia. Currently, OPEC comprise 14 countries, but my research does not cover all of them. Figure 19 indicates the change in inflation in each country. It can be seen that Qatar showed negative inflation for three years. The year 2019 was a success for several OPEC countries, as all countries except Kuwait were able to show declining inflation, the rise of inflation rate in Kuwait was not significant either. Iran stands out with its highly volatile inflation rate, the main reason for the high inflation was the consequences of the Arab Spring and major political events.

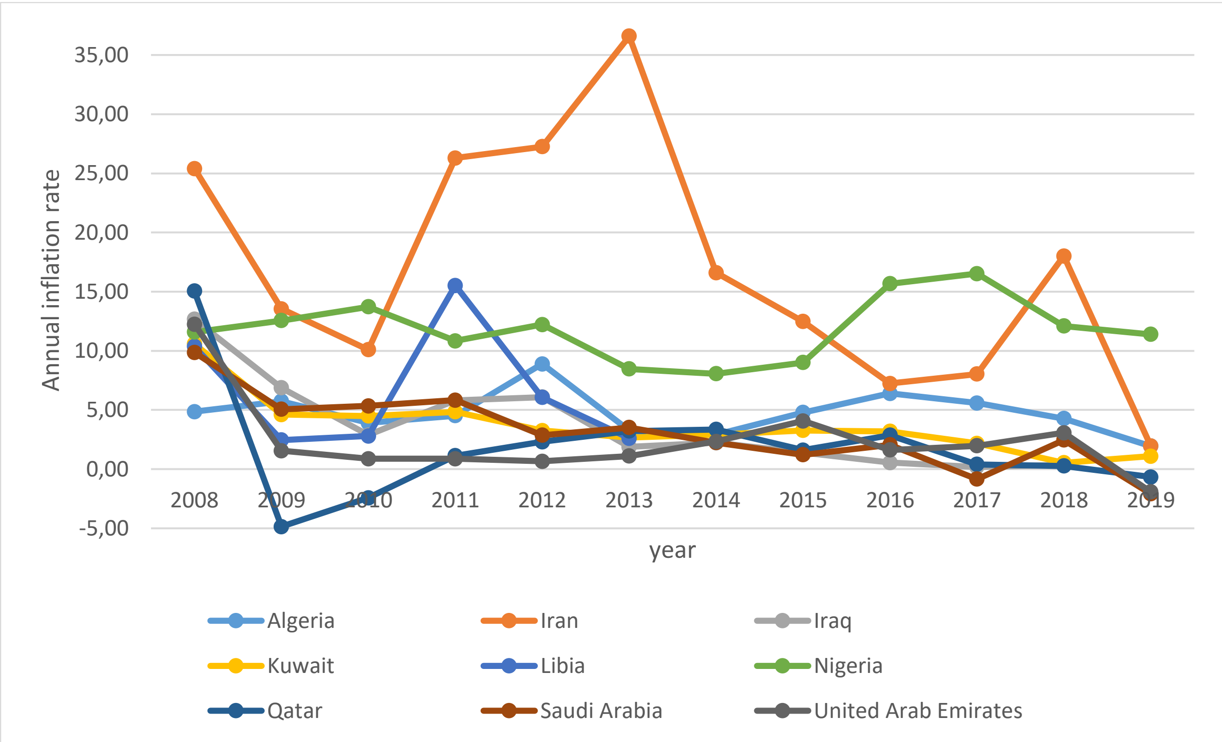


Figure 19: Annual Inflation rate in OPEC countries from 2008 to 2019

Source: Author's own editing based on WDI

I continued my analysis similarly to oil-exporting countries and I compared the aggregate inflation averages with the development of oil prices. As shown in Table 1, I highlighted not only the averages but also the lowest values in dark blue. Qatar in 2009 had the lowest inflation rate at -4.86. Observing the averages, I found that in annual breakdown, the value of 12, 51 in 2008 was significantly higher than in any of the following years and even higher than half of the average. It was the lowest in 2019 in all countries. In addition to the lack of data in Libya, the data is also incomplete in Iraq.

Table 1: Annual inflation of OPEC countries from 2008 to 2019

year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	*average*
Algeria	4,86	5,74	3,91	4,52	8,89	3,25	2,92	4,78	6,40	5,59	4,27	1,95	*4,76*
Iran	25,41	13,55	10,09	26,29	27,26	36,60	16,61	12,48	7,25	8,04	18,01	1,95	*16,96*
Iraq	12,66	6,87	2,88	5,80	6,09	1,88	2,24	1,39	0,56	0,18	0,37		*3,72*
Kuwait	10,58	4,61	4,50	4,84	3,26	2,68	2,91	3,27	3,20	2,17	0,54	1,09	*3,64*
Libia	10,36	2,46	2,80	15,52	6,06	2,61							*6,63*
Nigeria	11,58	12,55	13,72	10,84	12,22	8,48	8,06	9,01	15,68	16,52	12,09	11,40	*11,85*
Qatar	15,05	-4,86	-2,43	1,14	2,32	3,21	3,35	1,61	2,87	0,41	0,27	-0,67	*1,86*
Saudi Arabia	9,87	5,06	5,34	5,83	2,87	3,51	2,24	1,22	2,05	-0,83	2,47	-2,09	*3,13*
United Arab Emirates	12,25	1,56	0,88	0,88	0,66	1,10	2,35	4,07	1,62	1,97	3,07	-1,93	*2,37*
average	*12,51*	*5,28*	*4,63*	*8,41*	*7,73*	*7,04*	*5,08*	*4,73*	*4,95*	*4,26*	*5,14*	*1,67*	*6,10*

Source: Author's own editing based on WDI

In order to compare the data, I also created a graph showing the inflation of OPEC countries relative to the price of oil in each year.

Comparing the two figures, I noticed that in the case of OPEC countries, inflation and oil price developments follow each other, except in 2016, when, as shown in Figure 20, they move in opposite directions. In the other years, the increase and decrease of the two data coincide.

I could not show such a correlation for the oil exporting countries. Therefore, I considered it important to examine the development of trends. Similar to oil-exporting countries, the trend is declining here, but not correlating with oil prices, but opening like scissors.

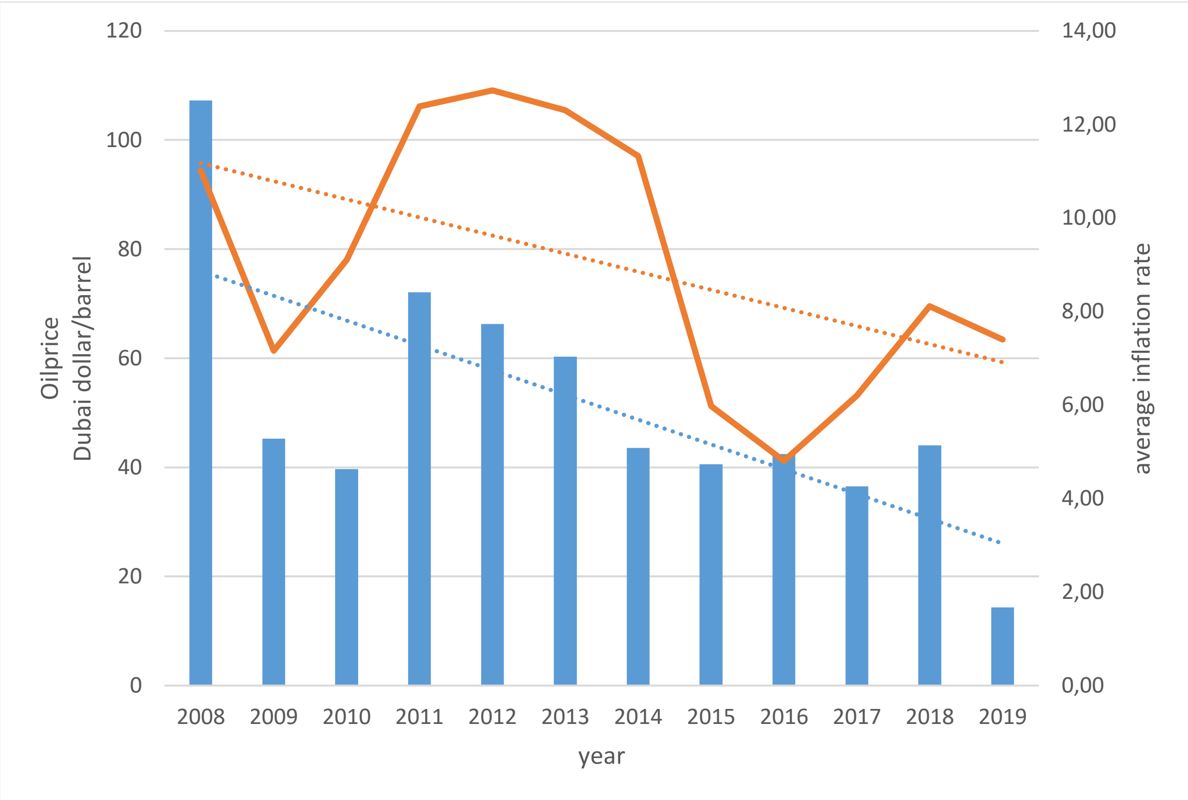


Figure 20: Changes in the price of oil (orange) and changes in average inflation (blue bars) of oil exporting countries from 2008 to 2019 with the corresponding trends

Source: Author's own editing based on WDI

5.1.3. Analysing EU countries

The third factor of our research is the study of European Union countries.

I included the nine major founding countries of the European Union in my study. The exit of the UK did not influence the research, since the examined period is 2008-2019. I first compared the development of inflation in each country, and then I compared it with the development of oil prices.

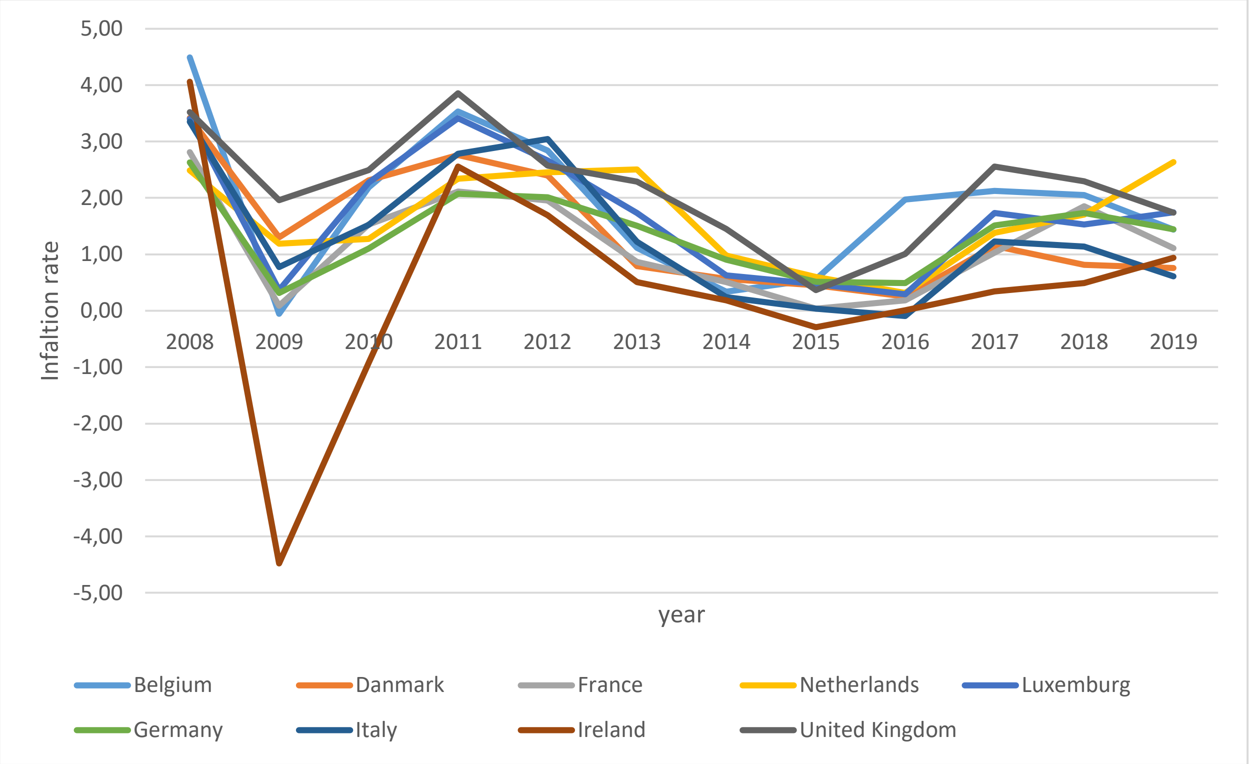


Figure 21: Annual inflation rate in selected European Union countries from 2008 to 2019

Source: Author's own editing based on WDI

Figure 21 shows that that inflation in Ireland is significantly different from the other countries, this is the only country where the inflation was negative. The rate of inflation in EU countries is much more even than in any previous country examined. None of the countries reached above 4%. 2011 was the year when inflation reached a relatively high value. The inflation policy of the Union is one of the key factors in low inflation rate in this region. Figure 22 reflects the inflation policy of EU as average annual inflation rates do not show significant differences. The lowest average inflation was reached in 2009 with the value of 0.16% and the highest in 2011 with the value of 2.82%. The extent of the trend shows a declining line similar to other examined regions.

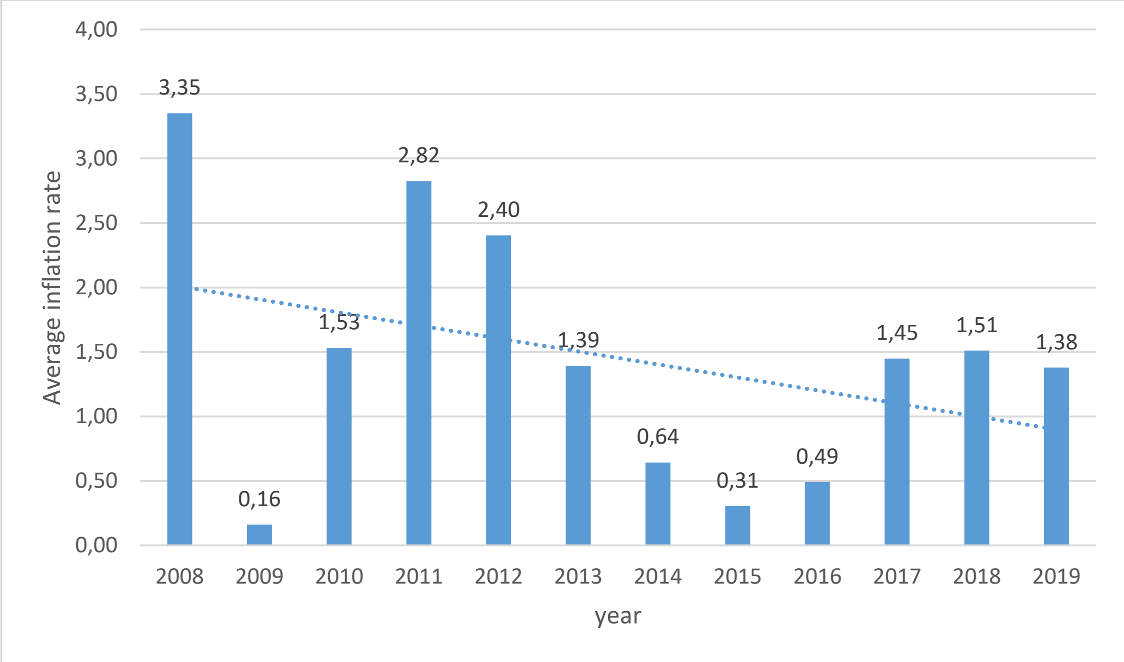


Figure 22: Average annual inflation rate with a trend line for selected EU countries from 2008 to 2019

Source: Author's own editing based on WDI

If we break down the averages for each country, we can see in Figure 23 that the UK has the highest average inflation rate with 2, 17%, and Ireland has the lowest rate with 0, 42%.

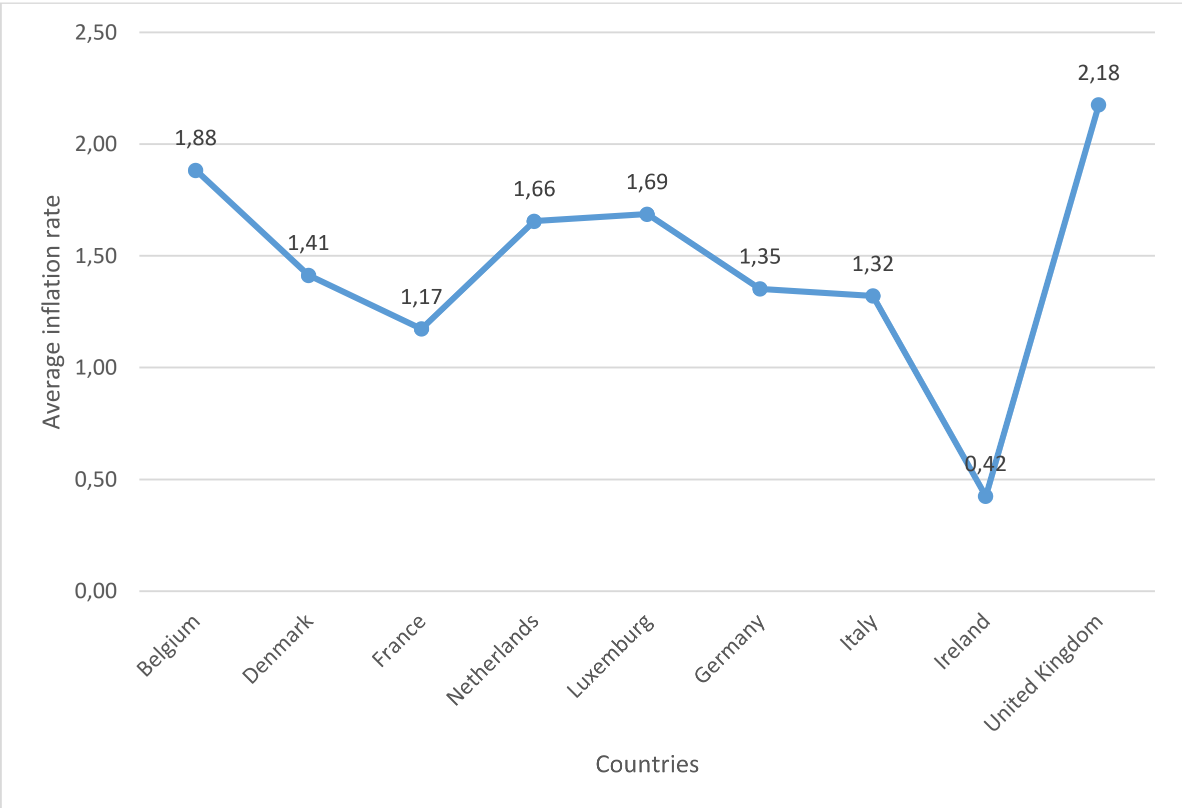


Figure 23: Average inflation rate of selected EU countries

Source: Author's own editing based on WDI

I compared inflation and oil price changes in EU countries the results can be seen in Figure 24. Changes in inflation showed co-movements with changes in oil price. The trend line showed more similarities to the OPEC countries as the two run in parallel.

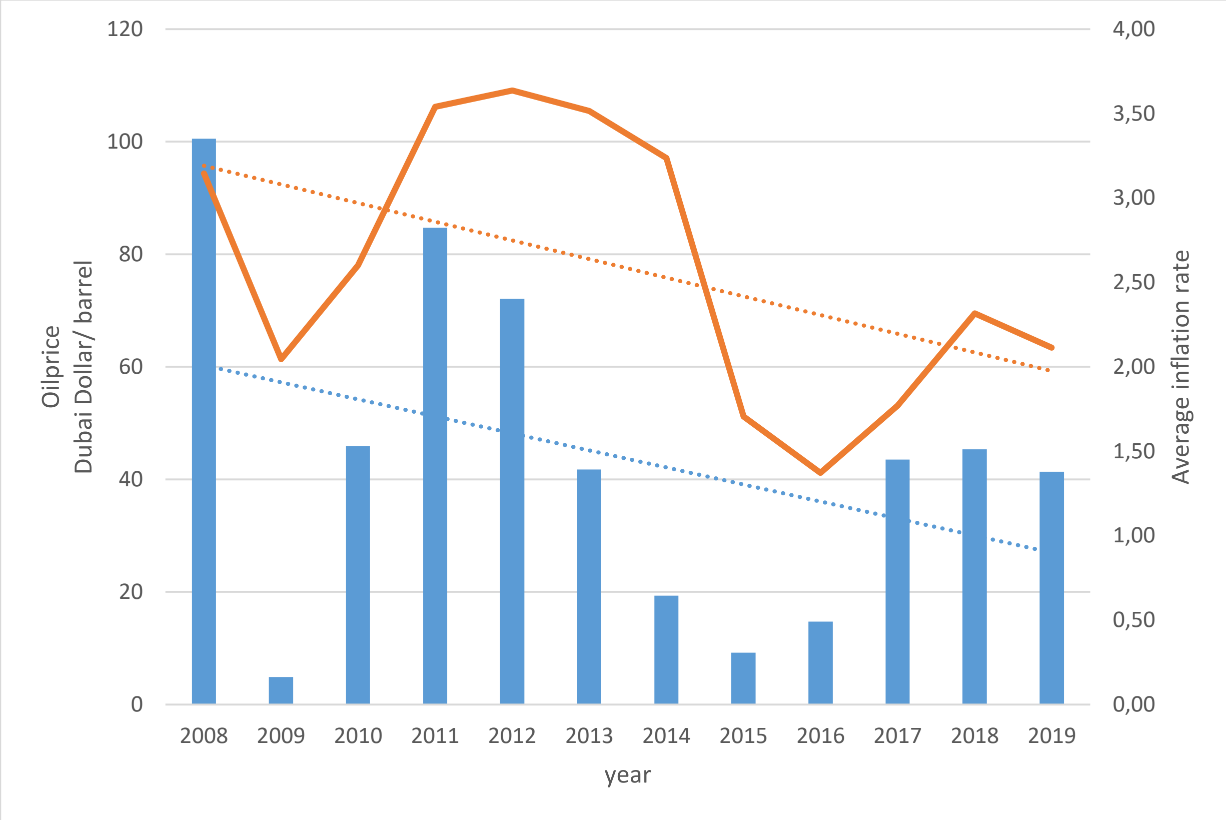


Figure 24: Inflation and oil prices in selected EU countries from 2008 to 2019

Source: Author's own editing based on WDI

If we examine the average rate of inflation in the 3 regions and the relationship between oil prices over time, (Figure25) we can see that the development of oil prices (orange), shows similarities to OPEC and EU countries, while in the case of oil exporting countries this observation is not valid.

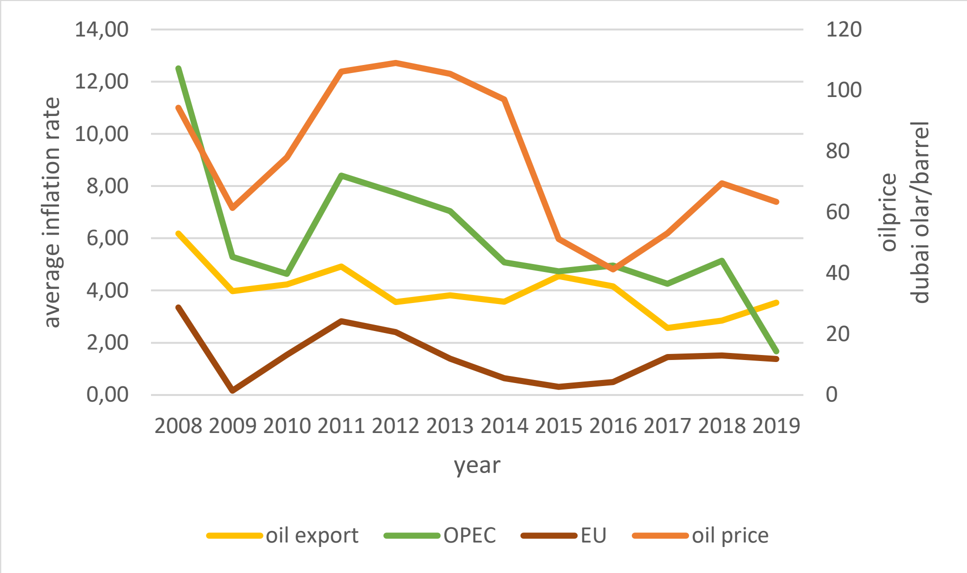


Figure 25: Oil price and inflation rates of examined country groups from 2008 to 2019

Source: Author's own editing based on WDI

In the next phase I examined the correlation between the inflation average of the three country groups and the changes of oil prices (Table 2). The average inflation of the OPEC countries (r = 0.608) and the average of the EU countries (r = 0.643) (p = 0.05) can be considered a relatively strong relationship according to Pearson's correlation. However in the case of oil exporting countries this relationship is weak (r = 0.263, p = 0.05). Pearson's correlation can be detected and considered positive in all cases, the relationship is not strong for oil-exporting countries.

Table 2: Correlation coefficient in relation to average inflation of examined country groups and oil price.

		oil price	oil export	OPEC	EU
oil price	Pearson Correlation	1	,263	,608*	,643*
	Sig. (2-tailed)		,409	,036	,024
	N	12	12	12	12
oil export	Pearson Correlation	,263	1	,711**	,437
	Sig. (2-tailed)	,409		,010	,155
	N	12	12	12	12
OPEC	Pearson Correlation	,608*	,711**	1	,724**
	Sig. (2-tailed)	,036	,010		,008
	N	12	12	12	12
EU	Pearson Correlation	,643*	,437	,724**	1
	Sig. (2-tailed)	,024	,155	,008	
	N	12	12	12	12

* Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

Source: Author's own editing based on WDI

I confirmed my hypothesis that there is a linear relationship between oil price and inflation rate. Falling oil prices decrease inflation rate in oil exporting countries, OPEC countries and major EU countries. The relationship is present on a different level, the most significant in the case of OPEC countries and EU countries, in the case of major oil exporting countries the relationship is not significant.

5.2. The analysis of the relationship between oil price and unemployment rate

H2/A/: There is a negative linear relationship between oil price and unemployment rate in oil exporting and OPEC countries.

H2 /B/: There is a positive linear relationship between oil price and unemployment rate in major EU countries.

Hypothesis 2 consists of two sub-hypotheses. First, we need to examine the impact of oil price developments on oil-exporting countries between 2008 and 2019. Similarly to my previous research, the price of oil determined in Dubai Dollar Price Index., broken down by year. The development of the world market price of crude oil is shown in Figure 26.

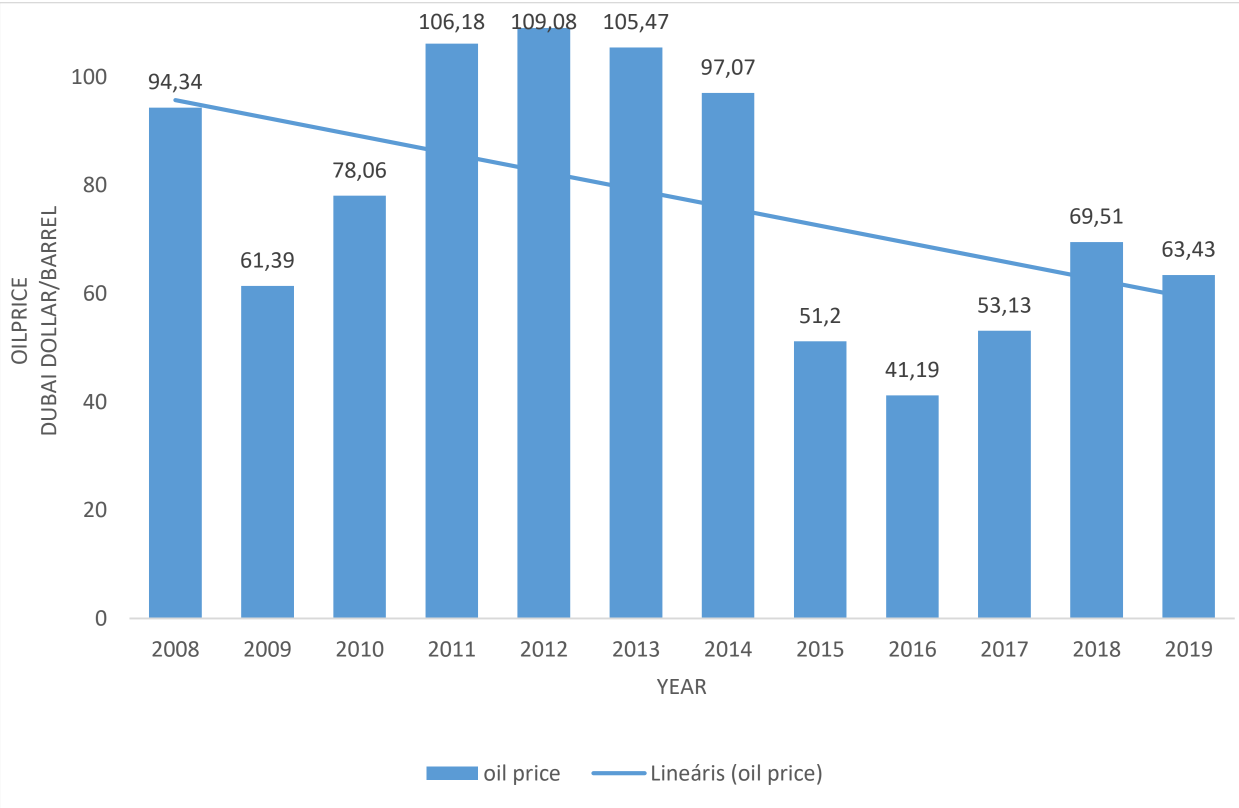


Figure 26: The development of crude oil price from 2008 to 2019

Source: BP Statistical review (2019)

5.2.1. Analysing oil exporting countries

I started my analysis by presenting the unemployment rate in each country. Unemployment rate data already include 2020 values (Figure 27) and although I did not compare them to oil price developments, I have kept them at this stage of the research. The 2020 pandemic contributed to the significant growth in almost every country.

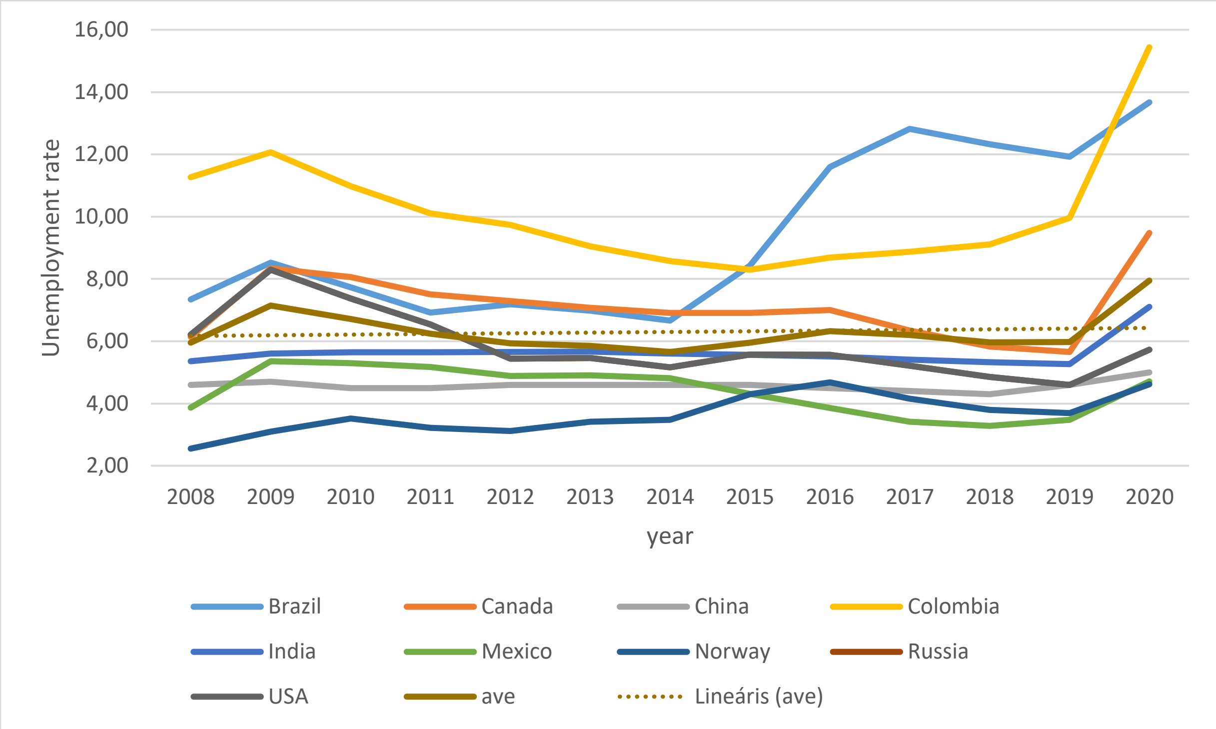


Figure 27: Unemployment rate in oil exporting countries

Source: Author's own editing based on WDI

Unemployment rates rose in each country in 2020 due to pandemic situation. We can see a relatively high unemployment rate in Columbia in 2009, higher than in other countries with a declining trend. Norway had the lowest unemployment rate, with the highest value of 4.68 in 2016.

The average unemployment rate per country is shown in a box-plot figure in Figure 28. Brazil has the largest variance, but its average unemployment rate is lower than that of Colombia, which had the highest value of each country, as indicated in the Figure. The smallest standard deviation and average change belonged to China with a value of less than around 4.5.

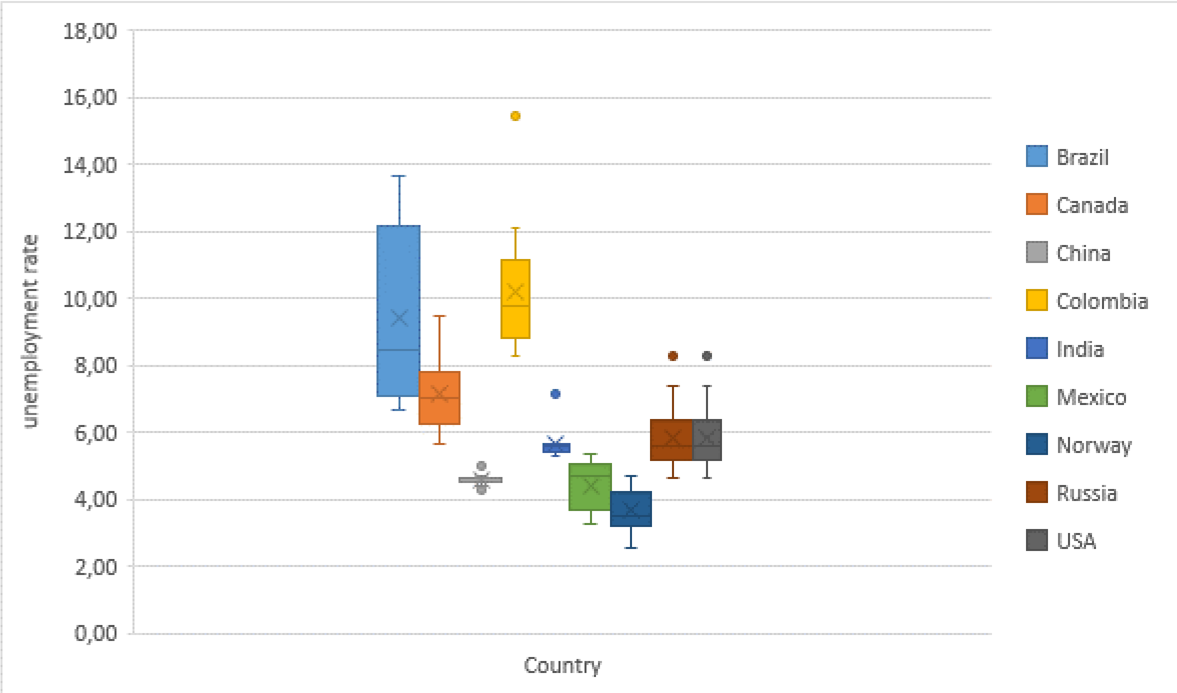


Figure 28: Box plot table based on average and standard deviation of unemployment rate in oil exporting countries from 2008 to 2020

Source: Author's own editing based on WDI

Figure 29 shows how the average unemployment rate in oil-exporting countries developed over the period under review. Unemployment was firstly the highest in 2009 and has been steadily declining since then with a slight increase in 2016. In 2020 we can experience the highest unemployment rate of almost 8%.

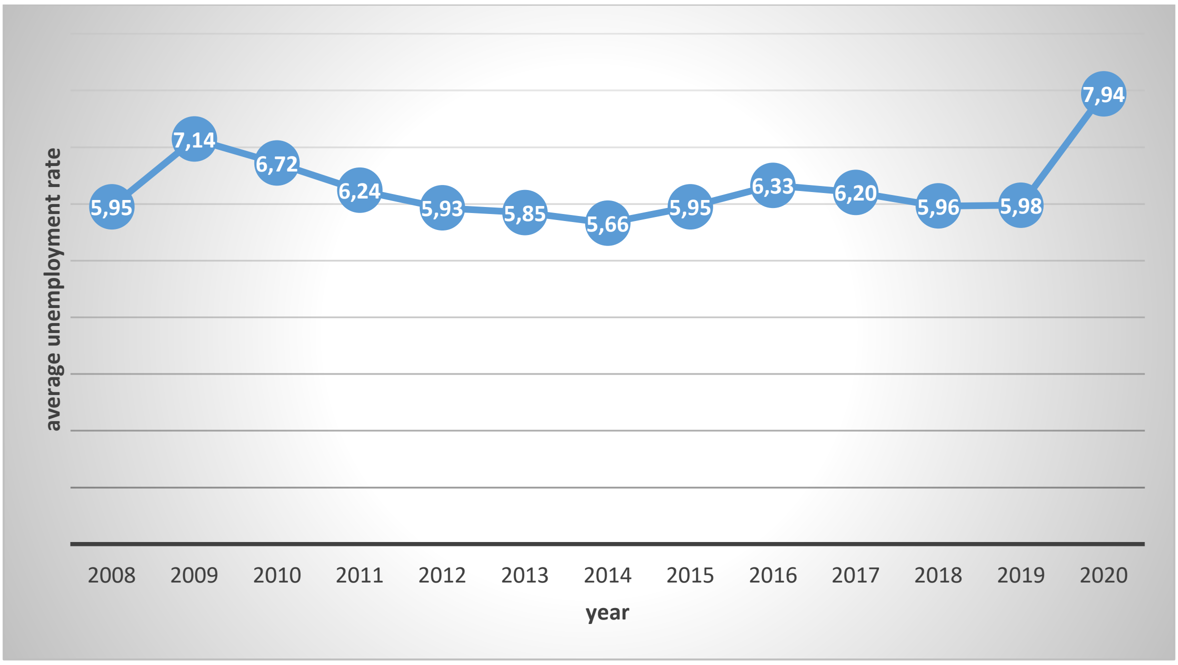


Figure 29: Average unemployment rate of oil exporting countries from 2008 to 2020

Source: Author's own editing based on WDI

If we add oil price change to the above chart as we can see in Figure 30, the two data show negative correlation here. The rise in oil prices is accompanied by a fall in unemployment in oil-exporting countries. To examine the quality of the relationship and to support my hypothesis, I later performed ANOVA analysis.

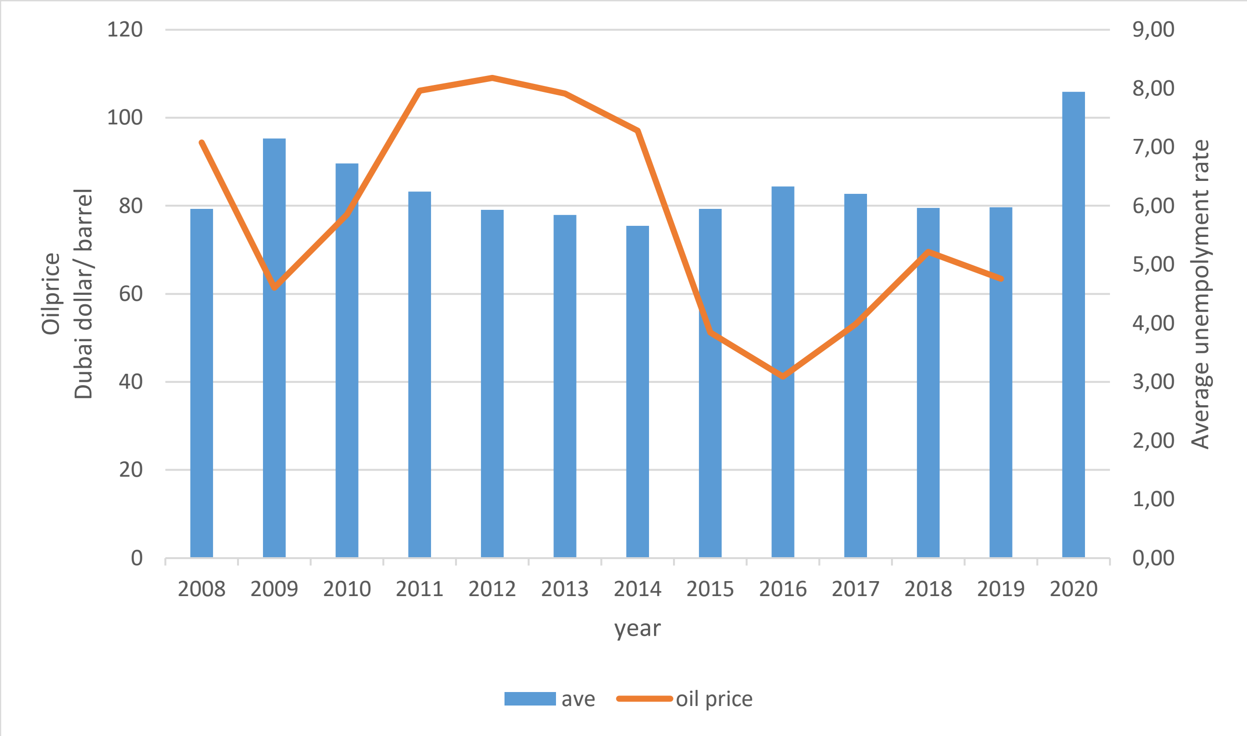


Figure 30: Average unemployment in oil exporting countries and changes in oil prices from 2008 to 2019

Source: Author's own editing based on WDI

5.2.2. Analysing OPEC countries

I analysed the rate of unemployment in OPEC countries and it can be seen from Figure 31 that 2020 show a significant jump in numbers caused by the pandemic.

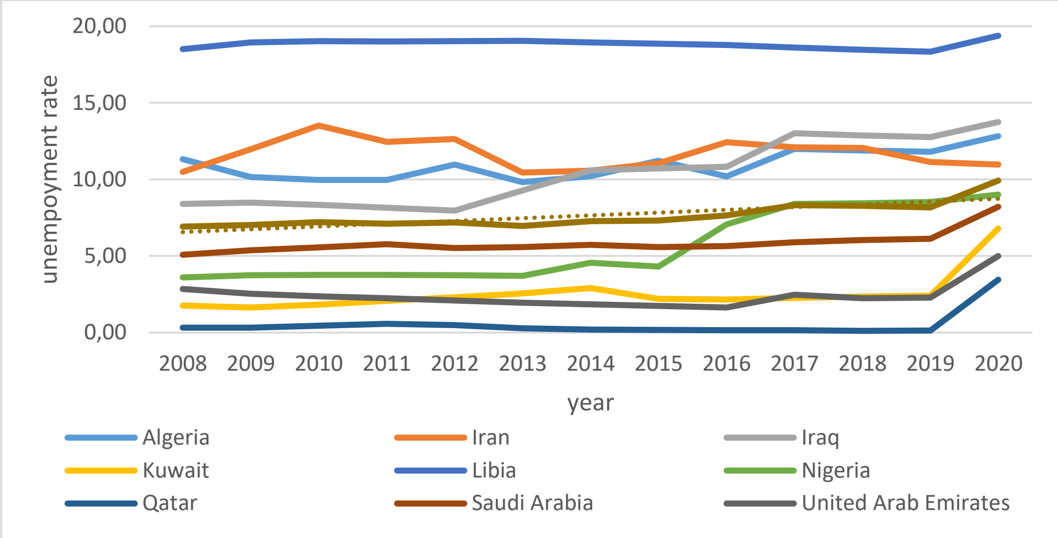


Figure 31: Unemployment rate in OPEC countries

Source: Author's own editing based on WDI

Figure 32 shows the standard deviation of each country. 4 countries show some level of outstanding value, namely Qatar, Kuwait, UAE and Saudi Arabia, which have low unemployment rates on average, but in 2020 there was a significant rise in each country. It can be said that unemployment is on average the same as in oil-exporting countries, but unlike them, there is no significant spike in the graph. Interestingly, Iraq and Nigeria have the largest variance in unemployment in the period 2008-2020. Most countries have a rate of change of no more than 4%, compared to oil-exporting countries, where most of the countries did not have such a low standard deviation.

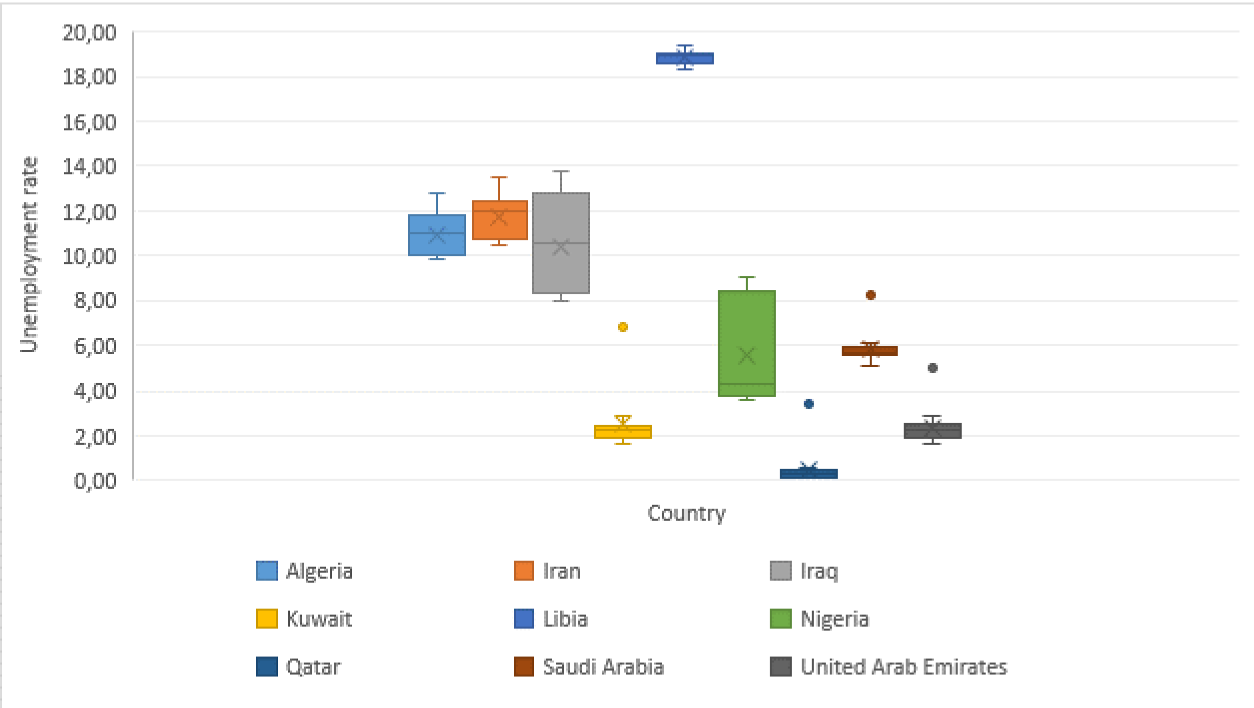


Figure 32: Box plot table based on average and standard deviation of unemployment rate in OPEC countries from 2008 to 2020 based on WDI

Source: Author's own editing

Annual average unemployment rate for OPEC countries was calculated in the next step which is shown in Figure 33. The unemployment rate ranged from 6.9 to 7.65% between 2008 and 2016, but after 2013 there was a steady increase throughout. In 2020, the average unemployment rate reached almost 10%, which has never been so high among OPEC countries. In order to prove my hypothesis, it is necessary to compare these data with the movement of oil prices.

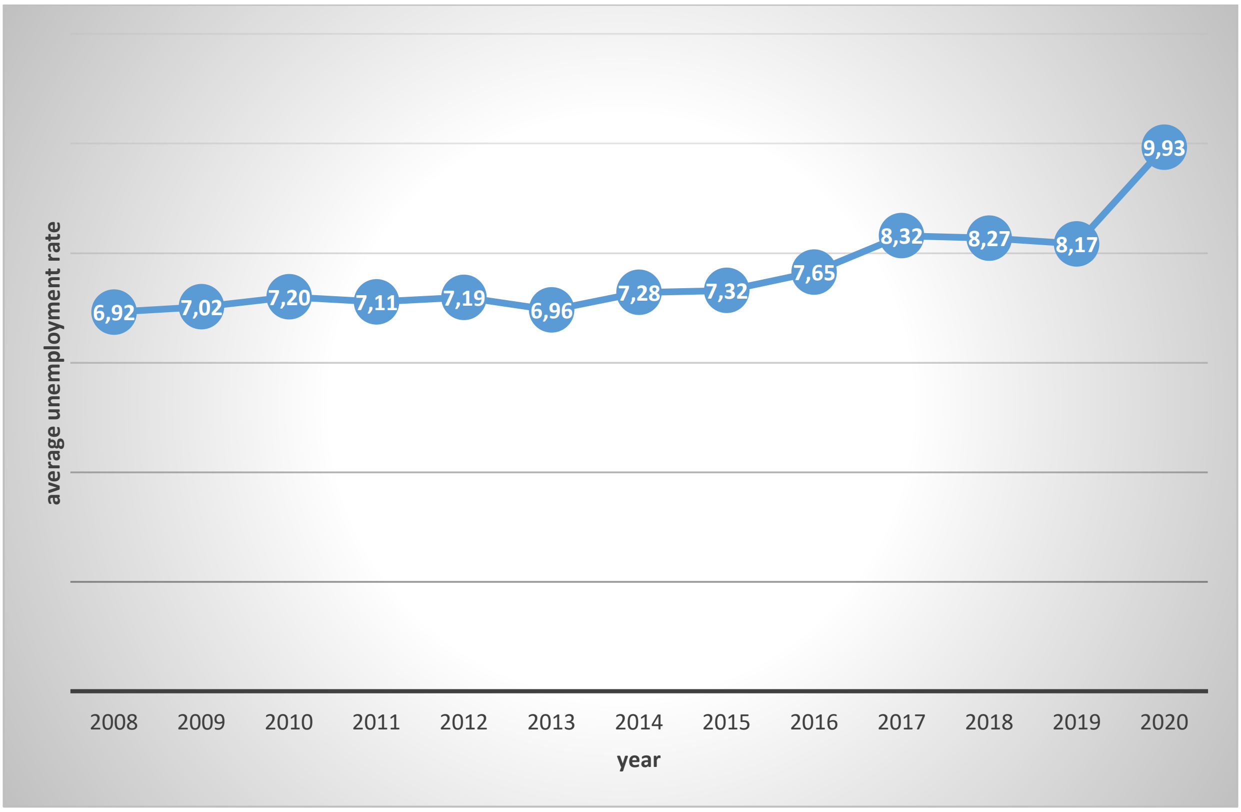


Figure 33: Average unemployment rate of OPEC countries from 2008 to 2020

Source: Author's own editing based on WDI

Figure 34 shows that when oil prices are high, unemployment falls in OPEC countries, but this trend was interrupted in 2015, when the two indicators moved together. This is interesting because not only my assumption but also theoretical research assumes that changes in oil prices have the opposite effect on unemployment in OPEC countries.

To substantiate my assumption, further research is needed. I carried out further analysis after testing my hypothesis on EU countries.

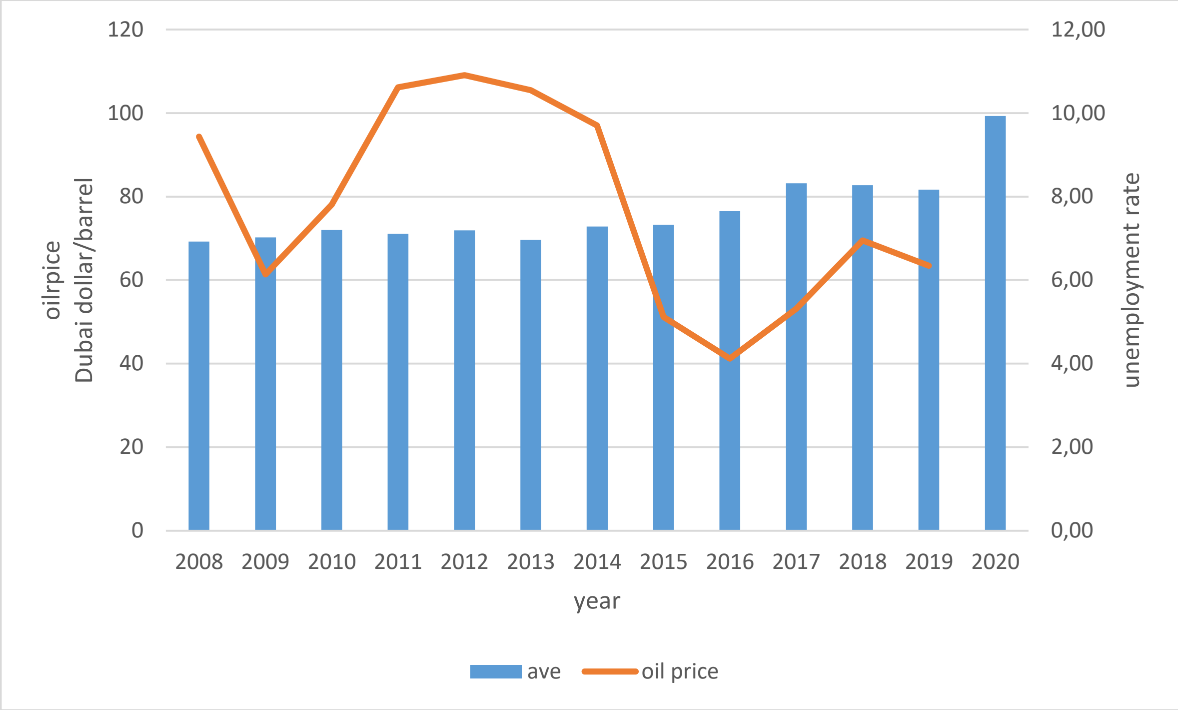


Figure 34: Average unemployment in OPEC countries and changes in oil prices from 2008 to 2019

Source: Author's own editing based on WDI

5.2.3. Analysing EU countries

Unemployment rates in the European Union show a mixed picture, as shown in Figure 56, the highest curve belongs to Ireland, which peaked in 2013 at 15.45%. This was 3% more than in Italy (12, 68%) in 2014. In general, unemployment in the EU countries tends to be between 2 and 10% and the linear trend is declining relative to the overall average.

A graphical analysis of Figure 35 shows that the economic downturn of 2008 had a more visible effect from 2010, but peaked between 2012 and 2014. After the following years in most countries it shows a decline until 2020. The EU's policy of keeping Member States' unemployment rates low and preferably below 8% has been reached.

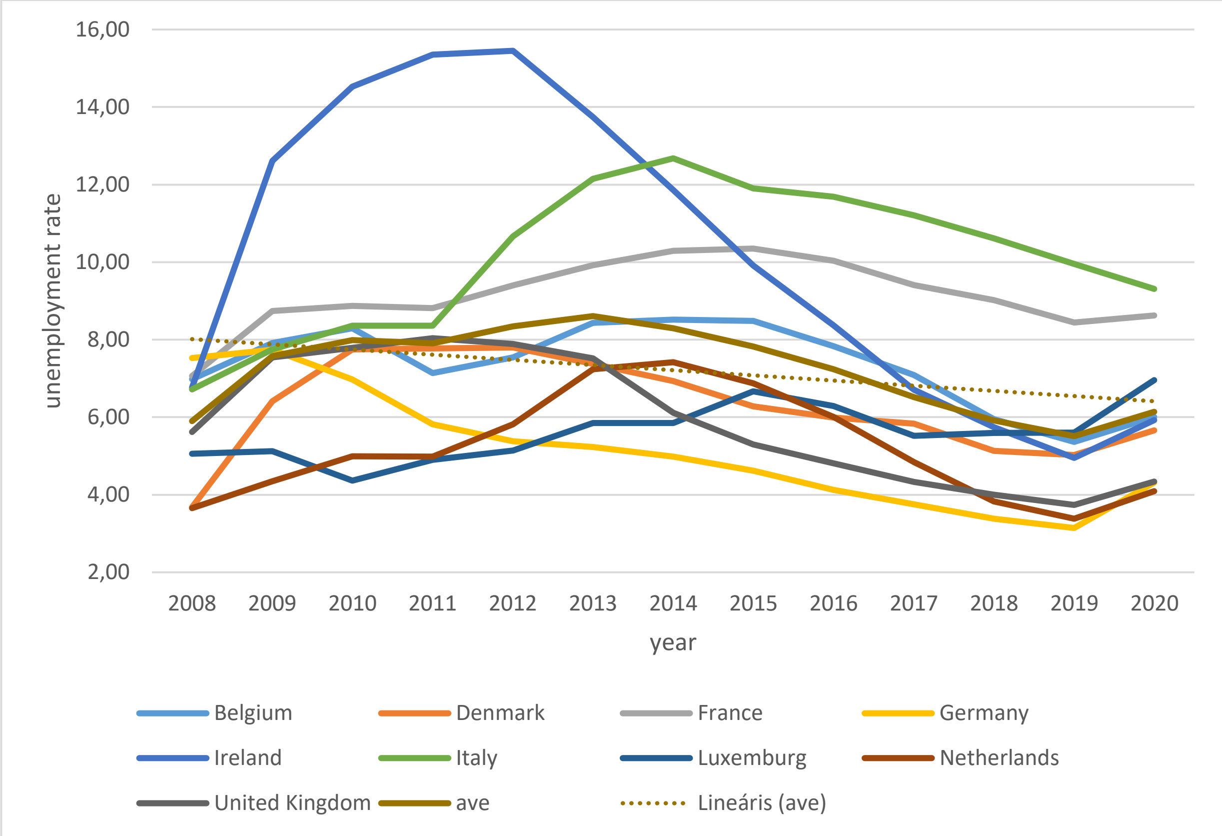


Figure 35: Unemployment rate in selected EU countries

Source: Author's own editing based on WDI

Figure 36 shows that, unlike the oil-exporting and OPEC countries surveyed earlier, none of the countries has an extreme value. Although Ireland shows high values, even Italian unemployment, which appears to be high is not significantly larger than other EU countries. The case of Italy differs from that of other countries in that the average is higher here, in contrast to other countries, where they approach the lower part of the boxes. The most stable country is Luxembourg, which has a low unemployment rate of 4-7% and is a relatively stable country, with the highest value in 2020.

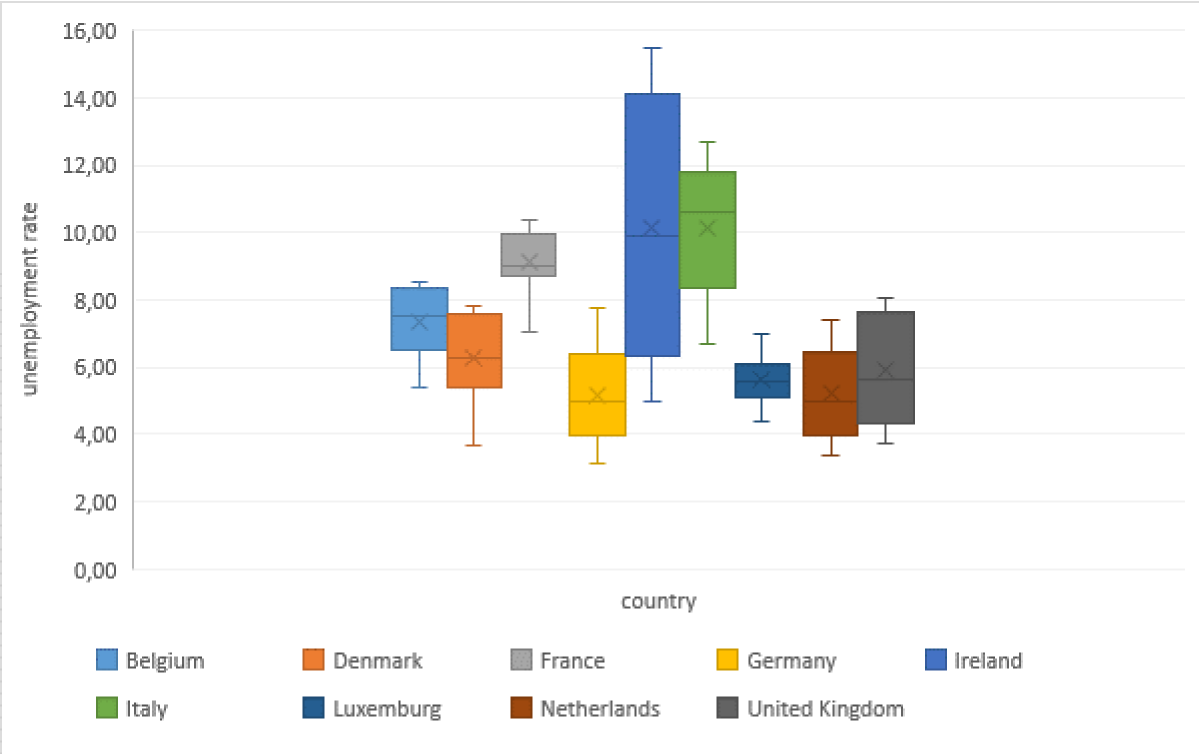


Figure 36: Box plot table based on average and standard deviation of unemployment rate in selected EU countries from 2008 to 2020

Source: Author's own editing based on WDI

Examining the averages over the period 2008-2020, we can see that there is no year when unemployment is below 5.51% and the highest value was 8.62% in 2013 according to Figure 37. From 2013, there was a relative decline and the trend showed moderate fluctuation until 2020.

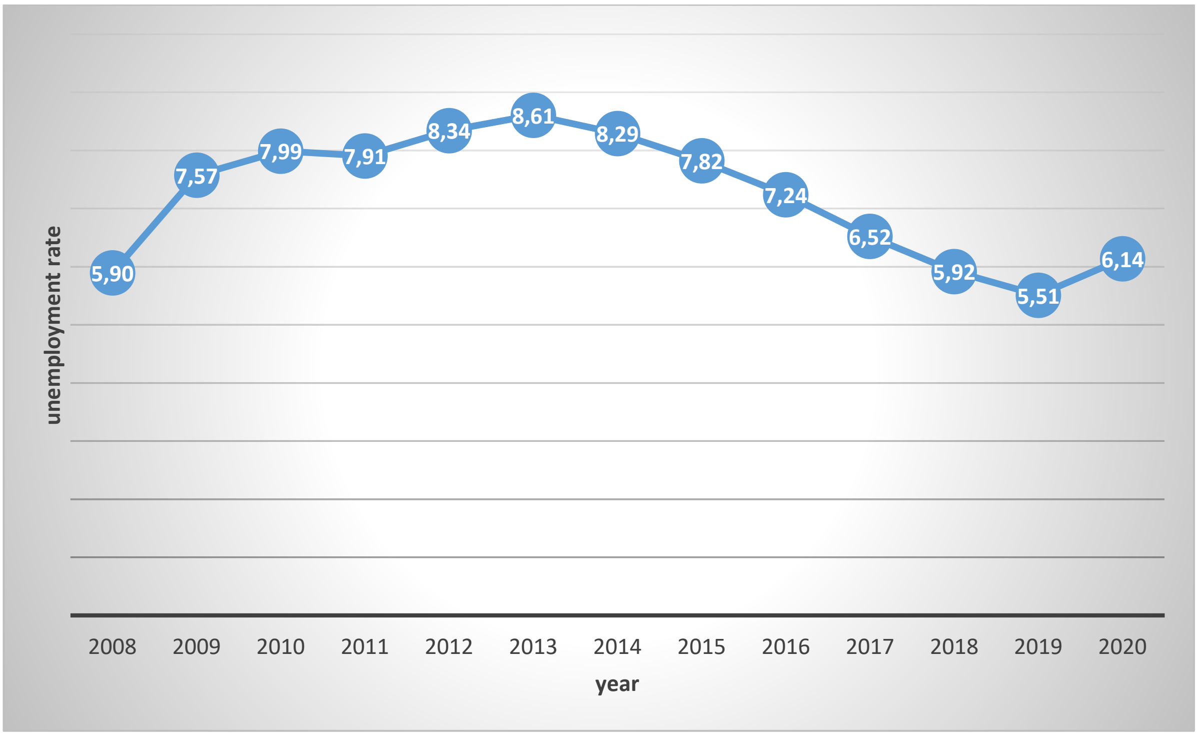


Figure 37: Average unemployment rate of selected EU countries from 2008 to 2020

Source: Author's own editing based on WDI

I concluded my research of EU countries with a comparison, namely, in the joint representation of unemployment and oil prices. As Figure 38 shows, the high unemployment rate in EU countries correlates more closely with changes in oil prices. I examine this correlation with a different method, but I assume that the appearance of oil prices in the economy and its impact on unemployment is more complex. The labour market may respond to oil price changes in a slower pace because of price inelasticity.

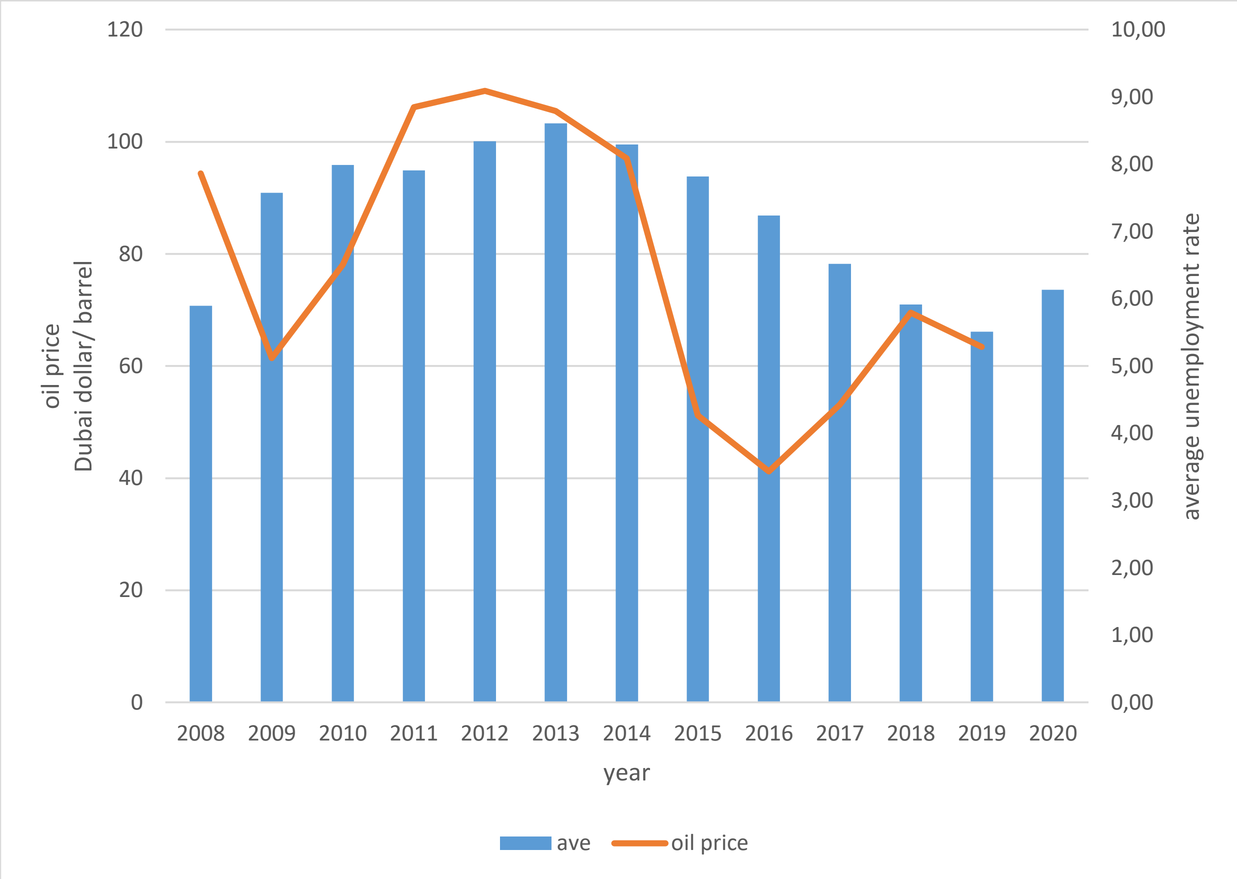


Figure 38: Average unemployment in OPEC countries and changes in oil prices from 2008 to 2019

Source: Author's own editing based on WDI

I compared the different types of countries with the change in oil prices. Figure 39 shows that oil prices and unemployment rates seem to move in opposite direction in oil-exporting countries, while in the case of EU and OPEC countries the two indicators seemingly follow each other.

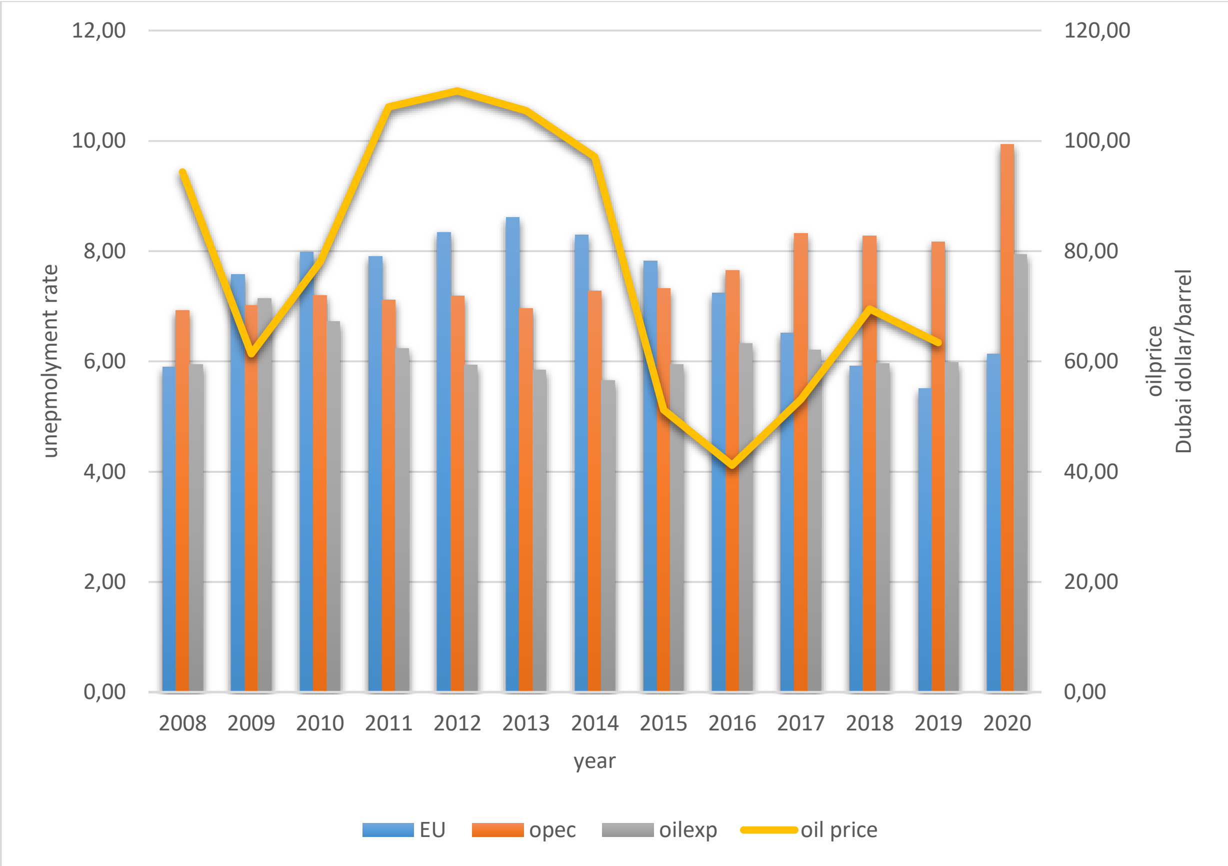


Figure 39: Oil price and unemployment rate in each examined country group from 2008 to 2019

Source: Author's own editing based on WDI

I examined the relationship between unemployment rate of each country group and oil prices. I performed a correlation analysis with the SPSS program. As shown in Table 3, examining the hypothesis, I was able to show correlations between the unemployment rate and the change in oil prices. The tests were satisfactory as they reached the 95% correlation level, so I accepted the hypothesis.

The examined relationship is stronger on the basis of statistical indicators than I first assumed. For the EU countries, the correlation value was 0.430 (p = 0.05). We can say there is a correlation between the rise in oil prices and the change in the unemployment rate. This relationship is detectable, not significantly strong or weak. In contrast, in the case of oil expending countries, as I stated in my hypothesis, is the opposite - 0.366 (p = 0.05), the relationship is the opposite, but weaker than in the case of the EU countries. My hypothesis was confirmed that rising oil prices would reduce unemployment in oil-exporting countries.

This relationship is even stronger in the OPEC countries, where the Pearson's correlation rate is r = -0.571 (p = 0.05), which means a significant opposite relationship. In other words, the effect is even more pronounced in the case of OPEC countries, that if the price of oil rises, they will be able to employ more people, and thus the unemployment rate will fall.

Table3: Correlation between the unemployment rate of examined country groups and oil price

		EU	opec	oilexp	oil price
EU	Pearson Correlation	1	-,653*	,061	,430
	Sig. (2-tailed)		,021	,850	,163
	N	12	12	12	12
opec	Pearson Correlation	-,653*	1	-,158	-,571
	Sig. (2-tailed)	,021		,623	,053
	N	12	12	12	12
oilexp	Pearson Correlation	,061	-,158	1	-,366
	Sig. (2-tailed)	,850	,623		,242
	N	12	12	12	12
oil price	Pearson Correlation	,430	-,571	-,366	1
	Sig. (2-tailed)	,163	,053	,242	
	N	12	12	12	12

*. Correlation is significant at the 0.05 level (2-tailed).

Source: Author's own editing based on SPSS calculations of data from WDI

Examining my hypothesis, I found that changes in oil prices can have an impact on either oil exporting or oil importing countries, but to varying degrees. My hypothesis consisted of two parts, the first is that as a result of rising oil prices, the unemployment rate will decrease in oil exporting and OPEC countries as they can employ more people. This statement was substantiated because both the correlation diagrams and the correlation table showed that there is an opposite relationship between them. The correlation is opposite, if oil prices fall, the unemployment rate in these oil exporting countries will rise.

The other part of the hypothesis is that in the case of non-oil producing countries in the EU, the price of oil should move in parallel with the unemployment rate. I was able to show positive relationship between them.

5.3. The analysis of the relationship between oil price and final consumption expenditure of households

H3: There is a negative linear relationship between oil price and the final consumption expenditure of households in oil exporting, OPEC and EU countries.

Regarding Hypothesis 3 I wanted to analyse to what extent the change in oil price appears in final consumption expenditure of household. I assumed falling oil prices generate larger demand and intensify household consumption in both oil exporting and oil-importing countries

5.3.1. Analysing oil exporting countries

As it can be seen in Table 4, the households final consumption expenditure of the oil exporting countries has been growing slightly since 2008, with the lowest in 2008 being China, at 35.29, and by 2019 it has risen to 38.95. It is followed by Norway, with 38.39 and by 2019 it has reached 44.83, an increase of 6%. The USA is the most stable, as their consumption changed from 6.81 in 2008 to 68.86 in 2019. There was also no significant increase in consumption in some countries, such as Canada, Colombia and Russia. The only country where I have seen a decline is Mexico, which has fallen from 66.93 to 64.88. Canada has been close to the average almost every year since 2008.

Table 4: Households final consumption expenditure of oil exporting countries from 2008 to 2019

year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Brazil	59,73	61,96	60,22	60,27	61,41	61,72	62,96	63,96	64,25	64,48	64,70	64,94
Canada	54,60	57,72	57,13	56,03	56,02	55,96	55,80	57,81	58,48	57,93	57,94	57,79
China	35,29	35,33	34,33	34,92	35,39	35,83	36,71	37,77	38,67	38,54	38,52	38,95
Colombia	66,08	66,52	65,93	64,57	65,63	65,53	65,97	68,48	69,06	68,51	68,04	68,39
India	56,68	55,96	54,72	56,21	56,46	57,65	58,13	59,01	59,30	59,02	59,32	60,29
Mexico	66,93	65,83	65,35	64,81	64,72	66,47	65,86	65,41	65,52	65,22	64,76	64,88
Norway	38,39	42,25	41,95	40,29	39,70	40,19	41,02	43,53	45,56	44,66	43,43	44,83
Russia	48,90	54,64	51,49	50,38	51,45	53,17	53,76	52,68	53,25	52,87	49,46	50,38
USA	67,81	68,12	67,94	68,46	67,96	67,43	67,45	67,48	68,23	68,34	67,99	67,86
ave	**54,93**	**56,48**	**55,45**	**55,11**	**55,42**	**55,99**	**56,41**	**57,35**	**58,04**	**57,73**	**57,13**	**57,59**

Source: Author's own editing based on WDI

Figure 40 shows that the average value, which appears to be stable at first, if I graphically plot it, no longer seems so stable, we can see highs and lows between 2010 and 2011 and a decrease between 2017 and 2019. Nevertheless, the trend is clearly positive.

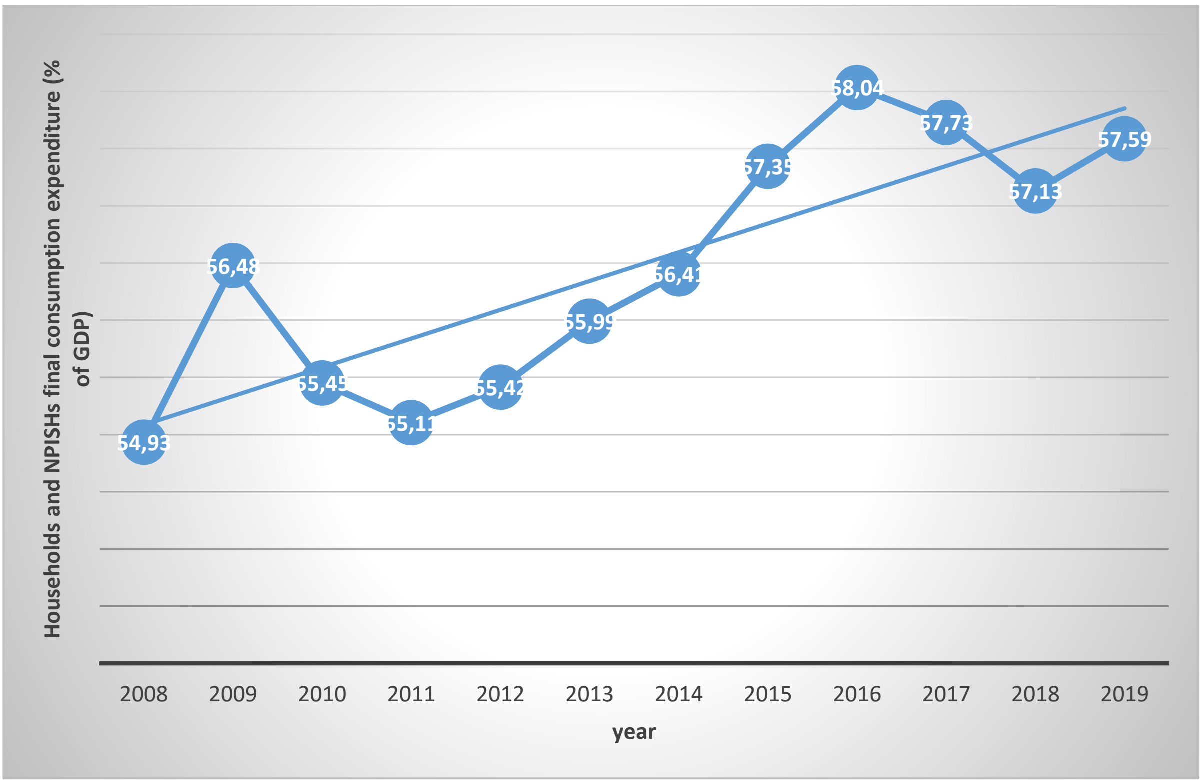


Figure 40: Households final consumption expenditure of oil exporting countries from 2008 to 2019

Source: Author's own editing based on WDI

Since I examined distribution, I researched how much fluctuation is experienced for each country. Figure 41 shows that the countries can be well distinguished from each other in the box-plot figure. Countries were characterized by stability.

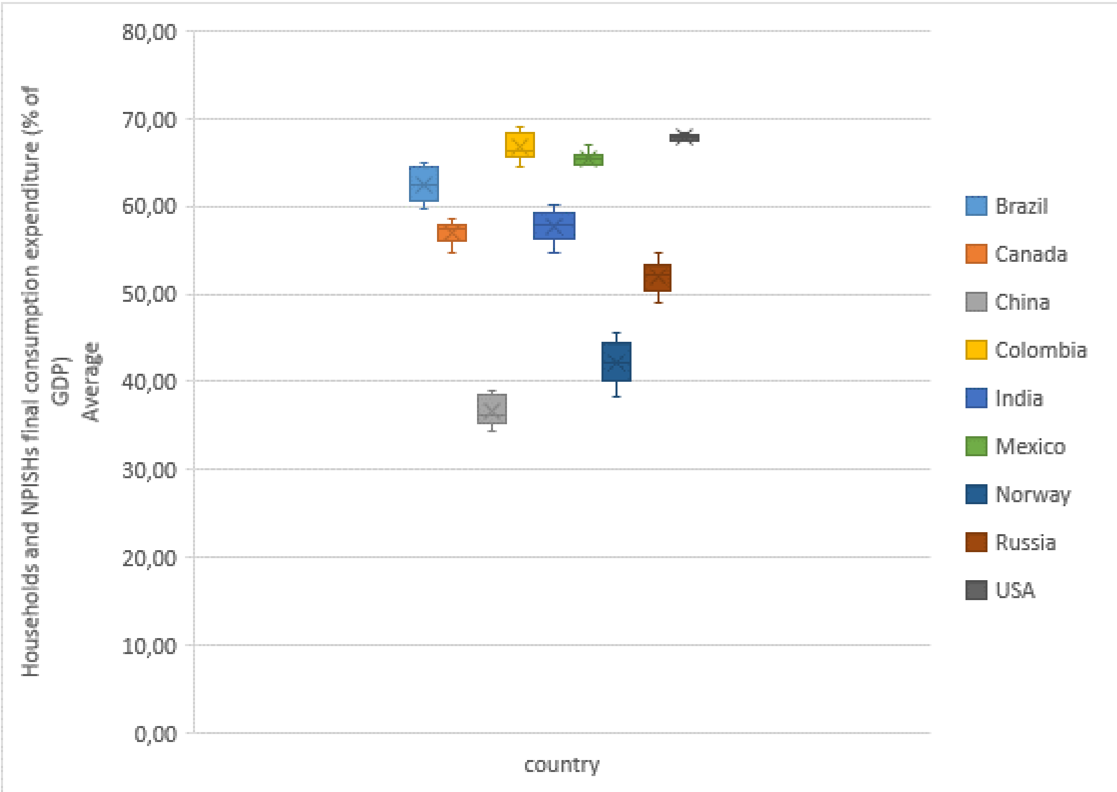


Figure 41: Boxplot of households final consumption expenditure of oil exporting countries from 2008 to 2019

Source: Author's own editing based on WDI

Figure 42 shows how I can represent the relationship between observed and expected normal values among oil exporting countries. As shown in Figure 59 above, the highest value was between 54 <and> 59. The deviation of the averages from the real average is not significant, but none of the countries is situated on the straight line representing the average.

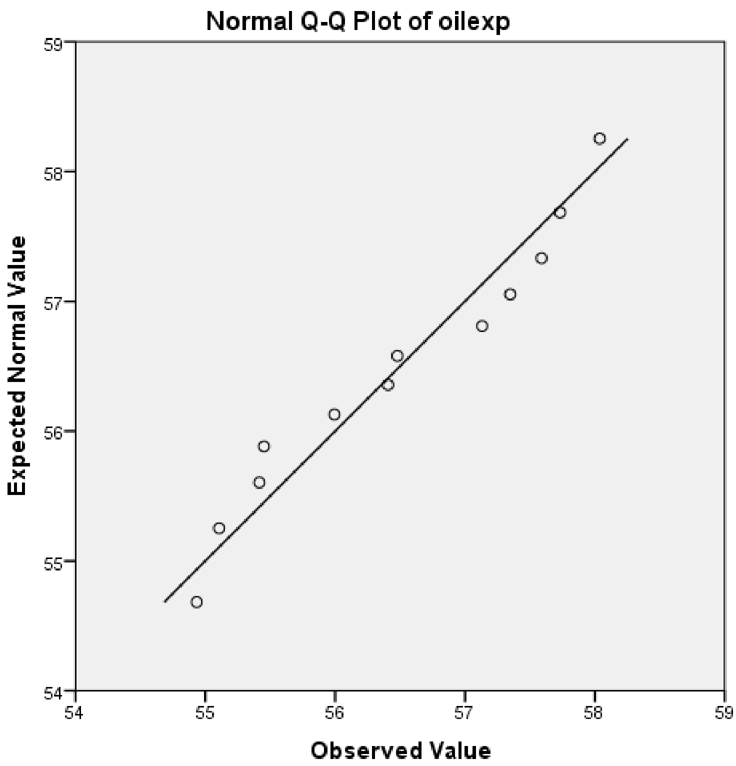


Figure 42: Q:Q plot of oil exporting countries

Source: Author's own editing based on SPSS calculations of data from WDI

I continued my research by comparing households final expenditure with changes in oil prices and, we can immediately see (Figure 43) that the indicators are moving in the opposite direction.

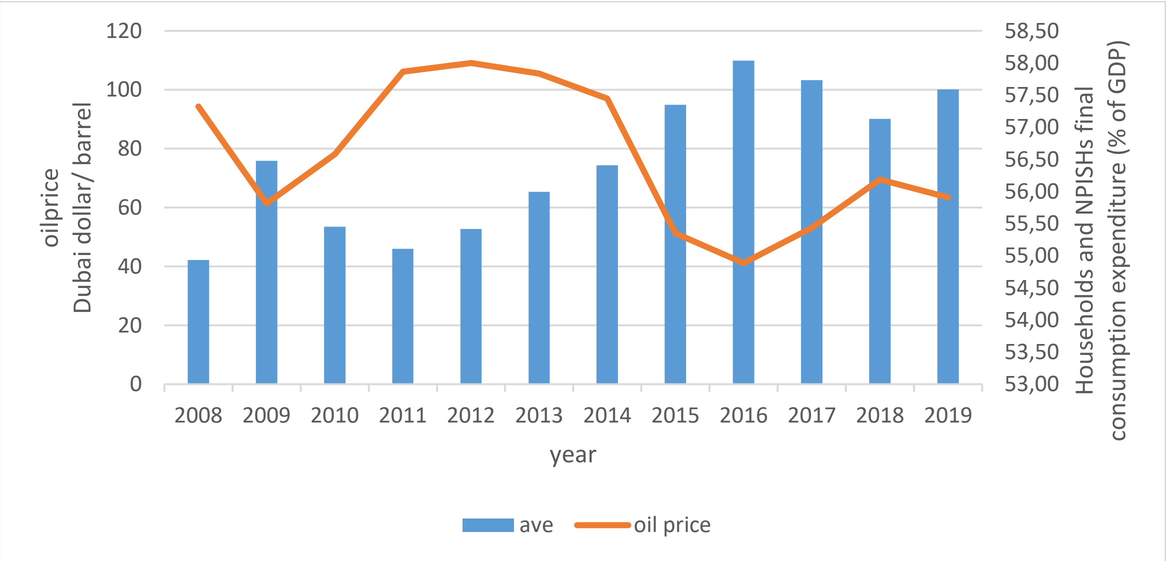


Figure 43: Oil price and households final consumption expenditure of oil exporting countries from 2008 to 2019

Source: Author's own editing based on WDI

5.3.2. Analysing OPEC countries

I continued my research by examining OPEC countries. I assumed that household consumption would be similar to oil-exporting countries, and trends may even become stronger. Table 5 shows the consumption indicators for OPEC countries, I was not able to find data for Kuwait for 2019 As can be seen from the table, the average consumption figures in 2008 were 36.51, which increased to 47.39 11 years later. In other words, we can see significant increase in consumption. Significant increases were observed in all countries except the UEA and Nigeria, with the largest increase observed in Iraq and Saudi Arabia and Algeria.

Table 5: Households final consumption expenditure of OPEC countries from 2008 to 2019

year		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Algeria		30,18	37,56	34,32	31,18	32,15	34,66	36,36	41,01	42,51	42,56	41,89	43,50
Iran		41,66	44,50	42,92	43,39	47,67	45,57	46,32	50,30	49,39	47,62	48,52	49,65
Iraq		31,26	52,25	44,46	35,67	39,76	48,50	51,80	58,21	64,11	58,77	57,51	62,71
Kuwait		28,14	33,50	28,89	24,24	23,65	25,15	28,98	41,55	45,23	43,30	39,18	
Nigeria		60,13	68,10	67,16	66,03	58,60	72,89	71,75	78,57	81,54	80,13	76,60	73,49
Qatar		15,41	19,28	16,17	13,41	13,41	14,56	15,78	22,29	25,71	25,49	23,01	24,53
Saudi Arabia		26,88	36,78	32,28	27,08	28,46	29,96	32,08	40,30	42,81	41,19	37,91	38,94
United Arab Emirates		58,38	52,29	42,24	38,40	32,14	33,94	36,27	35,41	36,20	37,31	38,30	38,91
ave		**36,51**	**43,03**	**38,56**	**34,93**	**34,48**	**38,15**	**39,92**	**45,96**	**48,44**	**47,05**	**45,37**	**47,39**

Source: Author's own editing based on WDI

The summary of the table and the average consumption can be seen in Figure 44. We can see a smaller amount of average household consumption. The decline was caused by the effects of the 2008 economic crisis. In 2018 we can see another downward trend reducing consumption to 2015 levels.

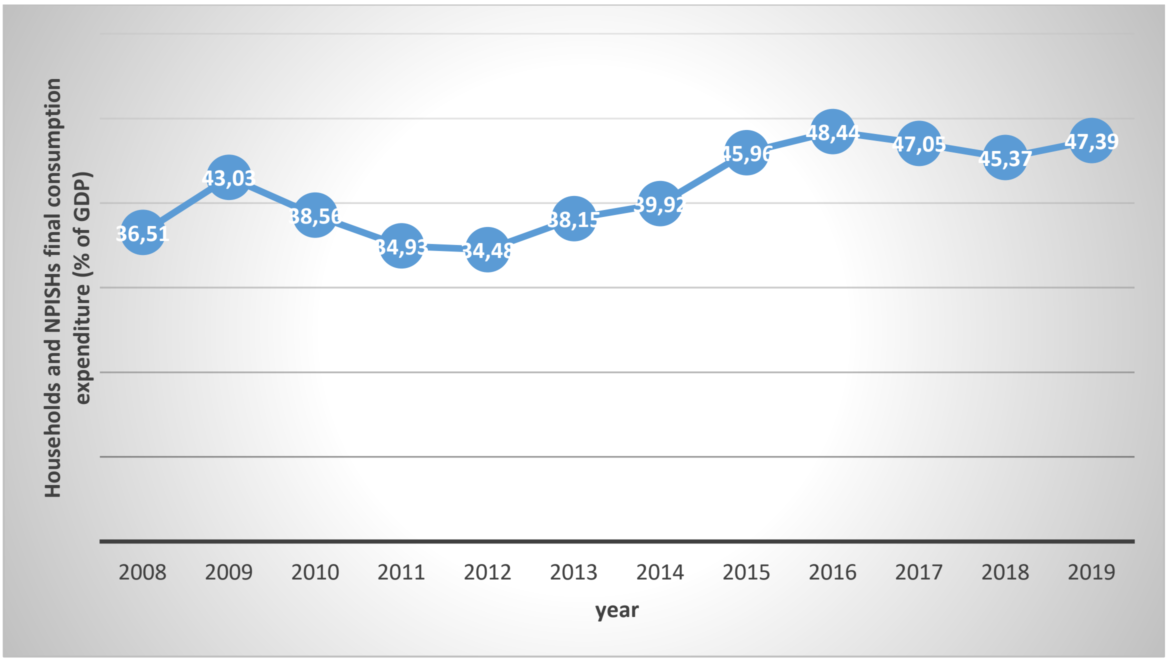


Figure 44: Households final consumption expenditure of OPEC countries from 2008 to 2019

Source: Author's own editing based on WDI

Comparing the data to oil exporting countries, it can be said that OPEC household consumption is considerably lower.

Each country shows a more complex picture of the box-plot in Figure 45 it can be seen that two points appeared above the UEA, indicating that they have reached outstanding values in 2008 and 2009, their consumption was above 50% in both years. It can also be seen from the box-plot figure that Nigeria ranks much higher than the other countries.

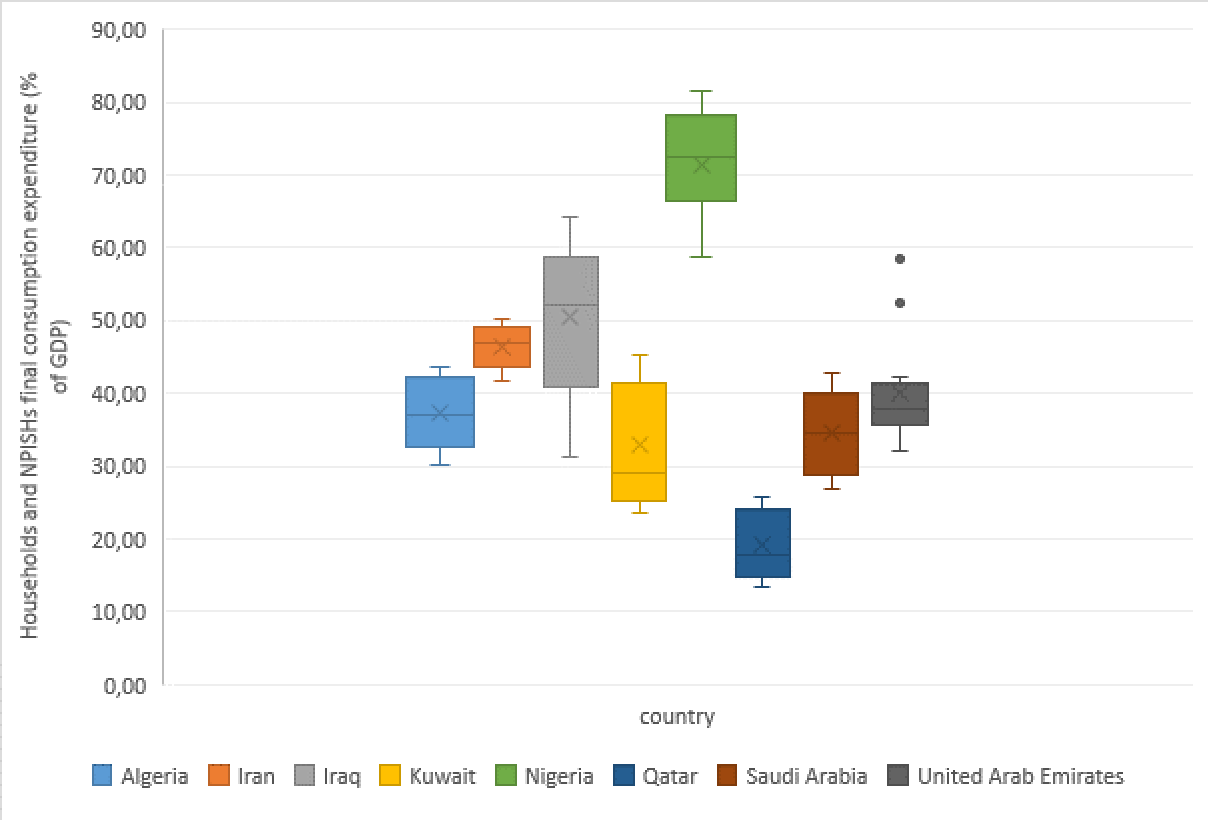


Figure 45: Boxplot of households final consumption expenditure of OPEC countries from 2008 to 2019

Source: Author's own editing based on WDI

In Q: Q plot (Figure 46), I examined if there is a country which average coincides with the expected or observed value in the range of 34 <> 50, I found Iran in that category with 47% in 2017.

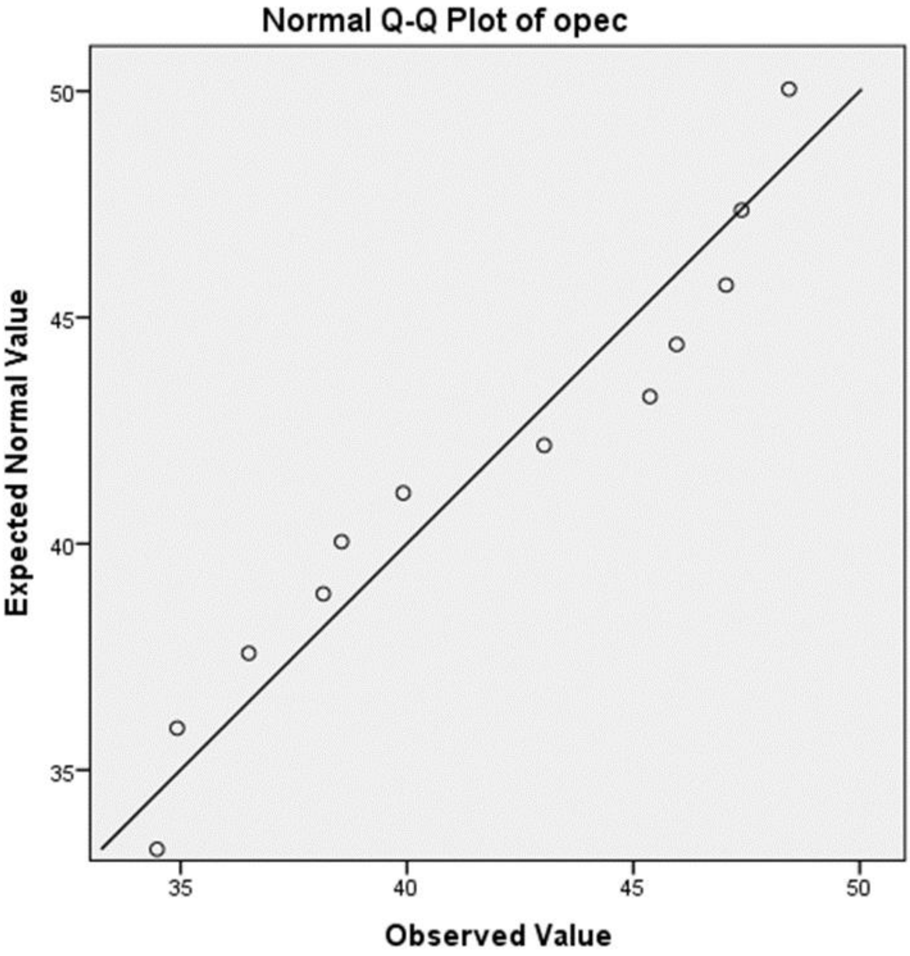


Figure 46: Q: Q plot of oil exporting countries

Source: Author's own editing based SPSS calculations of data from WDI

As I defined in my hypothesis I expect non-linear relationship between changes in oil prices and household average consumption. Figure 47 shows that the decline in oil prices is accompanied by an increase in the final consumption expenditure of households. My research question is how significant this is and what the relationship is between them. I assume that it will be negative and significant.

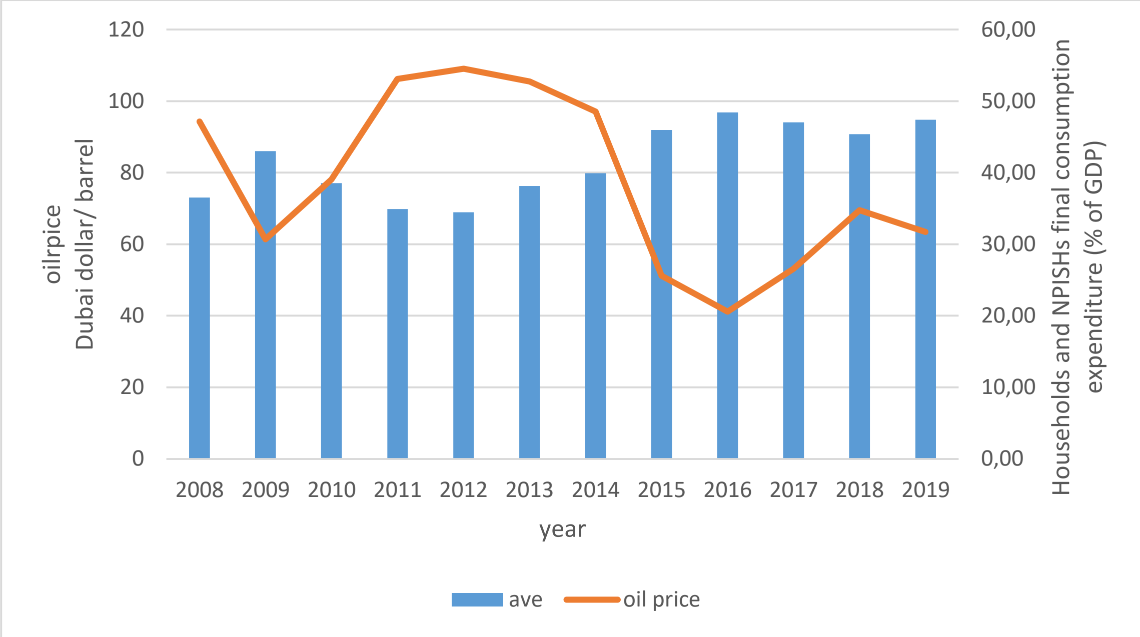


Figure 47: Oil price and households final consumption expenditure of OPEC countries from 2008 to 2019

Source: Author's own editing based on WDI

5.3.3. Analysing EU countries

I firstly examined the extent of the development of households final consumption expenditure in each country. As it can be seen from Table 6, each country has an indicator for each year and significant differences in consumption expenditure can be observed. At first glance, we see that EU countries are approaching 5%, similar to oil exporting countries. Consumption expenditure rates appear to be more stable for most countries, with values not moving as widely as in OPEC countries. This is also shown by the average expenditure, which was 50.86% in 2008 and fell to 48% by 2019.

Table 6: Households final consumption expenditure of selected EU countries from 2008 to 2019

year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Belgium	50,72	51,37	51,44	51,54	51,94	52,46	51,81	51,34	51,29	51,48	51,75	51,40
Denmark	47,39	48,48	47,61	47,91	48,04	47,69	47,16	47,11	46,67	46,36	46,72	46,09
France	54,47	55,38	55,36	54,98	54,72	54,64	54,31	54,05	54,26	53,98	53,89	53,73
Germany	54,22	56,44	55,11	54,39	54,91	54,56	53,42	52,97	52,75	52,27	52,30	52,39
Ireland	48,67	47,73	47,58	46,39	45,47	45,04	43,00	33,04	33,78	32,17	31,02	30,42
Italy	59,43	60,43	60,73	61,12	61,30	60,90	60,61	60,77	60,12	60,25	60,20	60,14
Luxemburg	32,91	34,16	32,19	31,33	32,19	31,67	30,91	30,14	29,67	29,81	29,76	29,49
Netherlands	45,65	45,70	45,45	45,64	45,51	45,49	45,30	45,05	44,62	44,34	44,13	43,78
United Kingdom	64,23	64,63	64,25	64,28	64,56	64,85	64,45	64,47	65,10	65,01	65,48	64,81
ave	50,86	51,59	51,08	50,84	50,96	50,81	50,11	48,77	48,70	48,41	48,36	48,03

Source: Author's own editing based on WDI

In my research, I examined the development of the average consumption expenditure over the period under review and it is evident that unlike oil-producing countries and OPEC countries, we can observe a dynamic decline after 2009, which is interrupted by a larger fall from 2014 to 2015, but continues after that. Changes after 2015 do not even reach 1%, so it can be said that their consumption is much more stable than in the other countries studied (Figure 48).

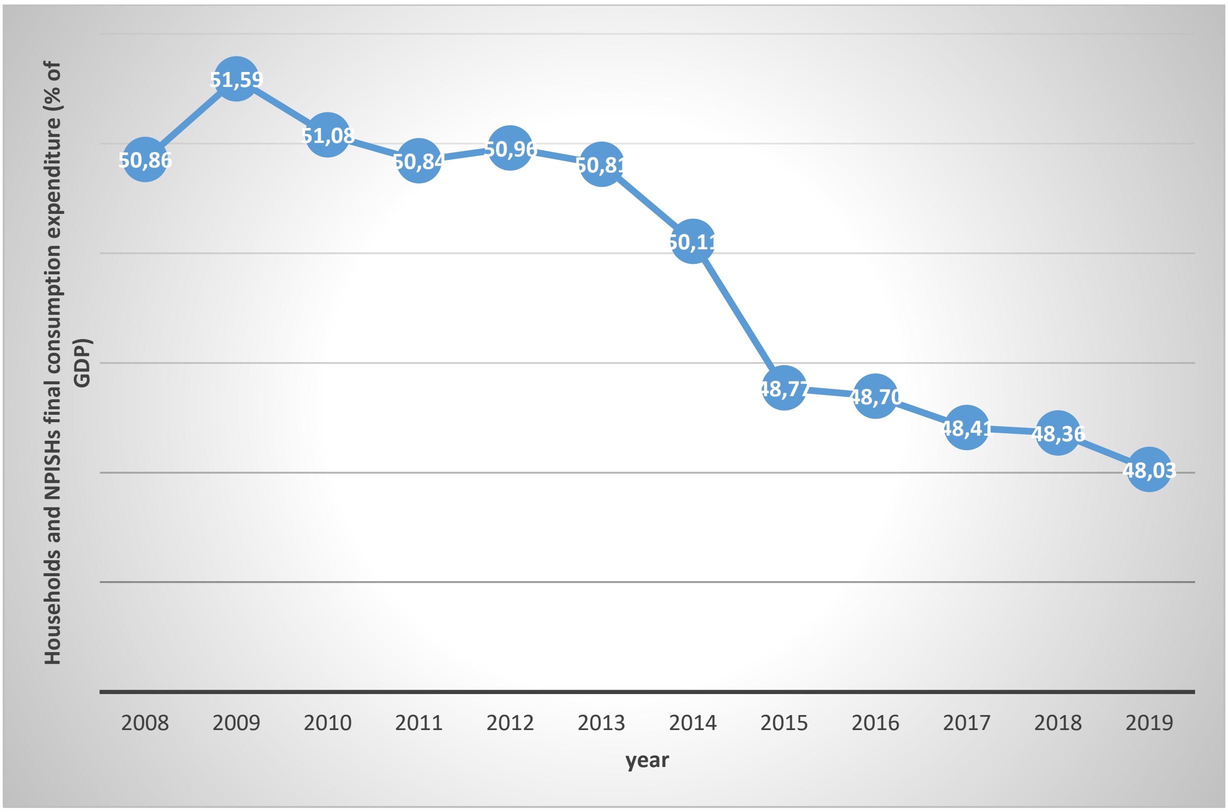


Figure 48: Oil price and households final consumption expenditure of OPEC countries from 2008 to 2019

Source: Author's own editing based on WDI

This observation is also supported by the box-plot in Figure 49 where the values are completely smooth, with Ireland alone being the one that stands out spectacularly from the other countries. The graph shows similarities to oil exporting countries.

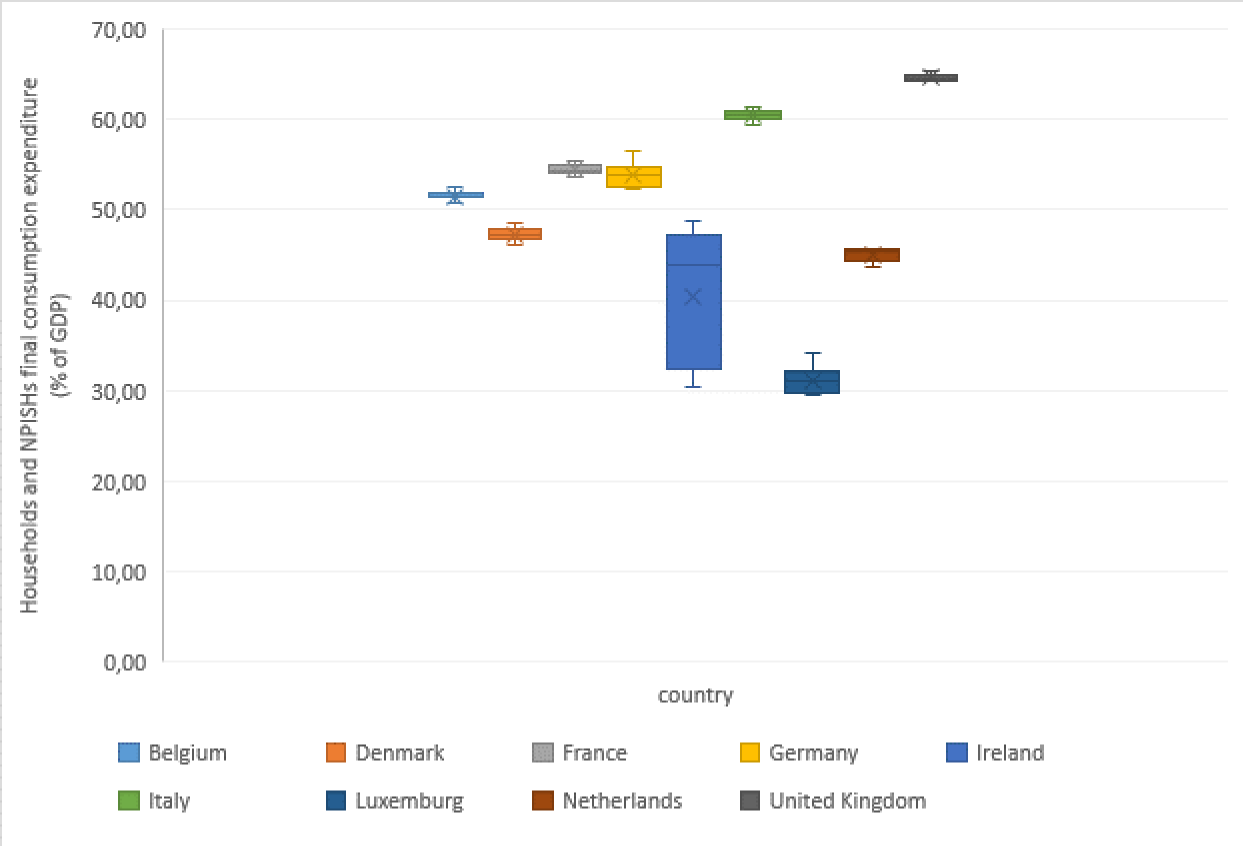


Figure 49: Boxplot of households final consumption expenditure of OPEC countries from 2008 to 2019

Source: Author's own editing based on WDI

I also plotted the Q-Q distribution in Figure 50 and observed that for European countries, the country average does not coincide with the Q – Q plots compare distributions. However, in terms of their location, they differ from both the expected normal value and the observed value. Denmark approached the average most in 2015 and Belgium in 2010. This suggests that the average distribution in each country is wider.

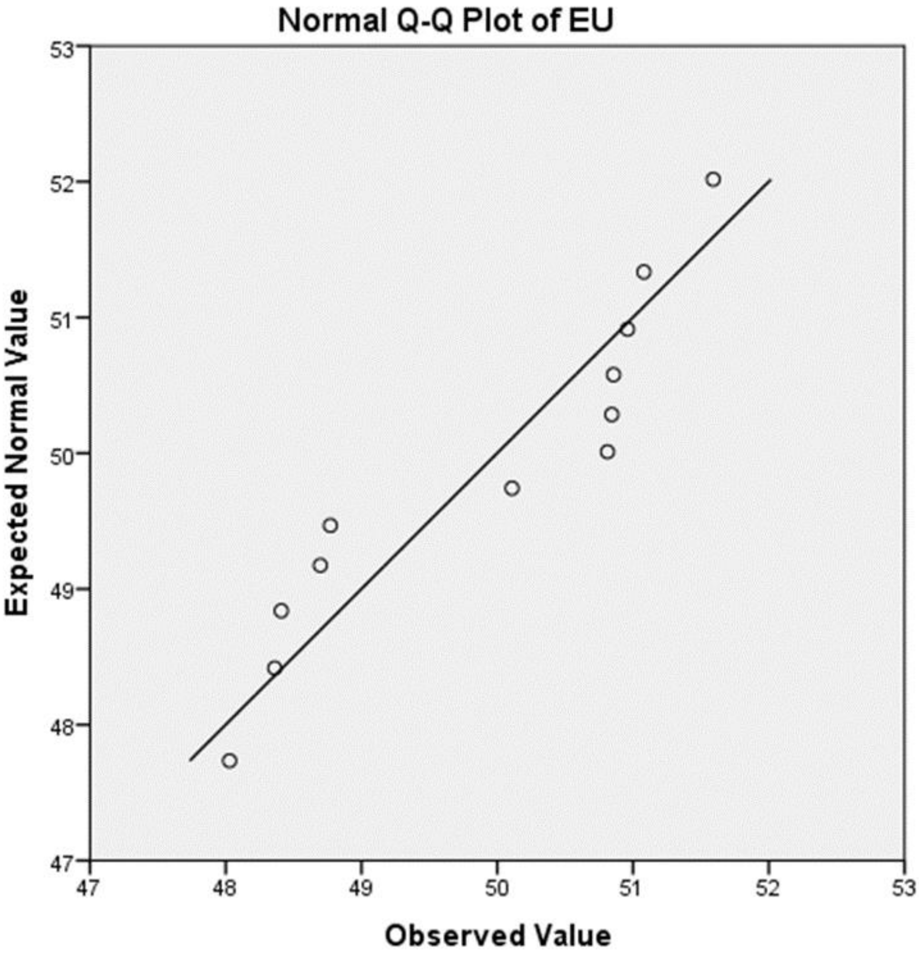


Figure 50: Q: Q plot of selected EU countries

Source: Author's own editing SPSS calculations of data from WDI

Figure 51 shows that the two factors examined follow each other slightly, but in terms of their extent, they do not appear to be as close as they appeared among the OPEC countries. The rise in oil prices in 2009 led to a decline in household consumption expenditure the curve appears to be broken in 2015 and 2016 and moved more in the opposite direction. Before 2016, oil prices and consumption expenditure appear to be moving in parallel, but this will change afterwards because by 2019, the two figures will be separated.

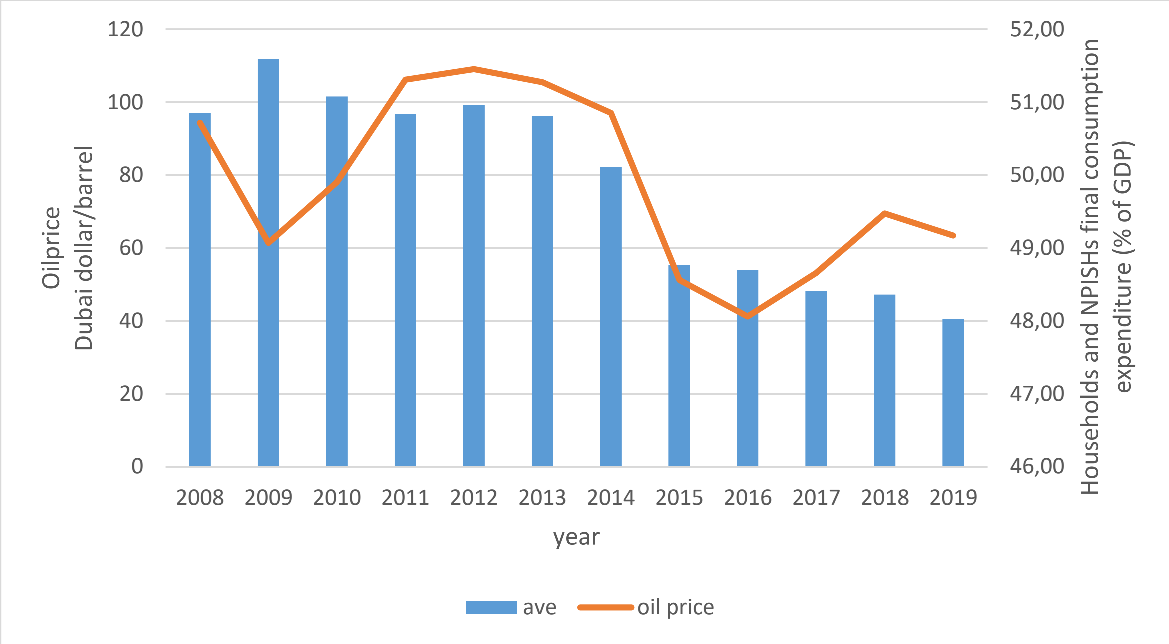


Figure 51: Oil price and households final consumption expenditure of selected EU countries from 2008 to 2019

Source: Author's own editing based on WDI

I continued my research with a correlation study to analyse the relationship observed so far between changes in oil prices and final household expenditure.

Table 7 depicting the correlation was expected to support or reject my hypotheses and I analysed the statistical averages using the bivariate correlation method. Correlation does not measure cause-and-effect, but was used to see how strong an effect exists among the factors examined.

Table 7: Correlation of oil price change and households final consumption expenditure

		EU	opec	oilexp	oil price
EU	Pearson Correlation	1	-,828**	-,851**	,656*
	Sig. (2-tailed)		,001	,000	,020
	N	12	12	12	12
opec	Pearson Correlation	-,828**	1	,967**	-,927**
	Sig. (2-tailed)	,001		,000	,000
	N	12	12	12	12
oilexp	Pearson Correlation	-,851**	,967**	1	-,847**
	Sig. (2-tailed)	,000	,000		,001
	N	12	12	12	12
oil price	Pearson Correlation	,656*	-,927**	-,847**	1
	Sig. (2-tailed)	,020	,000	,001	
	N	12	12	12	12

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Source: Author's own editing based on SPSS calculations of data from WDI

The analysis showed significant negative linear relationship in oil exporting and OPEC countries. For oil exporting countries, r = -0.847 and p is 99%, i.e. a very strong opposite relationship between them. The relationship is even stronger for OPEC countries, where r = -0.927 (p = 0.00). In the case of the European Union countries, on the other hand, I experienced weaker linear relationship, r = 0.656 (p = 0.05).

I was able to confirm only partially this hypothesis. There is a significant negative linear relationship between oil price changes and households final consumption expenditure in the case of oil exporting and OPEC countries, however this relationship positively linear and weaker in the case of selected EU countries.

5.4. The analysis of the relationship between oil price and CO2 emission

H4: There is a negative linear relationship between oil price and CO2 emission in oil exporting, OPEC and selected EU countries.

My hypothesis is based on the fact that if the price of oil rises, it must have an effect on CO2 emissions in some way. If oil is expensive, people will travel less, and they will purchase less amount of oil products. Thus, the price of oil has some level of regulatory power over CO2 emissions.

The unit used for the test for CO2 is million tonnes of carbon dioxide / year. I did not show the oil price development separately, but I used the oil price movement for the linear regression function. The formula for this is shown in each figure, which is characterized by a negative slope and its value is:$y = -3.5434x + 7211.6$ $R^2 = 0.2235$.

5.4.1. Analysing oil exporting countries

As shown in Table 8 CO2 consumption varies significantly among countries, but shows an increasing trend in each country. Significant differences can be detected among countries, for example, Norway is stable at around 35, while Colombia is rising steadily and increased significantly between 2008 and 2019.

Table 8: CO2 emissions in oil exporting countries from 2008 to 2019

	BRAZIL	CANADA	CHINA	COLOMBIA	INDIA	MEXICO	NORWAY	RUSSIA	USA
2008	374,00	545,60	7378,50	67,40	1466,90	431,60	35,50	1554,30	5675,70
2009	350,50	502,30	7708,80	65,20	1595,60	433,00	35,50	1445,30	5263,90
2010	398,30	526,70	8135,20	72,60	1661,00	442,40	36,50	1492,20	5465,60
2011	424,40	539,00	8805,80	71,30	1735,70	465,40	36,70	1555,90	5355,70
2012	443,40	523,20	8991,50	79,70	1849,20	473,70	36,50	1569,10	5137,00
2013	483,40	541,90	9237,70	83,50	1930,00	472,50	36,50	1527,70	5260,50
2014	504,60	551,30	9223,70	89,20	2083,30	459,20	35,80	1530,80	5300,40
2015	487,60	544,60	9174,60	89,80	2147,80	463,00	35,80	1489,50	5153,70
2016	451,00	535,90	9119,00	97,90	2234,20	468,50	34,70	1501,50	5053,70
2017	458,90	549,50	9229,80	93,20	2316,90	476,00	35,00	1488,40	5014,40
2018	441,80	550,30	9428,70	98,10	2479,10	462,50	35,50	1550,80	5145,20
2019	441,30	556,20	9825,80	100,60	2480,40	455,00	33,50	1532,60	4964,70

Source: Author's own editing based on WDI

I plotted the CO2 emissions of oil exporting countries as shown in Figure 52, in which the trend line represents average emission. Based on linear regression we can see that CO emission is increasing. The formula of the average trend and the value of r2: y = 27.506x - 53255; $R^2 = 0.8483$, I was able to show a rising (positive) value in their CO2 emissions.

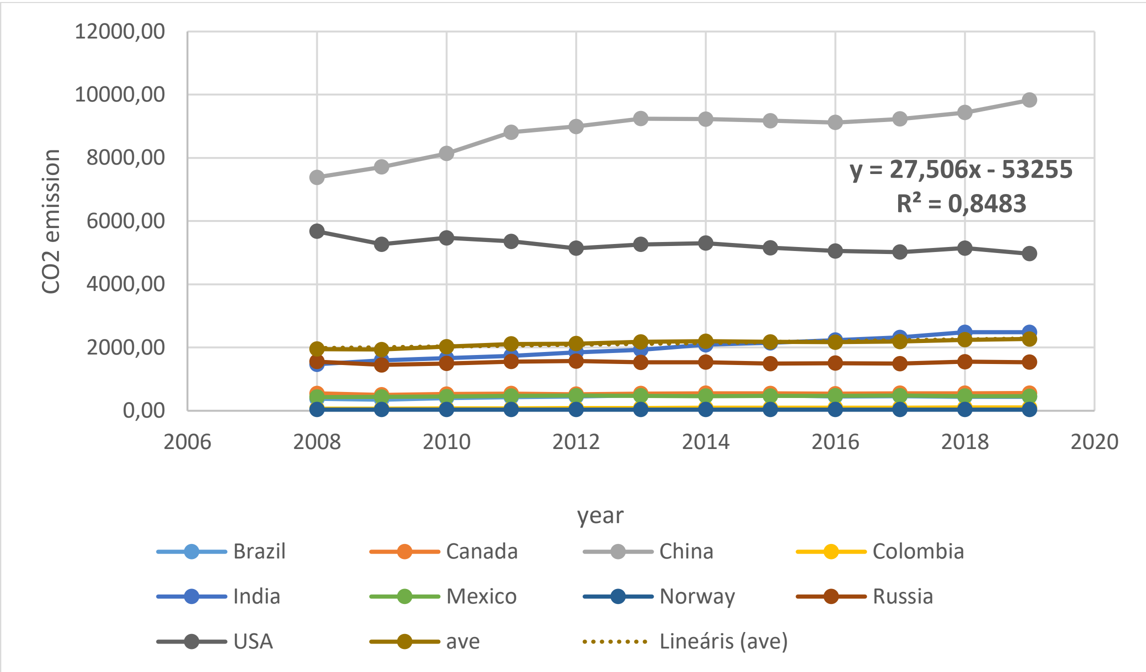


Figure 52: The relationship of the linear regression trend of oil price change and CO2 emission

Source: Author's own editing based on WDI

In the next phase of the research I carried out a correlation examination. As shown in Table 9, based on the descriptive statistics, China has the highest CO2 emissions and the standard deviation is also the highest there (732, 32), followed by India (344.37) and the USA (201, 47). The lowest standard deviation was achieved by Norway and here the average is 35, 62 and the standard deviation is 0.9, meaning CO2 emission was kept on a low level without any change. Here I was able to divide the countries into four groups based on the extent of CO2 emissions. The first Norway and Colombia, who are below 100, the second group has values between 400 and 500, the third group includes Russia and India below 2000, and the last group has values above 5000. In other words, the spectrum of annual CO2 emissions of oil exporting countries are wide.

Table 9: Mean and standard deviation of CO2 emission in oil exporting countries

Descriptive Statistics			
	N	Mean	Std. Deviation
Norway	12	35,625	,9206
Colombia	12	84,042	12,6199
Brazil	12	438,267	45,8551
Mexico	12	458,567	15,2641
Canada	12	538,875	15,1527
Russia	12	1519,842	36,6595
India	12	1998,342	344,3701
USA	12	5232,542	201,4776
China	12	8854,925	732,3244
Valid N (listwise)	12		

Source: Author's own editing based on WDI

Table 10 in Appendix A 2 shows the correlation coefficient, in which we examined the detectable relationship between oil prices and CO2 emissions in each country using Pearson's correlation coefficient.

As it can be seen from the Table, there is a negative and perceptible relationship between some countries and oil prices, such as India (r = -0.504, p = 0.05) and Colombia (r = -0.485, p = 0.05). In contrast, there is a positive and particularly strong relationship between oil-producing countries, such as Norway (r = 0.663, p = <0.05) and Russia (r = 0.678, p <0.05). But even in the case of the USA, there is a strong relationship with the correlation value of 0.525. For China, as the largest emitter of CO2, I did not find only a weak barely perceptible negative relationship with a value of -0.161.

The study was continued with a regression analysis and plotted in Table 11 in Appendix 2 together with ANOVA and coefficient analysis. The result of the ANOVA is 0.245 and the degree of freedom is F = 3.450. The significance in the coefficient table is the highest for Mexico and India the value for "t" is Mexico t =, 511 and India t = 0.584.

Based on this, I concluded that there is no definite relationship between oil prices and CO2 emissions in oil exporting countries.

5.4.2. Analysing OPEC countries

For the OPEC countries (Table 12) I also examined the components as in the oil exporting countries and compared the data obtained. It can also be seen here that there is a significant divergence between some countries, with Iran and Saudi Arabia being the largest emitters of CO2, followed by the United Arab Emirates. As we examine Table 11, we can see that here emissions are rising in the case of all countries between 2008 and 2019. The CO2 emissions of OPEC countries are much more homogeneous than those of oil producers. To substantiate this statement I set up a trend in the next step.

Table 12: CO2 emissions in OPEC countries from 2008 to 2019

	ALGERIA	IRAN	IRAQ	KUWAIT	QATAR	SAUDI ARABIA	UNITED ARAB EMIRATES	LIBIA	NIGERIA
2008	90,80	503,60	82,40	79,60	50,30	424,40	221,50	56,01	95,99
2009	95,80	516,50	93,20	81,20	51,00	443,20	205,50	57,98	76,08
2010	94,20	518,00	99,10	87,00	59,80	485,10	215,30	61,96	114,15
2011	100,60	538,00	104,00	85,90	68,00	501,50	222,30	39,70	131,69
2012	108,90	539,70	111,10	96,00	76,80	525,50	233,50	52,68	119,01
2013	115,40	572,90	119,50	100,50	83,70	534,30	248,90	56,27	124,33
2014	123,60	588,90	115,60	90,30	91,00	570,40	245,10	59,49	130,13
2015	129,00	585,70	115,60	98,30	100,90	587,10	267,10	57,00	115,93
2016	127,70	593,90	132,10	98,90	99,90	597,60	276,40	50,56	120,37
2017	127,80	622,10	133,70	98,40	102,40	591,10	269,20	43,729	130,275
2018	135,50	656,40	151,40	98,20	101,20	571,00	277,00	45,206	136,078
2019	147,10	670,70	148,60	97,30	102,50	579,90	282,60	46,428	140,026

Source: Author's own editing based on WDI

In Figure 53 CO2 depicts a moving curve and the linear trend is completely coincident with the mean value. Based on the formula of the prescribed trend curve, y = 6.4243x + 173.47; R f = 0.9752. I was able to detect a slightly increasing linear average and a positive regression curve for the OPEC countries. Based on this, I assume a relationship similar to that of the oil exporting countries for the OPEC countries.

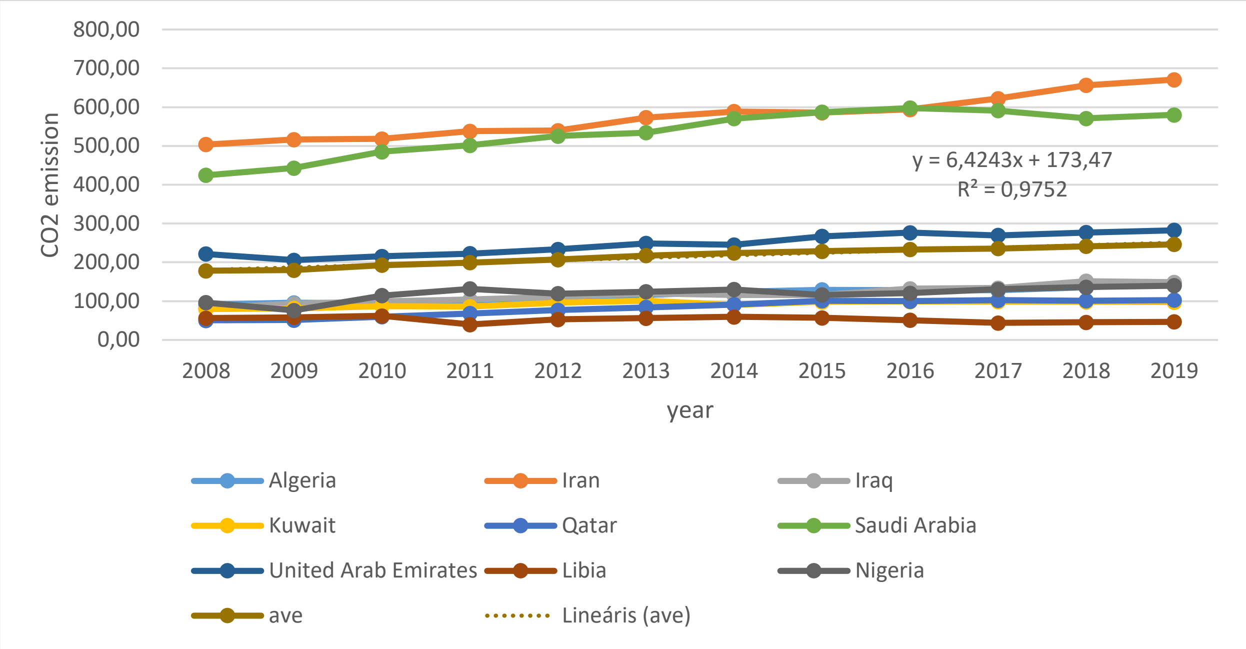


Figure 53: The relationship of the linear regression trend of oil price change and CO2 emission

Source: Author's own editing based on WDI

The study was continued and the mean and standard deviation were calculated first. As Table 13 shows, Saudi Arabia has the highest standard deviation of 59, 31 and the average is the second highest of 534, 26, followed by Iran with the highest average of 575, 53 but the standard deviation is 54.81. Among the OPEC countries, Libya has the lowest performance in terms of CO2 emissions52, 25 and also the standard deviation with the lowest 7.06. CO2 emissions to Kuwait are similarly even 7.47 and they also pollute the air at relatively low levels. These values are far behind those of the oil exporting countries, with emissions from China and the United States ten times higher than Iran's highest. Looking at the average of the OPEC countries, I was able to form three groups below 100, between 100 and 120, and above 200. That is, I have noticed that the CO2 emissions of some countries differ in quite characteristic ways.

Table 13: Mean and standard deviation of CO2 emission in OPEC countries

Descriptive Statistics

	N	Mean	Std. Deviation
Libia	12	52,251	7,0643
Qatar	12	82,292	20,5544
Kuwait	12	92,633	7,4695
Algeria	12	116,367	18,2283
Iraq	12	117,192	21,2910
Nigeria	12	119,504	18,0345
United Arab Emirates	12	247,033	27,1452
Saudi Arabia	12	534,258	59,3155
Iran	12	575,533	54,8163
Valid N (listwise)	12		

Source: Author's own editing based on SPSS calculations of data from WDI

I then examined the linear correlation values, the values of which are shown in Table 14 in Appendix 2 I used Pearson’s correlation and found that in all but two countries, a negative relationship could be detected between changes in oil prices and CO2 emissions. The two countries where I experienced a positive value are Libya r = 0.089, p = 0.05 and Nigeria r = 0.074, p = 0.05, but this is such a weak relationship that it is not even perceptible. The strongest negative relationship was found in the United Arab Emirates (-0.524) and Algeria (r = -0.474) at p = 0.05, but almost similarly in Iran (-0.438), Qatar (-0.454), and Saudi Arabia (0.440).) and Iraq (-0.419) Kuwait alone is the country that stands out from this line with only a very weak relationship (-0.292).

I further examined the model by regression analysis and depicted the results of the ANOVA analysis, in which the degree of the dependent variable was given by the change in the oil price. Based on Table 15 Appendix 2 it can be said that in contrast to the non-OPEC oil exporting countries, where I did not find a significant relationship between the countries' CO2 emissions and the change in oil prices, a perceptible relationship was found here between the factors.

Based on the above, we can say that, in contrast to oil exporting countries, I found signs in OPEC countries that show an opposite moderately strong relationship between changes in oil prices and CO2 emissions. That is, as the price of oil rises, the CO2 emission decreases. The exceptions are Libya and Nigeria, these are the lowest CO2 emitting countries.

5.4.3. Analysing EU countries

In the case of oil EU countries, CO2 emissions vary widely and do not depend on the proportion of the population as they do in other countries. Compared to Luxembourg, Germany has 8 times as much emissions.

The lowest CO2 country among the EU countries is Denmark (Table 16), followed by Luxembourg and Belgium. Looking at the Table it is apparent how fluctuating CO2 emissions are in most countries. In these countries the share of CO2 emissions did not increase significantly between 2008 and 2018 and significant changes are less common, in contrast to China and the US, or, as we have seen in the OPEC countries. In the case of the European Union countries, I have observed a decrease several times, while in the case of the Asian countries we can see a continuous expansion. While Germany was the largest emitter of CO2 from 2008 to 2019, its emissions fell to 84%, while in the UK it rose to 123%. Behind the changing CO2 emissions, I assume EU regulations and compliance with climate protection conventions.

Table 16: CO2 emissions in OPEC countries from 2008 to 2019

	Belgium	*France*	*Germany*	*Denmark*	*Italy*	*Luxemburg*	*Netherlands*	*Ireland*	*United Kingdom*
2008	104,41	371,10	806,50	47,42	446,90	109,38	231,40	163,40	557,50
2009	127,50	356,30	751,00	44,49	404,00	103,92	222,60	176,70	559,70
2010	136,40	361,50	780,60	45,82	409,80	109,67	232,40	185,30	615,70
2011	123,00	334,90	761,00	40,66	339,80	108,94	224,40	192,70	646,80
2012	119,00	336,30	770,30	36,43	386,60	10,59	217,30	192,00	643,80
2013	120,00	336,00	794,60	37,25	353,60	100,51	211,70	192,80	646,10
2014	111,70	302,30	748,40	33,15	330,20	96,62	200,80	192,60	644,60
2015	118,30	310,50	751,90	30,82	343,10	92,51	209,20	204,40	656,50
2016	120,10	315,30	766,60	31,79	343,60	89,87	212,70	219,30	662,50
2017	122,10	321,40	762,60	34,722	346,30	92,5	205,90	231,30	678,80
2018	125,10	311,80	725,70	34,651	336,30	95,69	202,70	230,00	697,60
2019	124,50	299,20	683,80	32,075	325,40	97,85	192,00	229,00	687,10

Source: Author's own editing based on WDI

There are significant differences in the rates of CO2 emissions from each country. The trend line is shown in Figure 54 and the rate is $y = -0.9552x + 312.73$, $R^2 = 0.2378$. Here we can see a negative trend line based on the average, as previously assumed based on Table 15. The countries where I have seen a significant increase are the United Kingdom, Ireland and Luxembourg. Compared to them, the other countries produced a slight continuous decrease and this adds up to the negative trend value.

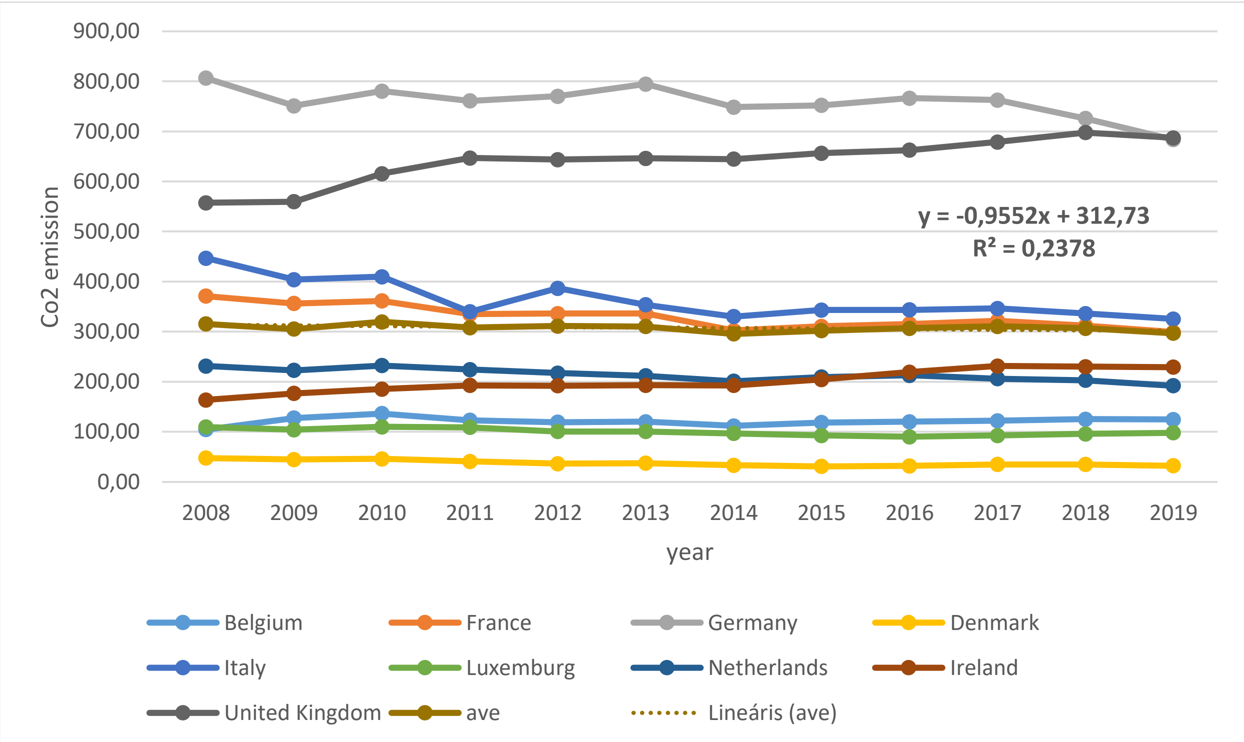


Figure 54: The relationship of the linear regression trend of oil price change and CO2 emission

Source: Author's own editing based on WDI

Looking at the descriptive statistical analyses, it can also be seen from Table 17 that Denmark has the lowest CO2 emissions of 37.44 and standard deviation is the lowest. Germany has the highest and the UK the highest, but Germany's variance is only the 3rd highest at 31.88, ahead of Italy by 38, 54 as well. Even the deviation of the Netherlands is interesting because it is only 12, 48, which is low compared to other countries.

Table 17: Mean and standard deviation of CO2 emission in EU countries

	N	Mean	Std. Deviation
Denmark	12	37,438	5,7924
Luxemburg	12	99,838	6,9195
Belgium	12	121,009	7,9114
Ireland	12	200,792	22,2127
Netherlands	12	213,592	12,4823
France	12	329,717	23,7206
Italy	12	363,800	38,5417
United Kingdom	12	641,392	44,4775
Germany	12	758,583	31,8822
Valid N (listwise)	12		

Source: Author's own editing based on SPSS calculations of data from WDI

Continuing the study, I assumed that the change in oil prices is also related to the level of CO2 in the EU countries. In Table 18 Appendix 2, the Pearson correlation rate was negative for three countries: Belgium (r = -0.284), Ireland (r = -0.558), and the United Kingdom (r = -0.242) p = 0.05. Luxembourg has the highest degree of positive correlation and here the 95% match is also considered significant, with a value of r = 0.619. For the other countries, this relationship strength is only around 0.3, which is considered weak.

I continued with regression analysis and plotted the ANOVA table obtained during the linear regression analysis (Table 19). The value of F was low 2.670 and the significance level remained low here as well, as could be assumed from in Table 16, where the dependent variable is the price of oil.

Table 19: ANOVA analysis of oil exporting countries

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5903,086	9	655,898	2,670	,302[b]
	Residual	491,297	2	245,649		
	Total	6394,384	11			

a. Dependent Variable: oilprice

b. Predictors: (Constant), United Kingdom, Belgium, Germany, Luxemburg, Italy, Netherlands, Ireland, Denmark, France

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-25,024	454,043		-,055	,961
	Belgium	-1,163	1,251	-,382	-,930	,451
	France	1,729	1,987	1,701	,870	,476
	Germany	-,293	,741	-,388	-,396	,730
	Denmark	1,978	6,612	,475	,299	,793
	Italy	-,364	,550	-,582	-,661	,576
	Luxemburg	-,719	5,313	-,206	-,135	,905
	Netherlands	-1,358	1,217	-,703	-1,117	,380
	Ireland	-2,459	1,696	-2,265	-1,450	,284
	United Kingdom	1,262	,902	2,328	1,399	,297

a. Dependent Variable: oilprice

Source: Author's own editing based on SPSS calculations of data from WDI

The result of the Coefficients test is negative for t values except for two countries, (France 0.870 and Denmark 0.299). This supports the negative slope of the trend and the x value obtained there. The CO_2 significance values obtained here in relation to the price of oil are particularly high in Luxembourg, almost reaching 1, which can be considered significant. The values are around 0.7 for Germany and Denmark.

The hypothesis of my research was that there is a negative linear relationship between oil price change and CO_2 emissions for each country type. I used linear regression method in several ways. I examined the average of each country type and looking at the trends, I found that the linear trend chart is increasing for oil producing and OPEC countries and decreasing slightly for EU countries.

Based on the descriptive statistical indicators, I found that the CO_2 emissions of each country vary widely, the averages and the degree of variance are different, but the most significant was in different EU countries.

Correlation studies have shown that OPEC and oil exporting countries have a more significant negative relationship, whereas this is not obvious and is not true for all countries. The relationship was more positive in the EU countries, but no significant relationship could be established here either.

The linear regression calculations supported this assumption, as I could not show a significant and close relationship between CO2 emissions and oil price changes in either the ANOVA or Coefficients calculations.

Based on this, I came to the conclusion that there is a weak relationship, but this cannot be considered a linear change in the price of oil and CO2 emissions. I think it is likely that other factors also have an impact on CO2 emissions, such as compliance with climate agreements, the market and the production of large consumers, factories or the activities of other actors in the economy. As a result of this I rejected this hypothesis.

5.5. The analysis of the relationship between oil price and GDP growth

H5/A/: There is a positive linear relationship between oil prices and the GDP growth of oil exporting and OPEC countries.

H5/B/: There is a negative linear relationship between oil prices and the GDP growth of major EU countries

Changes in the price of oil have a different impact on economic performance in oil exporting and oil importing countries. According to this hypothesis in oil-exporting countries falling oil prices have a negative impact on GDP growth, while in oil importing countries falling oil prices have a positive impact on GDP growth. During the examination of the hypothesis, I worked with the GDP of each country. In the first part of the hypothesis, I investigated oil exporting countries and then turned to oil importing countries.

5.5.1. Analysing oil exporting countries

I started my research with analyzing the GPD growth in oil exporting countries. I began the study with the annual analysis of the 9 oil exporting countries.

Table 20 shows that the performance of each country was fluctuating with a negative value for Brazil, Mexico, Norway and the USA. Russia's GPD in 2008, showed a remarkably high value compared to other countries, which by 2019 decreased significantly.

Economic fluctuations is a natural process and the economic crisis that erupted in 2008 could have had a significant impact on each country’s GPD growth values, depending on how well they were able to adapt.

Table 20: GDP growth in oil exporting countries from 2008 to 2019

year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Brazil	5,09	-0,13	7,53	3,97	1,92	3,00	0,50	-3,55	-3,28	1,32	1,32	1,14
Canada	1,01	-2,93	3,09	3,15	1,76	2,33	2,87	0,66	1,00	3,17	2,01	1,66
China	9,65	9,40	10,64	9,55	7,86	7,77	7,43	7,04	6,85	6,95	6,75	6,11
Colombia	3,28	1,14	4,49	6,95	3,91	5,13	4,50	2,96	2,09	1,36	2,52	3,26
India	3,09	7,86	8,50	5,24	5,46	6,39	7,41	8,00	8,26	7,04	6,12	4,18
Mexico	1,14	-5,29	5,12	3,66	3,64	1,35	2,85	3,29	2,63	2,11	2,19	-0,05
Norway	0,48	-1,73	0,70	0,98	2,70	1,03	1,97	1,97	1,07	2,32	1,29	1,15
Russia	5,20	-7,80	4,50	4,30	4,02	1,76	0,74	-1,97	0,19	1,83	2,54	1,34
USA	-0,14	-2,54	2,56	1,55	2,25	1,84	2,53	2,91	1,64	2,37	2,93	2,16

Source: Author's own editing based on WDI

Descriptive statistical items, mean, standard deviation, and variance are shown in a separate table. The longest distance (RANGE) was found in Russia, its value was 13.0 and it was the lowest with a minimum value of -7.8. And the highest percentage of GDP growth was in China, as we can read from Table 20, 10,636. Based on this, the measure of r (standard deviation) also belongs to Russia at 3,553, and the Variance at 12,623, followed by Brazil with a ratio of 9.9. That is, the performance of the Russian economy is much more volatile than that of any other, and this assumes that it has been steadily declining over the years or, as can be seen from the Table 21. Brazil has the second highest standard deviation and is followed by Mexico. These countries also achieved the lowest GPD growth. I found the highest GPD growth in China and India, along with China. Examining the mean value I have found that China and India are the ones that show the most fluctuating performance.

Table 21: Descriptive statistics of oil exporting countries

	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
Brazil	11,074	-3,546	7,528	1,571	3,160	9,988
Canada	6,099	-2,928	3,171	1,648	1,692	2,863
China	4,526	6,110	10,636	7,999	1,444	2,084
Colombia	5,808	1,140	6,948	3,466	1,658	2,747
India	5,411	3,087	8,498	6,461	1,709	2,921
Mexico	10,404	-5,286	5,118	1,889	2,634	6,939
Norway	4,430	-1,727	2,703	1,162	1,133	1,284
Russia	13,000	-7,800	5,200	1,387	3,553	12,623
USA	5,464	-2,537	2,927	1,672	1,558	2,429

Source: Author's own editing based on WDI

I displayed the results graphically. In Figure 55, I illustrated GPD growth of oil exporting countries between 2008 and 2019.. The formula of the line of the average linear trend: $y = -0.0315x + 3.233$ has a negative slope and the value of r2 can also be considered very low: $R^2 = 0.0072$.

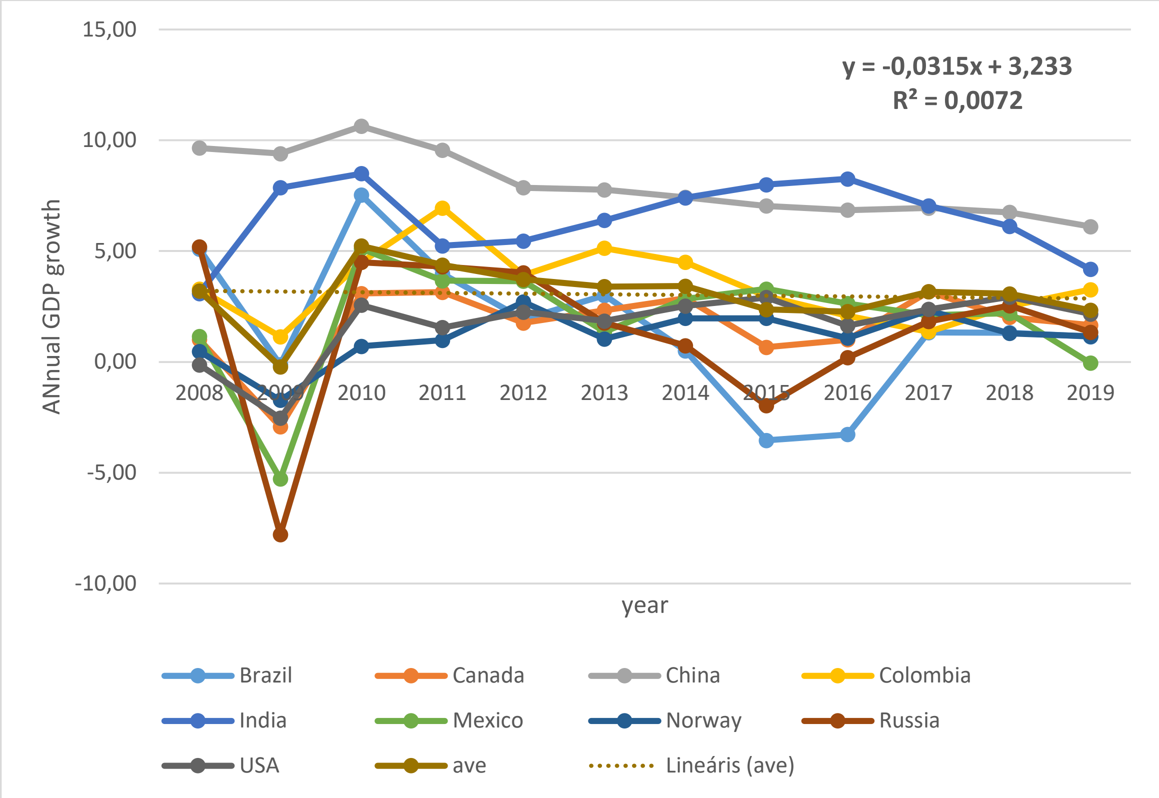


Figure 55: Oil price, GDP growth and the linear trend line

Source: Author's own editing based on WDI

In Figure 56 I marked the trend line for oil price and average value with a dotted line. Oil prices are showing strong fluctuations, which countries are apparently following at some level. The two linear trend lines, on the other hand, show an opposite direction, while the average has a slightly increasing slope as shown by the formula described above, while the change in oil prices has a clearly negative slope $y = -3.3162x + 99.059$, $R^2 = 0.2459$. That is, the two trends point in a convergent direction.

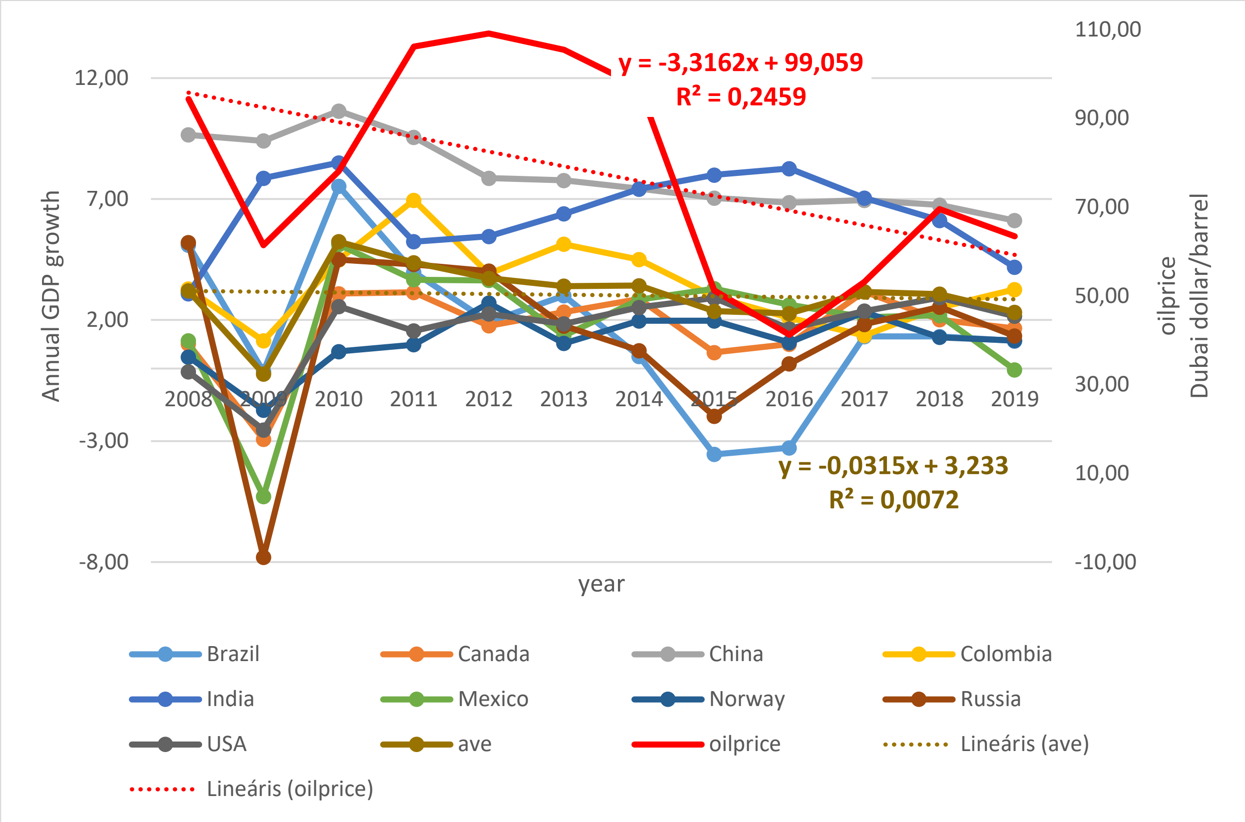


Figure 56: GDP growth and linear trend formula of oil price and average value of oil exporting countries

Source: Author's own editing based on WDI

Table 22 summarizes the regression parameters for each country.

Table 22: Correlation coefficients of annual change of GDP growth

	r year	r2 year	GDP ave.
Brazil	-0,515	0,087	1,571
Canada	0,288	0,364	1,648
China	-0,916	0,000	7,999
Colombia	-0,286	0,367	3,466
India	0,073	0,822	6,461
Mexico	0,136	0,674	1,889
Norway	0,502	0,096	1,162
Russia	-0,027	0,933	1,387
USA	0,616	0,033	1,672

Source: Author's own editing based on WDI

I further expanded this study by examining the change in oil prices in Table 23. I took into account the average of each country for the period 2008-2019. The value of r is different, in the case of India it is negative (r = -0.471, p = 0.05) i.e. it is a moderately strong relationship. The root mean square result shows otherwise for the US, this is close to 1, suggesting a very close relationship, despite the average GDP of the US. The value of r is Colombia's strongest, and consequently its lowest, the value of r2, which is almost equal to zero, that is, its relationship with the price of oil can be said to be strong. I would also highlight Norway from this table, which has a low significance value, but r2 is the second highest and the average annual GDP is the lowest among all the countries studied.

Table 23: The relationship between oil price and GDP growth

	r oil	r2 oil	GDP ave.
Brazil	0,613	0,034	1,571
Canada	0,362	0,247	1,648
China	0,414	0,181	7,999
Colombia	0,776	0,003	3,466
India	-0,471	0,122	6,461
Mexico	0,244	0,445	1,889
Norway	0,144	0,655	1,162
Russia	0,521	0,083	1,387
USA	0,022	0,947	1,672

Source: Author's own editing based on SPSS calculations of data from WDI

In Figure 57 we can see the impact of annual GDP growth and oil price changes in relation to oil exporting non OPEC countries. In the case of India and China, changes in oil prices have a different effect than in other countries. While in the case of India, the annual GDP growth has a more significant impact as it is closer to the y-axis on which I plotted the change of annual GDP growth. And in the case of China, oil price change has a more significant impact than the change in annual GDP growth. The other countries are located along a perpendicular descending diagonal, the highest values belong to the U.S. and Norway, and the lowest to the x-axis are Brazil and Colombia.

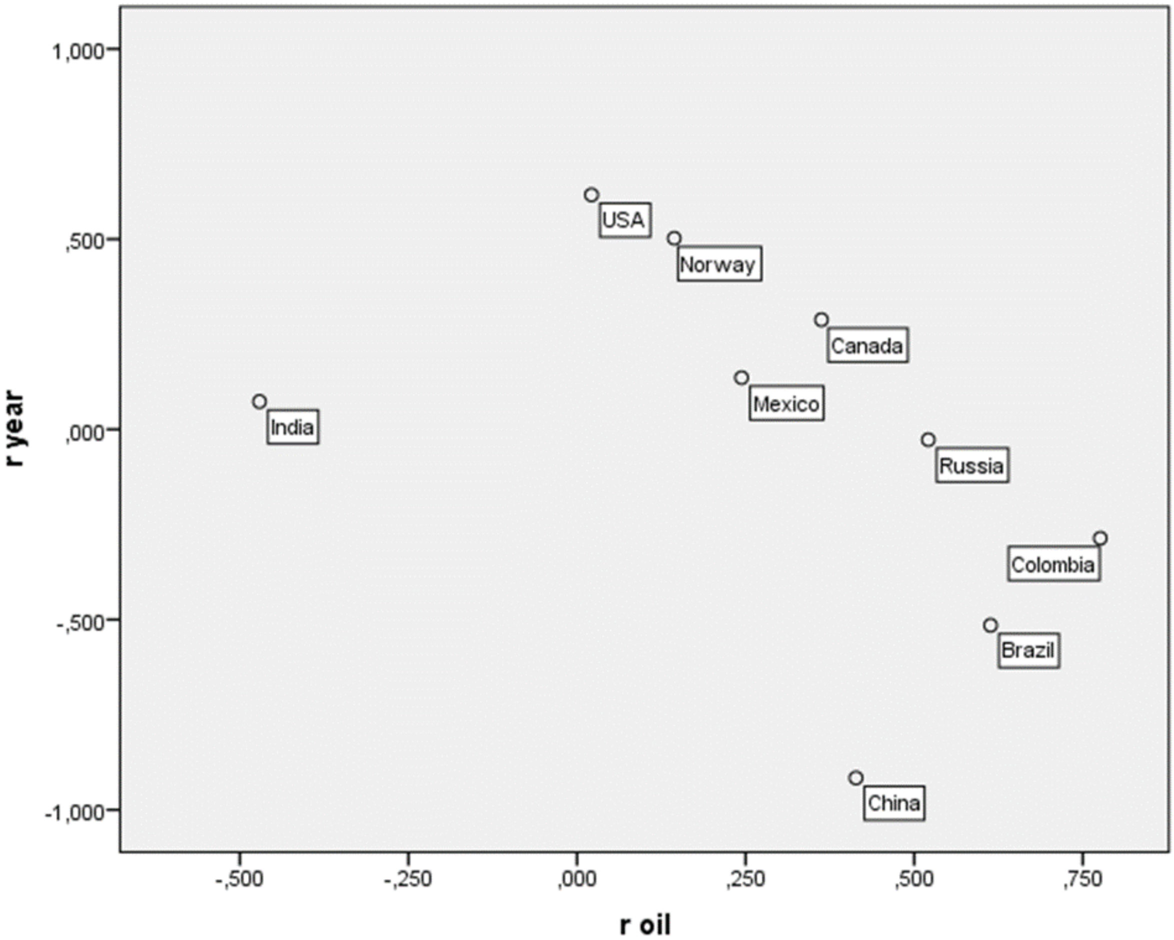


Figure 57: Scatterplot on the impact of annual GDP growth and the price change of oil in oil exporting countries

Source: Author's own editing based SPSS calculations of data from WDI

5.5.2. Analysing OPEC countries

I continued our research by examining OPEC countries. I first examined general information on the size of GDP growth and its evolution. I have found that the African and OPEC countries show a very diverse picture in terms of GDP growth developments. The collection of data between 2008 and 2019, for example, in Algeria, encountered a problem where only one decimal place was given and Algeria showed a positive development in terms of numbers throughout, with no indicator going negative in any year. In contrast, Iran achieved high negative GDP growth in three cases. Kuwait reached a very low value in 2009 after the economic crisis. Qatar achieved very high GDP growth in 2010 of almost 20%. Libya has a special situation, with a particularly low GDP growth in 2014 and a very high GDP growth in 2017. Table 24 also shows significant fluctuation of GDP growth among most of the countries.

Table 24: GDP growth in OPEC countries from 2008 to 2019

year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Algeria	2,40	1,60	3,60	2,90	3,40	2,80	3,80	3,70	3,20	1,30	1,20	0,80
Iran	0,25	1,01	5,80	2,65	-7,44	-0,19	4,60	-1,32	13,40	3,76	-6,03	-6,78
Iraq	8,23	3,38	6,40	7,55	13,94	7,60	0,70	2,48	15,21	-2,49	-0,56	4,40
Kuwait	2,48	-7,08	-2,37	9,63	6,63	1,15	0,50	0,59	2,93	-4,71	1,25	0,43
Qatar	17,66	11,96	19,59	13,38	4,73	5,56	5,33	4,75	3,06	-1,50	1,23	0,77
Saudi Arabia	6,25	-2,06	5,04	10,00	5,41	2,70	3,65	4,11	1,67	-0,74	2,43	0,33
United Arab Emirates	3,19	-5,24	1,60	6,93	4,48	5,05	4,28	5,11	3,06	2,37	1,19	1,68
Libia	2,67	-0,79	5,02	-6,20	12,31	-13,60	-24,00	-8,86	-2,80	26,68	15,13	2,54
Nigeria	6,76	8,04	8,01	5,31	4,23	6,67	6,31	2,65	-1,62	0,81	1,92	2,21

Source: Author's own editing based on WDI

I continued the research with general descriptive statistical analyses and calculated in Table25 mean, standard deviation, and variance. The range is the lowest for Algeria, 3.0, and the highest for Libya, more than 16 times. Accordingly, the lowest and highest GDP growth rates also occurred in Libya, ranging from -24.0 to 26.681. Qatar follows this, alternating between -1.4 and 19.6. The second lowest GDP was for Iran, Kuwait. Iraq is one of the lowest. Based on this, the value of mean for Qatar was 7,211 and the lowest belonged to Libya. It can be said that most OPEC countries move on a wider scale than we I have experienced among oil exporting countries.

Table 25: Descriptive statistics of OPEC countries

	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
Algeria	3,000	0,800	3,800	2,558	1,074	1,154
Iran	20,841	-7,445	13,396	0,807	5,940	35,288
Iraq	17,707	-2,495	15,212	5,569	5,401	29,170
Kuwait	16,704	-7,076	9,628	0,952	4,492	20,182
Qatar	21,090	-1,498	19,592	7,211	6,820	46,518
Saudi Arabia	12,056	-2,059	9,997	3,233	3,294	10,853
United Arab Emirates	12,173	-5,243	6,930	2,809	3,058	9,352
Libia	50,681	-24,000	26,681	0,675	13,525	182,934
Nigeria	9,654	-1,617	8,037	4,275	3,081	9,491

Source: Author's own editing based on WDI

We continued the study with analysing the trends. In Figure 58 we can see that GDP fell in all countries except Nigeria in 2009, which may have been the effect of the global economic crisis. Figure 57 immediately shows how significant the fluctuations are for Libya, Iraq and Iran. Based on this, we can assume that there will be countries that follow the trend, and we can expect that the annual GDP growth will have a stronger impact than the development of oil prices, so it is necessary to draw the trend formula.

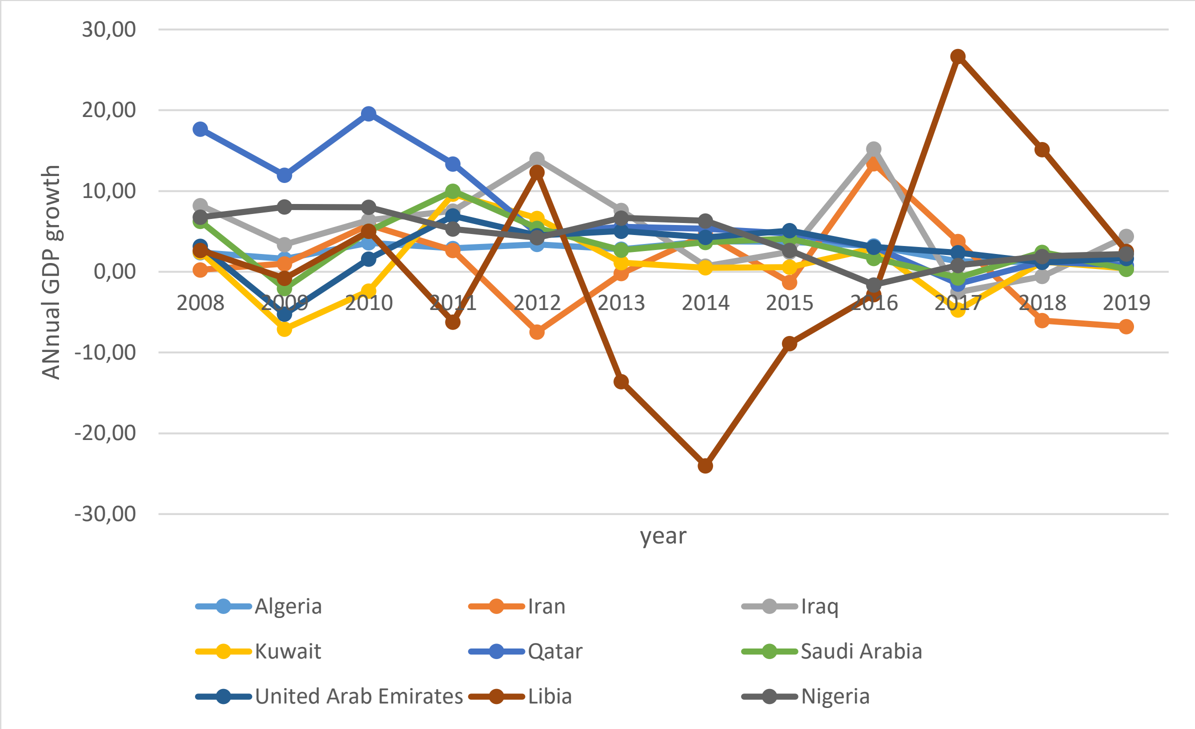


Figure 58: Annual GDP growth of OPEC countries

Source: Author's own editing based on WDI

In Figure 59, examining the trend functions, I plotted the trend line of the countries with the highest and lowest averages. The formula for the oil price function is $y = -3.3162x + 99.059$ $R^2 = 0.2459$, and compared to this, the trend line of the average is also negative, $y = -0.308x + 5.1228$ $R^2 = 0.2831$, but its slope is lower. We can say that the average trend line of GDP growth and the linear regression function of oil also follow each other, i.e. it can be assumed that there is some kind of relationship between them. It can be assumed that there is a relationship between oil price developments and GDP developments and that this relationship is stronger than in the case of oil-exporting countries.

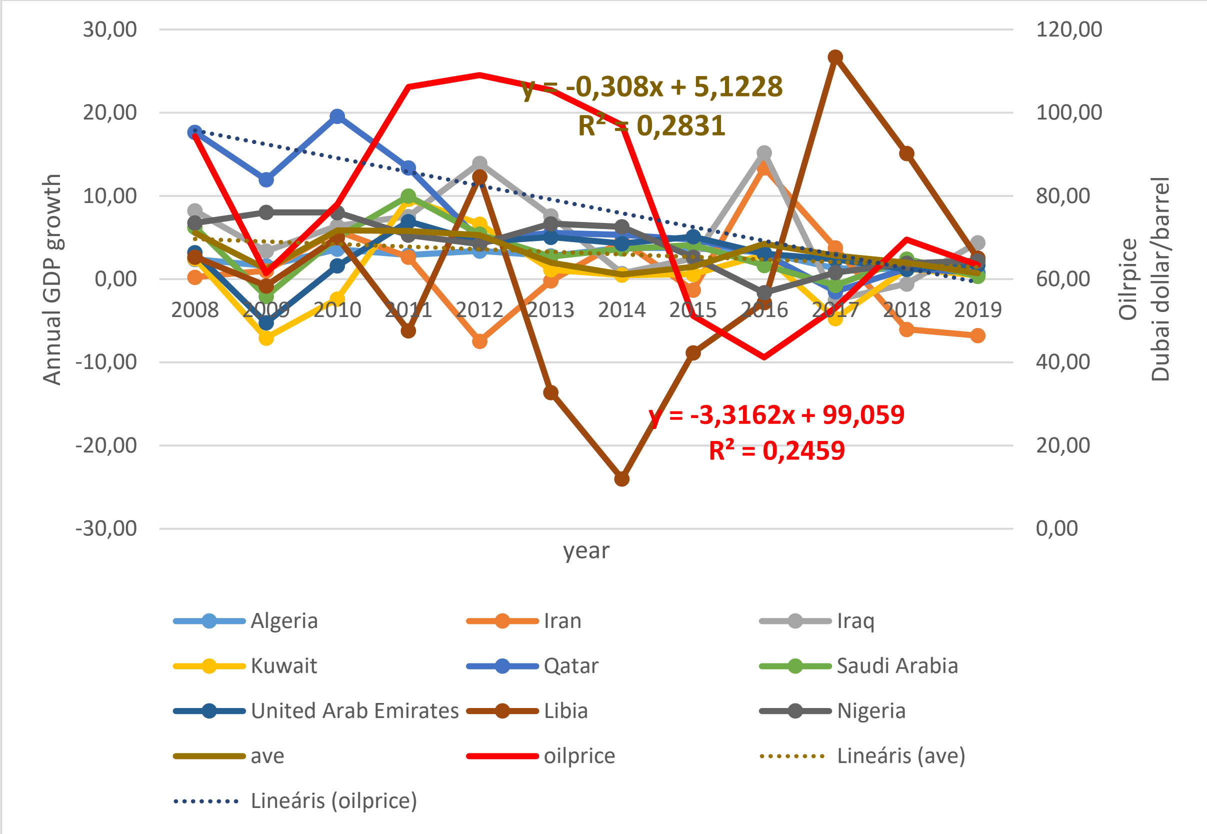


Figure 59: GDP growth and linear trend formula of oil price and average value of OPEC countries

Source: Author's own editing based on WDI

In the next phase I examined the effect we can find between annual change and the change in the average GDP growth and the change in the price of oil.

Firstly I examined the evolution of r and r2, which can be seen in Table 26.In terms of linear regression r values, the highest negative Qatar (r = -0.890, p = 0.05) and, accordingly, the annual development of r2, it is the lowest (r2 = 0.000, p = 0.05) the average GDP growth is the highest (GDP = 7,211). The second highest is Nigeria, but this country's GDP averages are at the middle level. The value of r2 in Kuwait (r2 = 0.952) and the United Arab Emirates (r2 = 0.707) was also very high and the average GDP growth of both countries is rather low, i.e. the GDP rate does not fluctuate widely from year to year.

Table 26: Correlation coefficients of annual change of GDP growth

	r year	r2 year	GDP ave
Algeria	-0,398	0,200	2,558
Iran	-0,166	0,607	0,807
Iraq	-0,333	0,290	5,569
Kuwait	-0,046	0,888	0,952
Qatar	-0,890	0,000	7,211
Saudi Arabia	-0,420	0,174	3,233
United Arab Emirates	0,117	0,707	2,809
Libia	0,221	0,491	0,675
Nigeria	-0,799	0,002	4,275

Source: Author's own editing based on SPSS calculations of data from WDI

I analysed the data examining the relationship between the change in oil price and the change in average GDP growth. In Table 27 I indicated the relationship between r, r2, and GDP, only the change in oil price became the independent variable. Here I found a negative value for r for the two countries, Iran (r = -0.307, p = 0.05) and Libya (r = -0.293, p = 0.05), ie they have an opposite relationship between changes in oil prices and GDP growth.. R2 values are also very low, with the highest in Iraq being 0.436, which can be considered significantly weak. Comparing these values with those of oil exporting we can say that they are low regarding both significance and linear regression values. Based on this I concluded that annual GDP growth has a more significant impact on OPEC countries than oil price change.

Table 27: The relationship between oil price and GDP growth

	r oil	r2 oil	GDP ave
Algeria	0,329	0,296	2,558
Iran	-0,307	0,332	0,807
Iraq	0,249	0,436	5,569
Kuwait	0,553	0,062	0,952
Qatar	0,380	0,223	7,211
Saudi Arabia	0,653	0,021	3,233
United Arab Emirates	0,454	0,138	2,809
Libia	-0,293	0,355	0,675
Nigeria	0,621	0,310	4,275

Source: Author's own editing based on SPSS calculations of data from WDI

I concluded my analysis for OPEC countries with the scatter plot, I wanted to know which countries move together. Figure 60 shows that my analysis above was partially confirmed and I was able to form three groups during the analysis. The first group included Libya and Iran, which responded relatively more significantly to the annual change in their GDP growth than to changes in oil prices. The next group is Qatar and Nigeria, which have been more sensitive to changes in oil prices than other countries. The third and final group is characterized by the fact that the change in the price of oil is a more important factor (the values are positive here) than the changes in the period (here most of them have a negative sign). The United Arab Emirates is the only country that has achieved the highest value, but does not form an independent group in itself. .

In summary, there are countries which GDP growth is affected by oil price fluctuations, but not all OPEC countries are equally affected.

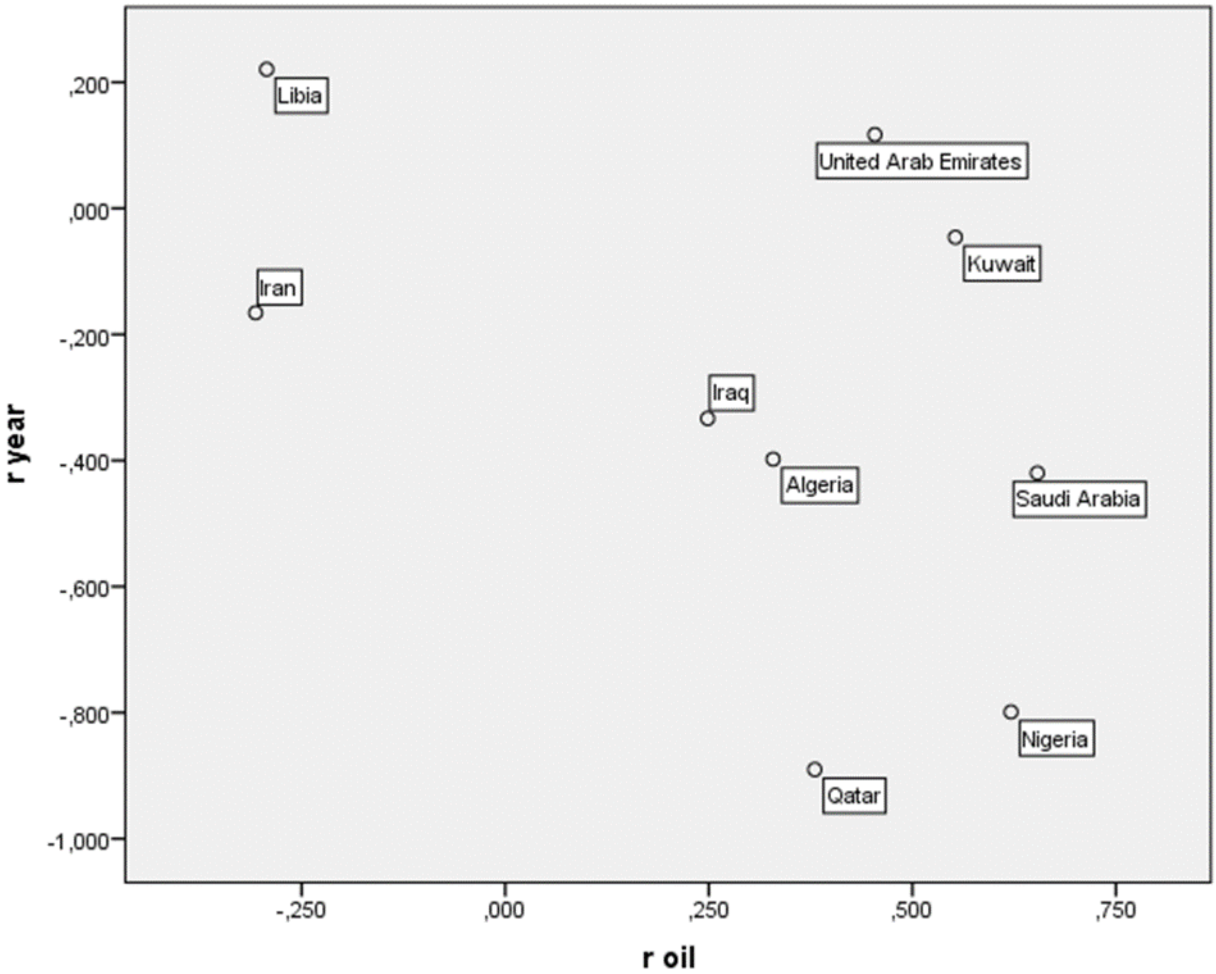


Figure 60: Scatterplot on the impact of annual GDP growth and the price change of oil in OPEC countries

Source: Author's own editing based on SPSS calculations of data from WDI

5.5.3. Analysing EU countries

Table 28 shows how GDP growth developed in each country between 2008 and 2019. They reacted very sensitively after the 2008 crisis, as all countries recorded negative GDP in 2009. Similarly low values were achieved in 2012, where all countries approached 0 the Netherlands, Luxembourg and Italy were the ones that showed a negative value. The year 2019 also showed a very low values, with a spectacular decline even in Ireland, which provided outstanding performance before it.

Table 28: GDP growth in OPEC countries from 2008 to 2019

year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Belgium	0,45	-2,02	2,86	1,69	0,74	0,46	1,58	2,04	1,27	1,61	1,81	1,74
France	0,25	-2,87	1,95	2,19	0,31	0,58	0,96	1,11	1,10	2,29	1,79	1,51
Germany	0,96	-5,69	4,18	3,93	0,42	0,44	2,21	1,49	2,23	2,60	1,27	0,56
Denmark	-0,51	-4,91	1,87	1,34	0,23	0,93	1,62	2,34	3,25	2,82	2,18	2,85
Italy	-0,96	-5,28	1,71	0,71	-2,98	-1,84	0,00	0,78	1,29	1,67	0,94	0,34
Luxemburg	-1,28	-4,36	4,86	2,54	-0,35	3,65	4,30	4,31	4,57	1,80	3,11	2,30
Netherlands	2,17	-3,67	1,34	1,55	-1,03	-0,13	1,42	1,96	2,19	2,91	2,36	1,68
Ireland	-4,48	-5,08	1,81	0,34	0,23	1,35	8,56	2,51	3,68	8,15	8,17	5,55
United Kingdom	-0,28	-4,25	1,95	1,54	1,48	2,14	2,61	2,36	1,92	1,89	1,34	1,46

Source: Author's own editing based on WDI

I analysed the descriptive statistics in Table 29. The largest range is in Ireland, where its value is much lower than in the OPEC countries, only 13.63 and the change in value varied between -5, 07 and 8, 5. Luxembourg and Germany can still be considered high in the range compared to the other countries, as both countries are above 9 and while Germany is between -5.69 and 4.17, Luxembourg is between -4, 35 and 4, 86. The other countries can be said to have moved in the same negative and positive directions and the lowest is Belgium, which is barely slightly higher than the minimum value. The proportion of mean- averages is negative in Italy alone, where it is -0.30, but the highest average was shown by Ireland, with 2, 56. The Standard Deviation is the highest due to this and the lowest in Belgium. The variance level is also in line with this, 20, 83 in Ireland and 1, 49 in Belgium. Based on the descriptive statistics I found that these examined EU countries have more stable economies than both the oil exporting and OPECC countries.

Table 29: Descriptive statistics of EU countries

	Range	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*	*Variance*
Belgium	4,8850	-2,0207	2,8643	1,1862	1,2213	1,491
France	5,1647	-2,8733	2,2914	0,9309	1,3835	1,914
Germany	9,8737	-5,6938	4,1799	1,2153	2,5159	6,330
Denmark	8,1525	-4,9065	3,2460	1,1670	2,2088	4,879
Italy	6,9942	-5,2809	1,7133	-0,3019	2,1213	4,500
Luxemburg	9,2236	-4,3586	4,8650	2,1212	2,8021	7,851
Netherlands	6,5778	-3,6669	2,9109	1,0634	1,8440	3,400
Ireland	13,6359	-5,0792	8,5567	2,5656	4,5639	20,830
United Kingdom	6,8553	-4,2478	2,6075	1,1796	1,8563	3,446

Source: Author's own editing based on SPSS calculations of data from WDI

The graphical analysis in Figure 61 shows that countries' GDP growth are moving together. Ireland stands out from this, but if we look at the values we can see that this country is also following a type of trend. Italy and the Netherlands move almost completely parallel to each other, and it is Luxembourg marked in green that protrudes from this representation in some form.

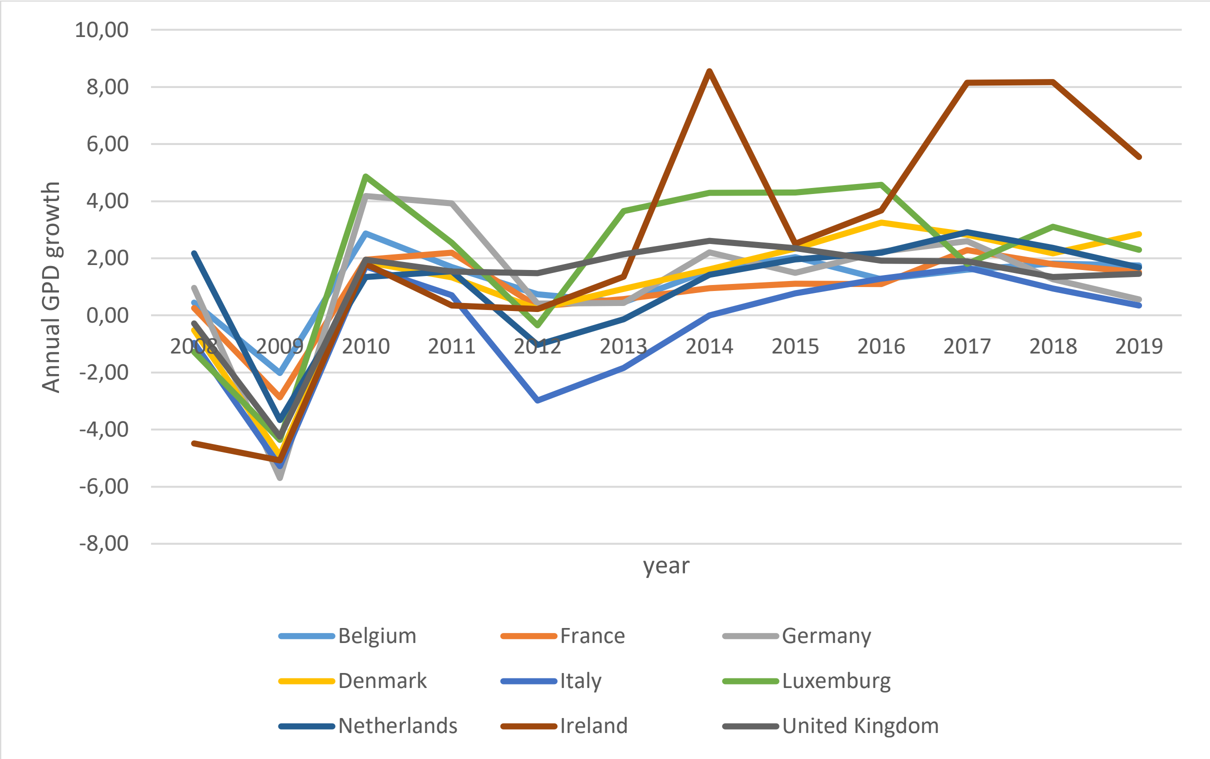


Figure 61: Annual GDP growth of EU countries

Source: Author's own editing based on WDI

Examining the formulas, I found that in a y = 0.3552x - 1.0723 R^2 = 0.3979 way, the linear regression formula can be described towards GDP averages and, of course, the change in oil prices in the previously known y = -3.3162x + 99.059 Same as R 0, = 0.2459. EU countries will move in the opposite direction to changes in oil prices. EU countries will move in the opposite direction to changes in oil prices. While oil prices show a declining trend over the longer term, the GDP growth of these countries, despite the fact that descriptive statistics do not seem to support this everywhere, still points to growth overall (Figure 62).

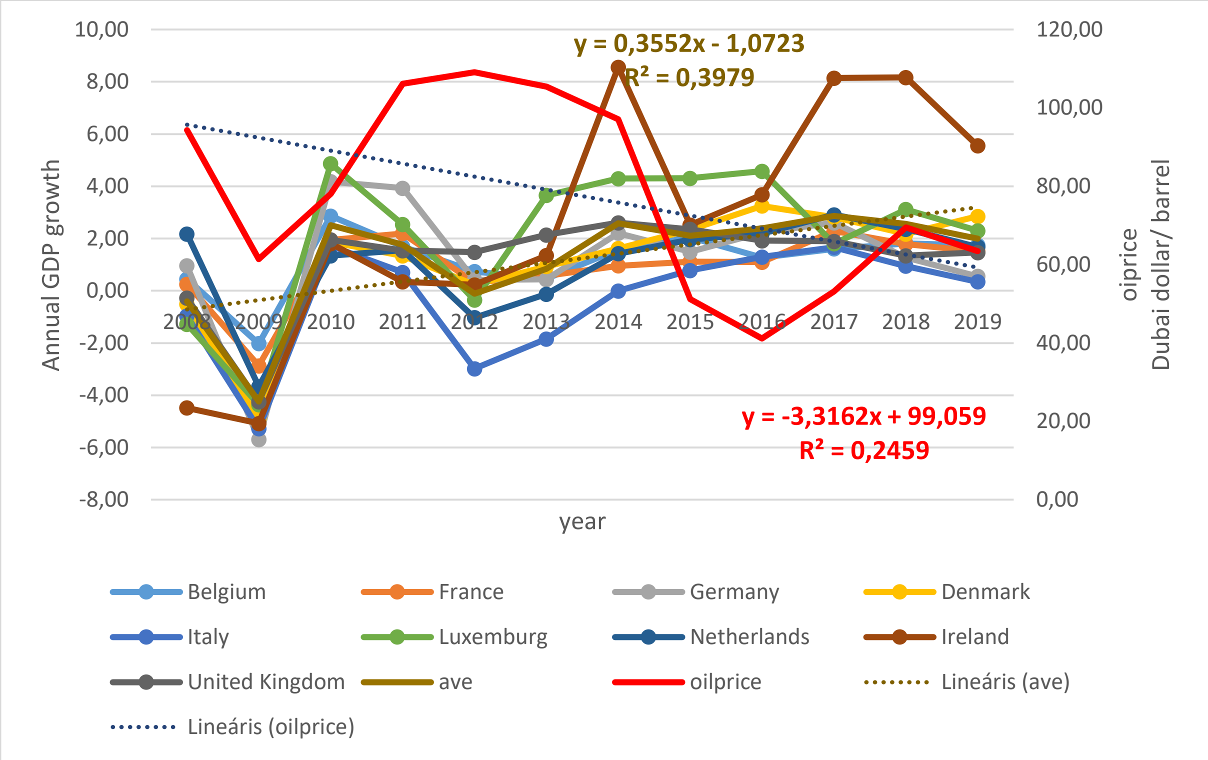


Figure 62: GDP growth and linear trend formula of oil price and average value of EU countries

Source: Author's own editing based on WDI

In the next step of my research, I looked at the r and r2 values in the trend diagram, and what linear curved results we get as a result of r and r2. As shown in Table 30, the r values are more mean values, but I found no negative value anywhere, and in addition to Ireland (r = 0.842, p = 0.05), Denmark (r = 0.707, P = 0.05) is the a country that has responded better over the years. Accordingly, r2 values are the lowest here, almost undetectable in Ireland (r2 = 0.001). Italy with a negative GDP (-0.302) also shows only the moderately strong category (r = 0.512, p = 0.05) in relation to the years in the significance test.

Table 30: Correlation coefficients of annual change of GDP growth

	r year	r2 year	GDP
Belgium	0,442	0,150	1,186
France	0,505	0,094	0,931
Germany	0,219	0,494	1,215
Denmark	0,707	0,010	1,167
Italy	0,512	0,089	-0,302
Luxemburg	0,495	0,102	2,121
Netherlands	0,503	0,096	1,063
Ireland	0,842	0,001	2,566
United Kingdom	0,503	0,096	1,180

Source: Author's own editing based on SPSS calculations of data from WDI

In Table 31 I examined how changes in GDP growth and oil prices interact. It immediately appears that all countries except the United Kingdom (r = 0.117, p = 0.05) and Germany (r = 0.135, p = 0.05) have a negative r value, i.e. these two countries that react positively to the price of oil change. However, the value of r2 in the United Kingdom is 0.718, which is not remarkably high compared to other countries, and in Germany this value is r2 = 0.676.

Table 31: The relationship between oil price and GDP growth

	r oil	r2 oil	GDP
Belgium	-0,064	0,844	1,186
France	-0,003	0,992	0,931
Germany	0,135	0,676	1,215
Denmark	-0,224	0,485	1,167
Italy	-0,313	0,322	-0,302
Luxemburg	-0,109	0,735	2,121
Netherlands	-0,229	0,474	1,063
Ireland	-0,258	0,418	2,566
United Kingdom	0,117	0,718	1,180

Source: Author's own editing based on SPSS calculations of data from WDI

I concluded my study by drawing the scatterplot diagram for these countries as well. Figure 63 shows that we can create three large groups from the countries. In the first group, I put Ireland and Denmark because they have been given a higher value for annual GDP growth change. For the other group, I marked Germany alone because this country is particularly responsive to changes in oil prices. Italy, Netherlands, Luxemburg, Belgium, France and the UK are the countries which are less dependent on changes in oil prices to varying extent.

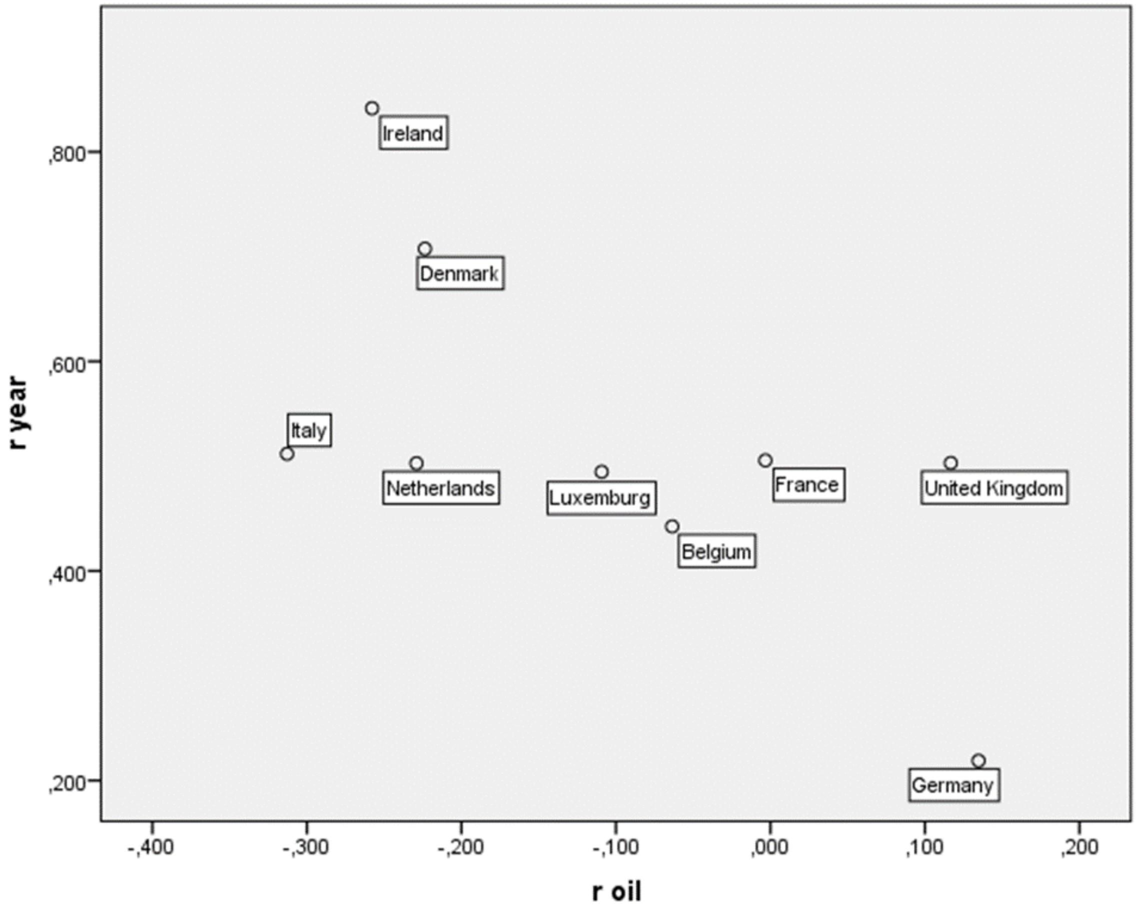


Figure 63: Scatterplot on the impact of annual GDP growth and the price change of oil in EU countries

Source: Author's own editing based on SPSS calculations of data from WDI

Summarizing the above research results, I have found that oil-exporting countries react to oil price rises with an increase in their GDP growth. Similar conclusion can be drawn in the case of OPEC countries. Correlation analysis used for the significance of the relationship have shown that these relationships are not valid in all cases and countries, there are countries that respond more intensively to oil prices, and there are some that respond later.

In the case of the EU countries, I have observed that their trend line is opposite, that is, if the price of oil rises, their GDP growth will fall, and although this relationship is not so significant, it can still be demonstrated. Based on this, I confirmed my hypothesis.

5.6. The analysis of the strength of the link between oil price and key macroeconomic indicators

In my research, I sought the answer to what kind of relationship I can show between inflation, unemployment, household consumption, CO2, and annual GDP growth. After analysing my hypotheses I examined that I was able to detect a change in the development of each factor.

I expanded the research questions and performed a regression analysis using the linear regression method. I was curious to find a change over time, consistent with literature research, suggesting that the effect of oil prices on the factors examined decreases over time.

Analysing the data posed several challenges, as on the one hand I had to examine the different aspects of the 3 types of country in time, and on the other hand I was curious about the link between the variables.

I used the linear regression analysis with the analysis of Pearson's correlation coefficient, since the numbers formed a time series of data. I was able to best examine the strength of the relationship between the variables.

In the second step of my research, I divided the time interval into two parts in order to compare the results.

The aggregated data was examined as my starting point for conducting the study. The data are shown in Table 32 Appendix 2 and I have noticed that each variable showed different relationship in connection with oil price changes.

I continued my research and divided the examined 12 years into two periods, the first between 2008-2013 and the second over 6 years between 2014 and 2019.

The period 2008-2013

Examination of the first period Table 33 Appendix 2 shows that the effect on inflation of changes in oil prices in EU countries increased between 2008 and 2013, but decreased among oil exporters. Household consumption was not only significantly but also reversed, with a close and opposite value, showing a correlation of -0.893 (p = 0.05) in the EU, while a slight decrease in the other countries. Unemployment in the OPEC countries developed differently, I found a very weak positive correlation, which previously showed an opposite value to 0.048 from -0.571 (p = 0.05) and in the case of oil exporting countries this correlation even strengthened -0.366- from -0.924 (p = 0.5). Based on the development of the average GDP, there was no significant change in the oil exporting countries, while in the EU countries the correlation coefficient changed from -0.142 to 0.567.

The period 2014-2019

I examined the changes compared to 2008 and illustrated this in Table 34 Appendix 2 I have noticed that the link between oil price and inflation rate has fallen in all countries, and I detected opposite relationship for oil exporters it changed from 0.049 to -0.260 (p = 0.05).

In the case of household consumption expenditure the correlation value changed to positive in the EU countries to 0.671 (p = 0.05), and I could show stronger relationship in all cases over the time.

Analysing unemployment rate resulted in showing weaker relationships in all the examined country groups.

After 2014, the level of CO_2 emissions changed differently in all countries from 0.697 to 0.362 ($p = 0.05$) for oil-exporting countries, from 0.697 to -0.275 ($p = 0.05$) for OPEC countries. The correlation coefficient showed an opposite close relationship in the EU showing the values of 0.043 to -0.642 ($p = 0.05$).

Analysing the relationship between oil price and GDP growth in the case of oil exporting countries the relationship has risen to 0.722 but negative relationship was detectable -0.735 (p=0,05) for OPEC countries. Researching the EU countries, I found that the relationship weakened here by 2014 to 0.201 from 0.567 ($p = 0.05$) in the period 2008-2013.

Based on Table 35, I can conclude that the relationship between oil price and key macroeconomic indicators weakened in the examined time period and my results support HOOKER (2002) and BLANCHARD and GALI (2007) views' on the weakening relationship. In the case of household consumption expenditure I was not able to justify this, I could show a higher linear correlation over time.

Table 35: Pearson's correlation between oil price and the key indicators between 2008 and 2013/ 2014 and 2019 key data

indicator	All	2008-2013	2014-2019
infl_oilexport	0,263	0,049	-0,260
infl_OPEC	0,608	0,487	0,093
infl_EU	0,643	0,699	0,115
Hhexp_EU	0,656	-0,893	0,671
Hhexp_opec	-0,927	-0,895	-0,927
Hhexp_oilexp	-0,847	-0,568	-0,939
Unempl_EU	0,430	0,237	0,243
Unemp_opec	-0,571	0,048	-0,227
Unempl_oilexp	-0,366	-0,924	-0,899
CO2_oilexp	-0,171	0,789	0,362
CO2_OPEC	-0,433	0,697	-0,275
CO2_EU	0,222	0,043	-0,642
AnGPD_oilexp	0,526	0,587	0,722
ANGPD_OPEC	0,343	0,414	-0,735
ANGDP_EU	-0,142	0,567	0,201

Source: Author's own editing based on SPSS calculations of data from WDI

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

In this chapter I summarize my ideas on the basis of my research, I answer my research questions and present the results of the testing of my hypotheses. I also present the future directions of the research. From the point of view of the practical applicability, I formulate conclusions that may be useful for the future.

The Arab oil embargo of 1973–1974, which caused the first oil shock, has triggered several discussions on the causal link between oil price and macroeconomic indicators. Changes in the price of crude oil has a different impact on economies. We can put economies in two categories from the point of this research, namely net oil-importers and net oil-exporters. If oil prices go up, it can have a negative effect on the GDP of oil-importers. On the other hand high oil prices can have a positive impact on the GDP of oil-exporters due to the increase in oil revenues. This dissertation examined the relationship between the fluctuation of oil price and different macroeconomic variables of oil-exporters and oil-importers.

Research Question 1.and the connecting hypothesis were as follows:

1. What is the relationship between oil price and inflation rate in oil exporting countries, OPEC countries and major EU countries?

The relationship between oil price and inflation rate is positive and linear in in oil exporting countries, OPEC countries and major EU countries. The strength of the relationship differs in each examined country groups.

Hypothesis 1: There is a positive linear relationship between oil price and inflation rate. Falling oil prices decrease inflation rate in oil exporting countries, OPEC countries and major EU countries.

I confirmed my hypothesis that there is a positive linear relationship between oil price and inflation rate in each examined country types. Falling oil prices decrease inflation rate in oil exporting countries, OPEC countries and major EU countries. The relationship is present on a different level, the most significant in the case of OPEC ($r = 0.608$) ($p = 0.05$) countries and EU countries, ($r = 0.643$) ($p = 0.05$) in the case of major oil exporting countries the relationship is not significant ($r = 0.263$, $p = 0.05$). In the case of oil exporting countries that inflation rate loosely follows the movement of oil prices. The average inflation rate in each country reacts loosely and inversely to oil prices. This phenomenon is detectable in the period of 2009-2016. After 2016 we can see a more linear relationship. The trend in both cases is decreasing and parallel to each other.

In general we can say that falling oil prices can help to reduce the cost of living. Products and services related to oil will fall, resulting lower cost of living and lower inflation rate. Central Banks are in better position with lower oil prices. They can keep interest rates lower without the risk of inflation Falling oil prices is one of the reasons why inflation is relatively low in Western Europe at the moment of writing this dissertation.

A drop in oil prices may help to bring inflation closer to the governments' target, but with inflation already close to zero, falling oil prices do not help to reduce excess inflation – they are in danger of causing deflation. Deflation can cause serious macroeconomic problem, e.g. debt inflation, rising interest rates and rising real wages.

Research Question 2.and the connecting hypothesis were as follows:

2. What is the relationship between oil price and unemployment rate in oil exporting countries, OPEC countries and major EU countries?

The relationship between oil price and unemployment rate is linear and negative in oil exporting and OPEC countries. The relationship is linear and positive in selected EU countries. The strength of the relationship does not significantly differ in the examined country groups.

Hypothesis 2/A/: There is a negative linear relationship between oil price and unemployment rate in oil exporting and OPEC countries.

Hypothesis 2 /B/: There is a positive linear relationship between oil price and unemployment rate in major EU countries.

Examining my second hypothesis, I found that changes in oil prices can have an impact on the unemployment rate of either oil exporting or oil importing countries, but to varying degrees. My hypothesis consisted of two parts, the first is that as a result of rising oil prices, the unemployment rate will decrease in oil exporting and OPEC countries as they can employ more people. This statement was substantiated because both the correlation diagrams and the correlation table showed that there is an opposite relationship between them. In the case of oil exporting countries r=- 0,366 (p=0.05), for OPEC countries r=-0,571 (p=0.05). The correlation is opposite, if oil prices fall, the unemployment rate in these oil exporting countries will rise.

The other part of the hypothesis is that in the case of non-oil producing countries in the EU, the price of oil should move in parallel with the unemployment rate. I was able to show positive relationship between them, r=0,430 (p=0.05).

Research Question 3.and the connecting hypothesis were as follows:

3. What is the relationship between oil price and household final consumption expenditure in oil exporting countries, OPEC countries and major EU countries?

The relationship between oil price and household final consumption is linear and negative in oil exporting and OPEC countries. The relationship is linear and positive in selected EU countries. The strength of the relationship is significant in oil exporting and OPEC countries.

Hypothesis 3: There is a negative linear relationship between oil price and the final consumption expenditure of households in oil exporting, OPEC and EU countries.

My third hypothesis that there is a negative linear relationship between oil price and the final consumption expenditure of households in oil exporting, OPEC and EU countries I was able to confirm only partially. There is a significant negative linear relationship between oil price changes and households final consumption expenditure in the case of oil exporting, r=-0,847 (p=0.01) and OPEC r=-0,927 (p=0.01) countries, however this relationship is positively linear and weaker in the case of selected EU countries, r=0,656 (p=0.05).

If real wages remain constant, falling oil price generate more discretionary income for consumers. It can be interpreted as a free tax cut with the same effect as expansionary fiscal policy. In theory, the fall in oil price has an increasing effect on the consumption of goods and services adding more value to real GDP. The synergy of lower prices, more purchasing power and lower cost of living can intensify economic growth.

Research Question 4.and the connecting hypothesis were as follows:

4. What is the relationship between oil price and CO_2 emission in oil exporting countries, OPEC countries and major EU countries?

There is no definite positive or negative linear relationship between oil price and CO_2 emissions in the examined country groups.

Hypothesis 4: There is a negative linear relationship between oil price and CO_2 emission in oil exporting, OPEC and major EU countries.

My fourth hypothesis of my research was that there is a negative linear relationship between oil price change and CO_2 emissions for each country type. I used linear regression method in several ways. I examined the average of each country type and looking at the trends, I found that the linear trend chart is increasing for oil producing and OPEC countries and decreasing slightly for EU countries.

Based on the descriptive statistical indicators, I found that the CO_2 emissions of each country vary widely, the averages and the degree of variance are different, but the most significant was in different EU countries.

Correlation studies have shown that OPEC and oil exporting countries have a more significant negative relationship, whereas this is not obvious and is not true for all countries. The relationship was more positive in the EU countries, but no significant relationship could be established here either.

The linear regression calculations supported this assumption, as I could not show a significant and close relationship between CO_2 emissions and oil price changes in either the ANOVA or Coefficients calculations.

Based on this, I came to the conclusion that there is a weak relationship, but this cannot be considered a linear change in the price of oil and CO_2 emissions. I think it is likely that other factors also have an impact on CO_2 emissions, such as compliance with climate agreements, the market and the production of large consumers, factories or the activities of other actors in the economy. As a result of this I rejected this hypothesis.

Research Question 5.and the connecting hypothesis were as follows:

5. What is the relationship between oil price and GDP growth in oil exporting countries, OPEC countries and major EU countries?

The relationship between oil price and GDP growth is linear and positive in most of the examined oil exporting and OPEC countries. The relationship between oil price and GDP growth is linear and negative in major EU countries.

Hypothesis 5/A/: There is a positive linear relationship between oil prices and the GDP growth of oil exporting and OPEC countries.

Hypothesis 5/B/: There is a negative linear relationship between oil prices and the GDP growth of major EU countries

In my fifth hypothesis I have found that oil-exporting countries react to oil price rises with an increase in their GDP growth. Similar conclusion can be drawn in the case of OPEC countries. Correlation analysis used for the significance of the relationship have shown that these relationships are not valid in all cases and countries, there are countries that respond more intensively to oil prices, and there are some that respond later.

In the case of the EU countries, I have observed that their trend line is opposite, that is, if the price of oil rises, their GDP growth will fall, and although this relationship is not so significant, it can still be demonstrated. Based on this, I confirmed my hypothesis.

Research Question 6.was as follows:

6. Do oil price fluctuations have a different impact on the economy of oil exporting and oil importing countries?

Yes, they do. Oil price fluctuations have a different impact on the economy of oil exporting and oil importing countries.

We can deduct from the results of the testing of my hypotheses that the changes in the oil price have a different impact on the economy of various countries. The impact will be different in oil exporting countries from oil importing ones. The impact depends on the direction of the price trend.

Oil importers will benefit from a falling oil price as their oil imports ' value will decrease. This will reduce oil importers ' current account deficit; this is essential for a country like India that imports 75% of oil consumption and currently has a significant current account deficit. A falling oil price, however, will do the opposite for oil exporters to reduce the value of their exports and result in lower trade surpluses.

Falling oil prices have a negative impact on oil exporters. In order to fund government spending, many oil exporting countries rely on tax revenue from oil production. Russia, for example, receives 70 percent of all oil and gas tax revenues. Falling oil prices would lead to a shortfall in the government's budget, requiring either higher taxes or cuts in government spending. Other oil exporters like Venezuela are relying on oil revenues to fund generous social spending. A fall in oil prices could lead to a significant budget deficit and social problems. Other oil exporters, such as Saudi Arabia and the UAE, have built up significant reserves of foreign currency; because they have substantial reserves, they can tolerate temporary declines in oil prices.

Recently prices have dropped to such a degree that oil companies are quitting business. Regions like North Sea Oil, Arctic oil extraction sites and other high-cost regions are no longer commercial to operate. Industries have no choice but to cut demand and lay off workers.

With oil companies going bankrupt, we can experience a negative impact on the global financial system. Banks that have lent money to invest in oil can lose money, contributing to a tightening of global credit.

Dropping oil prices can cause reduced efficiency for alternative sources of energy. OPEC nations like Saudi Arabia want to protect their oil markets and not lose market share. Declining oil prices could slow investment in alternative forms of ' greener ' energy, such as electric cars.

Falling oil price can change the recent decline in car use, it can lead to an increase in traffic congestion and can cause environmental problems.

Oil producers such as Venezuela and Russia are faced with an unexpected combination of falling tax revenues, devaluation, inflation, and declining living standards. The drop in oil prices, however, is pushing countries to diversify and invest in sectors like mining and farming. This could be beneficial in the long term, as it is always risky to have an economy reliant on one commodity.

The falling oil prices is usually beneficial to the global economy. The price drop happened in 2016, though, is different because the price of oil dropped to a level that makes most of the oil production uneconomic. Large amounts of money were lost by many oil producers. Such massive losses could have serious effects on global finance and the global economy's situation. This can overshadow any benefits consumers and companies can get from cheaper prices.

Examining the macro economic problems rising oil prices can cause, we can state that the rise in the oil price has a positive impact on the oil importers, they will see an increase in their revenue. A rising oil price is able to shift economic and political power from oil importers top oil exporters. Higher oil prices would result in an increase in the role of oil exporters such as OPEC countries in their current account. It will lead to a decline in the role of oil importers in the current account (e.g. Germany, China). Oil exporters will see a rise in deposits of foreign currency that they can use to buy foreign assets.

Consumers may see a decline in discretionary income. They face higher rates of travel, but they have no allowance for rising incomes. Higher oil prices will lead to slower economic growth, particularly if consumer spending is small.

Cost-push inflation from rising oil prices provides policymakers with a challenge. Higher inflation typically requires higher interest rates to maintain target inflation. Demand for oil is inelastic in the short term. It means that a price rise triggers only a marginal drop in demand. Demand is invaluable since customers prefer goods based on oil, e.g. their vehicle just runs on fuel. Nevertheless, higher oil prices would enable customers to diversify consumption in the long term (e.g. purchase hydrogen-powered cars, etc.), and demand can become more price stable in the long run.

Research Question 7.was as follows:

7. Did the link between oil prices and key macroeconomic indicators deteriorate over the last decade?

Based on my research I can conclude that the relationship between oil prices and the macro economy weakened in the examined period. The reasons for this can be the underlying shock driving oil prices. Another explanation for the weakening relationship lies in changes in the transmission of shocks. The transmission of oil price shocks can change with the structure of the economy and policy framework. Energy efficiency can be the third factor. When energy efficiency leads to lower consumption, prices can fall. This is especially true if energy efficiency activities are widespread and on a large enough scale, such as fuel economy standards for vehicles. Some energy sources are global commodities; changes in demand in a single region may have little impact on energy prices. Local supply constraints, on the other hand, may translate into changes in energy prices locally if energy efficiency measures free up the supply of energy sources and lead to improved energy supply security.

6.2. Recommendations

Energy prices account for a sizable portion of our domestic expenditures, have a significant impact on industrial competitiveness, and influence energy consumption patterns. End-use prices are influenced by commodity market movements as well as policy decisions. Monitoring energy end-use prices around the world has become increasingly important for analysts and policymakers as countries move away from regulated pricing in energy markets. Based on the above I would like to recommend my dissertation to managers in the corporate sector and policy makers in the governmental sector.

Government policy, in the form of taxes and/or subsidies, has a significant impact on how gasoline prices vary around the world. For example, European consumers pay the highest gasoline prices, owing to high fuel taxes. On the other end of the spectrum, countries that subsidize liquid fuels have the lowest prices. In recent years, the prices of automotive diesel and gasoline have tracked the movements of crude oil prices. Not surprisingly, global pump prices are significantly higher on average than underlying crude spot prices because they include transformation, transportation, and marketing costs, as well as taxes levied on fuel sales. While the global gasoline price follows crude spot trends, regional dynamics differ. Significant changes have occurred in the MENA region in recent years as a result of both policy developments and economic effects (exchange rates and inflation).

Because of the role of policy, prices in Algeria and Saudi Arabia had little correlation with crude price movements until recent increases due to reductions in fuel subsidies and the implementation of value-added taxes in Saudi Arabia. Despite these trends, these two countries' prices remained among the lowest in the world in 2019. Egypt has gradually increased the fixed pump price to reduce the burden on the country's budget; however, the price expressed in 2015 US dollars decreased significantly due to the combined effect of inflation and currency depreciation.

Geographical variations in transportation fuel prices exist within a country due to a variety of factors such as pricing framework, sub-national taxes, distribution costs (consumer proximity to suppliers), marketing costs (retail competition and margins), and refining costs (different environmental regulations).

Sub-national gasoline prices in China, for example, are more homogeneous due to national price regulations than those in Brazil, where prices are market-based and heavily influenced by local taxes.

Taxation is a major source of revenue for governments, and it is used to fund the general budget or to internalize the external costs associated with the use of a given commodity. A growing number of countries have begun earmarking taxation in order to more clearly demonstrate the purpose of single excise taxes. Environmental taxes (either based on sulphur or carbon content); energy security taxes; or social taxation to subsidize access to energy for all are examples.

Governments use a variety of regulations and approaches to strike a balance between affordability, environmental concerns, and other policy goals. A significant number of countries, for example, fix the price to encourage greater access for the population, effectively subsidizing consumption. In other countries, where affordability is less of an issue and energy spending accounts for a smaller proportion of household expenditure, markets are more liberalized, with interventions limited to taxation. In a third group of countries, governments use an intermediate scheme to limit fluctuations in the end-use price linked to the crude spot market by partially controlling the end-use price (e.g., through a price cap). In liberalized markets, post-tax prices are generally higher.

I would suggest the introduction of a gasoline tax (in countries where it is not yet available) may be actual, although it will lead to an increase in gasoline prices. This will allow consumers and manufacturers to adapt to the new legislation and change their habits.

Alternatively, tax on crude oil can also be a solution. Special tax could be introduced. For example, if the oil price over $90, the tax rate will be 8 %. If the price is under $90 the tax rate will be 13%. Such a strategy would keep high rates and provide the same level of tax revenue for countries.

Vehicle manufacturers should pay more attention to fuel efficiency of engines in the future. Because car manufacturers have long product development cycles, they prefer uniform and predictable regulations on fuel efficiency and emissions standards.

The volatility in oil price intensifies uncertainty and can lead to cash flow management problems. Primarily governments and policy makers have to face these problems and they have to take steps to stabilize the situation.

Regulation on reducing import costs such as hedging will help mitigate the adverse effect of rising oil prices. Private oil companies that are multinational companies' branches will buy petroleum products using futures contracts if it is expected that rates will rise in the future. This can help for governments to maintain a steady price for customers. To reduce heavy dependence on oil, governments should diversify into non-petroleum energy sources. Natural gas, coal, and renewable energy sources such as solar, geothermal, wind, and hydro are the most important non-petroleum sources governments should focus in the future.

In the future policy makers cannot ignore the fact that burning oil is one of the largest sources of greenhouse gas emissions and thus a major contributor to climate change, which, if unchecked, could have serious global security implications and other consequences.

6.3. Research Limitations and Future Research Directions

The methods I used in research is not suitable the describe causality. Causality is influence by which one event, process, state (a *cause*) contributes to the production of another event, process, state (an *effect*) where the cause is partly responsible for the effect, and the effect is partly dependent on the cause. In the future it could be interesting to research causality between the variables I examined. For this Granger causality test could be performed. Vector autoregression (VAR) statistical model could also be used to capture the relationship between multiple quantities as they change over time.

For the future, I would consider it important for the countries involved in research to be more diverse and for more economic indicators to be taken into account.

The other change here is that I would consider it worthwhile to expand the range of existing data in time. The research has now spanned a decade, but if I had the opportunity, I would extend the time interval in the future and instead look at countries from 1990 onwards, in which it would be useful to include other groups, such as Eastern European countries.

The key issue of the research was the development of the price of oil, which was influenced by several factors in time, for example, the Arab Spring significantly increased the price of oil. The current pandemic has also shown and is shaping oil prices in a variety of ways. I would look at how specific geopolitical factors affect oil price developments and which countries could be highlighted.

In connection with my research, a question arose that the regions could be better focused in the future. The EU countries were specific and, in principle, the OPEC countries, but I would find it useful to be able to examine several countries on the American continent in addition to Europe, and this could be supplemented by either Africa or Asia.

In connection with the protection of the environment, one of my specific research questions was the extent of CO2 emissions and its correlations. An interesting area of research for each country would be the importance they attach to protecting and preserving the environment beyond oil extraction and export.

7. NEW SCIENTIFIC RESULTS

1. I have statistically proven that the relationship between oil price and inflation rate is positive and linear in in oil exporting countries, OPEC countries and major EU countries. Falling oil prices decrease inflation rate in oil exporting countries, OPEC countries and in major EU countries. The relationship is present on a different level, the most significant in the case of OPEC countries and EU countries, in the case of major oil exporting countries the relationship is not significant. Falling oil prices decrease inflation resulting growth in the economy of both oil exporting and oil importing countries.

2. I have statistically proven that the relationship between oil price and unemployment rate is linear and negative in oil exporting and OPEC countries. The relationship is linear and positive in major EU countries. The strength of the relationship does not significantly differ in the examined country groups. This statement has been substantiated because the research showed that there is an opposite relationship between the indicators. If oil prices fall, the unemployment rate in oil exporting countries will rise. In the case of major EU countries, the price of oil moves in parallel with the unemployment rate. Positive relationship has been verified between the indicators.

3. I have statistically proven that the relationship between oil price and household final consumption is linear and negative in oil exporting and OPEC countries. The relationship is linear and positive in major EU countries. The strength of the relationship is significant in oil exporting and OPEC countries. Falling oil prices generate larger consumption in oil-exporting countries but decreases consumption in oil-importing countries.

4. I have statistically proven that there is no definite positive or negative linear relationship between oil price and CO2 emissions in the examined country groups. There is a weak relationship, but this cannot be considered as a negative linear relationship.

5. I have statistically proven that. The relationship between oil price and GDP growth is linear and positive in most of the examined oil exporting and OPEC countries. The relationship between oil price and GDP growth is linear and negative in major EU countries. Oil exporting countries react to oil price rises with an increase in their GDP growth. In the case of the EU countries the relationship is opposite, if the price of oil rises, their GDP growth will fall. This relationship is not significant, but can be proven statistically.

6. During my research I came to the conclusion that oil price fluctuations have a different impact on the economy of oil exporting and oil importing countries. We can deduct from the results of the testing of my hypotheses that the changes in the oil price have a different impact on the economy of various countries. The impact will be different in oil exporting countries from oil importing ones. The impact depends on the direction of the price trend.

7. I have statistically proven that the relationship between oil prices and key macroeconomic indicators weakened in the period of 2008-2019.

The results of my research is summarized in Table 36 as follows:

Table 36: The summary of the results of the dissertation

HYPOTHESIS	RESULT OF TEST	CONCLUSIONS
H1: There is a positive linear relationship between oil price and inflation rate. Falling oil prices decrease inflation rate in oil exporting countries, OPEC countries and major EU countries.	This hypothesis has been confirmed.	The relationship is present on a different level, the most significant in the case of OPEC countries and EU countries, in the case of major oil exporting countries the relationship is not significant. Falling oil prices decrease inflation resulting growth in the economy of both oil exporting and oil importing countries.
H2/A/: There is a negative linear relationship between oil price and unemployment rate in oil exporting and OPEC countries. **H2 /B/: There is a positive linear relationship between oil price and unemployment rate in major EU countries.**	This hypothesis has been confirmed.	If oil prices fall, the unemployment rate in these oil exporting countries will rise. In the case of major EU countries, the price of oil moves in parallel with the unemployment rate. Positive relationship has been verified between the indicators.
H3: There is a negative linear relationship between oil price and the final consumption expenditure of households in oil	This hypothesis has been partially confirmed.	There is a negative linear relationship between oil prices and the final consumption expenditure of households in oil exporting

exporting, OPEC and EU countries.		and OPEC countries This relationship is positively linear and not significant in the case of EU countries. Falling oil prices generate larger consumption in oil-exporting countries but decreases consumption in oil-importing countries.
H4: There is a negative linear relationship between oil price and CO2 emission in oil exporting, OPEC and selected EU countries.	This hypothesis has not been confirmed.	There is a negative linear relationship between oil price and CO2 emission in oil exporting, OPEC and selected EU countries is not statistically proven. There is a weak relationship, but this cannot be considered as a negative linear relationship.
H5/A/: There is a positive linear relationship between oil prices and the GDP growth of oil exporting and OPEC countries. **H5/B/: There is a negative linear relationship between oil prices and the GDP growth of major EU countries**	This hypothesis has been confirmed.	Oil exporting countries react to oil price rises with an increase in their GDP growth. In the case of the EU countries the relationship is opposite, if the price of oil rises, their GDP growth will fall. This relationship is not significant, but can be proven statistically.

Source: Author's own editing

8. SUMMARY

Crude oil prices, like most other commodities in the market, have routinely experienced wild price swings alternating between periods of great scarcity, high demand, and high prices and periods of oversupply, low demand, and depressed prices. These so-called crude oil "Price Cycles" can last several years, depending on factors such as oil demand, the volume of oil drilled, processed, and sold by the major producers, and so on. These price swings have been triggered by economic and political events, technological advancements and changes within the petroleum industry, and continue to influence prices in the present day.

The objective of the dissertation was to answer my 7 research questions and examine oil price changes and their effect on economic development in the world. It analysed the relationship between oil prices changes and inflation rate, unemployment rate, household final consumption expenditure, CO2 emission and GDP growth in different country groups. It was assumed that oil prices strongly influence the economy of net oil exporting countries while little or no influence can be detected on the economy of net oil importing countries. In order I could answer my research questions I formulated 5 hypotheses. In the research, I primarily tested my hypotheses by analysing them with different statistical methods.

Firstly I analysed the relationship between oil price fluctuation and inflation rate of non OPEC oil-exporting, OPEC and oil importing EU countries. I confirmed my hypothesis that there is a linear relationship between oil price and inflation rate.

Examining my second hypothesis, I found that changes in oil prices can have an impact on the unemployment rate of either oil exporting or oil importing countries, but to varying degrees. My hypothesis consisted of two parts, the first is that as a result of rising oil prices, the unemployment rate will decrease in oil exporting and OPEC countries as they can employ more people. This statement was substantiated because both the correlation diagrams and the correlation table showed that there is an opposite relationship between them. The correlation is opposite, if oil prices fall, the unemployment rate in these oil exporting countries will rise. The other part of the hypothesis is that in the case of non-oil producing countries in the EU, the price of oil should move in parallel with the unemployment rate. I was able to show positive relationship between them.

My third hypothesis that there is a negative linear relationship between oil price and the final consumption expenditure of households in oil exporting, OPEC and EU countries I was able to confirm only partially. There is a significant non-linear relationship between oil price changes and households final consumption expenditure in the case of oil exporting and OPEC countries, however this relationship is linear and weaker in the case of selected EU countries.

My fourth hypothesis of my research was that there is a negative linear relationship between oil price change and CO2 emissions for each country type I could not show a significant and close relationship between CO2 emissions and oil price changes in either the ANOVA or Coefficients calculations.

In my fifth hypothesis I have found that oil-exporting countries react to oil price rises with an increase in their GDP growth. Similar conclusion can be drawn in the case of OPEC countries. Correlation analysis used for the significance of the relationship have shown that these relationships are not valid in all cases and countries, there are countries that respond more intensively to oil prices, and there are some that respond later.

In the case of the EU countries, I have observed that their trend line is opposite, that is, if the price of oil rises, their GDP growth will fall, and although this relationship is not so significant, it can still be demonstrated. Based on this, I confirmed my hypothesis. Based on my hypotheses I concluded that oil price fluctuations have a different impact on the economy of oil exporting and oil importing countries, and the link between oil prices and key macroeconomic indicators weakened in the last decade.

9. APPENDICES

9.1. Appendix 1: Bibliography

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9.2. Appendix 2: Large Tables

Table 10: Pearson correlation between oil price and CO2 emission in oil exporting countries

Correlations

		oilprice	Brazil	Canada	China	Colombia	India	Mexico	Norway	Russia	USA
oilprice	Pearson Correlation	1	,025	-,026	-,161	-,485	-,504	,035	,663*	,678*	,525
	Sig. (2-tailed)		,939	,936	,616	,110	,095	,914	,019	,015	,080
	N	12	12	12	12	12	12	12	12	12	12
Brazil	Pearson Correlation	,025	1	,615*	,810**	,692*	,625*	,777**	,004	,218	-,480
	Sig. (2-tailed)	,939		,033	,001	,013	,030	,003	,991	,496	,114
	N	12	12	12	12	12	12	12	12	12	12
Canada	Pearson Correlation	-,026	,615*	1	,596*	,657*	,624*	,365	-,370	,460	-,192
	Sig. (2-tailed)	,936	,033		,041	,020	,030	,243	,236	,133	,551
	N	12	12	12	12	12	12	12	12	12	12
China	Pearson Correlation	-,161	,810**	,596*	1	,877**	,887**	,792**	-,323	,238	-,804**
	Sig. (2-tailed)	,616	,001	,041		,000	,000	,002	,306	,456	,002
	N	12	12	12	12	12	12	12	12	12	12
Colombia	Pearson Correlation	-,485	,692*	,657*	,877**	1	,974**	,603*	-,603*	,090	-,788**
	Sig. (2-tailed)	,110	,013	,020	,000		,000	,038	,038	,782	,002
	N	12	12	12	12	12	12	12	12	12	12
India	Pearson Correlation	-,504	,625*	,624*	,887**	,974**	1	,586*	-,606*	,049	-,833**
	Sig. (2-tailed)	,095	,030	,030	,000	,000		,045	,037	,880	,001
	N	12	12	12	12	12	12	12	12	12	12
Mexico	Pearson Correlation	,035	,777**	,365	,792**	,603*	,586*	1	,085	,283	-,651*
	Sig. (2-tailed)	,914	,003	,243	,002	,038	,045		,794	,372	,022
	N	12	12	12	12	12	12	12	12	12	12
Norway	Pearson Correlation	,663*	,004	-,370	-,323	-,603*	-,606*	,085	1	,193	,538
	Sig. (2-tailed)	,019	,991	,236	,306	,038	,037	,794		,547	,071
	N	12	12	12	12	12	12	12	12	12	12
Russia	Pearson Correlation	,678*	,218	,460	,238	,090	,049	,283	,193	1	,167
	Sig. (2-tailed)	,015	,496	,133	,456	,782	,880	,372	,547		,603
	N	12	12	12	12	12	12	12	12	12	12

USA	Pearson Correlation	,525	-,480	-,192	-,804**	-,788**	-,833**	-,651*	,538	,167	1
	Sig. (2-tailed)	,080	,114	,551	,002	,002	,001	,022	,071	,603	
	N	12	12	12	12	12	12	12	12	12	12

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Author's own editing based on SPSS

Table 11 ANOVA analysis of oil exporting countries

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6007,394	9	667,488	3,450	,245[b]
	Residual	386,990	2	193,495		
	Total	6394,384	11			

a. Dependent Variable: oilprice

b. Predictors: (Constant), USA, Russia, Canada, Norway, Brazil, Mexico, Colombia, China, India

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-552,960	480,848		-1,150	,369
	Brazil	,357	,382	,678	,934	,449
	Canada	-1,496	1,768	-,940	-,846	,487
	China	,034	,031	1,018	1,067	,398
	Colombia	-3,934	3,349	-2,059	-1,175	,361
	India	,087	,148	1,238	,584	,618
	Mexico	,753	1,472	,477	,511	,660
	Norway	-22,318	29,899	-,852	-,746	,533
	Russia	,403	,208	,612	1,935	,193
	USA	,187	,231	1,563	,809	,503

a. Dependent Variable: oilprice

Source: Author's own editing based on SPSS

Table 14: Pearson correlation between oil price and CO2 emission in OPEC countries

		oilprice	Algeria	Iran	Iraq	Kuwait	Qatar	Saudi Arabia	United Arab Emirates	Libia	Nigeria
oilprice	Pearson Correlation	1	-,474	-,438	-,419	-,292	-,454	-,440	-,524	,089	,074
	Sig. (2-tailed)		,119	,154	,176	,357	,138	,152	,080	,784	,818
	N	12	12	12	12	12	12	12	12	12	12
Algeria	Pearson Correlation	-,474	1	,967**	,933**	,807**	,955**	,904**	,954**	-,393	,700*
	Sig. (2-tailed)	,119		,000	,000	,002	,000	,000	,000	,206	,011
	N	12	12	12	12	12	12	12	12	12	12
Iran	Pearson Correlation	-,438	,967**	1	,968**	,744**	,903**	,833**	,921**	-,500	,738**
	Sig. (2-tailed)	,154	,000		,000	,005	,000	,001	,000	,098	,006
	N	12	12	12	12	12	12	12	12	12	12
Iraq	Pearson Correlation	-,419	,933**	,968**	1	,821**	,899**	,850**	,911**	-,532	,758**
	Sig. (2-tailed)	,176	,000	,000		,001	,000	,000	,000	,075	,004
	N	12	12	12	12	12	12	12	12	12	12
Kuwait	Pearson Correlation	-,292	,807**	,744**	,821**	1	,889**	,882**	,845**	-,289	,673*
	Sig. (2-tailed)	,357	,002	,005	,001		,000	,000	,001	,362	,016
	N	12	12	12	12	12	12	12	12	12	12
Qatar	Pearson Correlation	-,454	,955**	,903**	,899**	,889**	1	,981**	,956**	-,398	,749**
	Sig. (2-tailed)	,138	,000	,000	,000	,000		,000	,000	,200	,005
	N	12	12	12	12	12	12	12	12	12	12
Saudi Arabia	Pearson Correlation	-,440	,904**	,833**	,850**	,882**	,981**	1	,898**	-,349	,749**
	Sig. (2-tailed)	,152	,000	,001	,000	,000	,000		,000	,266	,005
	N	12	12	12	12	12	12	12	12	12	12
	Pearson Correlation	-,524	,954**	,921**	,911**	,845**	,956**	,898**	1	-,429	,685*

United Arab Emirates	Sig. (2-tailed)	,080	,000	,000	,000	,001	,000	,000		,164	,014
	N	12	12	12	12	12	12	12	12	12	12
Libia	Pearson Correlation	,089	-,393	-,500	-,532	-,289	-,398	-,349	-,429	1	-,565
	Sig. (2-tailed)	,784	,206	,098	,075	,362	,200	,266	,164		,055
	N	12	12	12	12	12	12	12	12	12	12
Nigeria	Pearson Correlation	,074	,700*	,738**	,758**	,673*	,749**	,749**	,685*	-,565	1
	Sig. (2-tailed)	,818	,011	,006	,004	,016	,005	,005	,014	,055	
	N	12	12	12	12	12	12	12	12	12	12

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Source: Author's own editing based on SPSS calculations

Table 15: ANOVA analysis of oil exporting countries

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1199,536	908,198		1,321	,317
	Algeria	2,399	2,274	1,814	1,055	,402
	Iran	-1,477	1,354	-3,358	-1,091	,389
	Iraq	1,483	2,408	1,310	,616	,601
	Kuwait	-,332	3,200	-,103	-,104	,927
	Qatar	6,275	5,325	5,350	1,179	,360
	Saudi Arabia	-1,922	1,197	-4,729	-1,606	,249
	United Arab Emirates	-1,759	1,084	-1,980	-1,623	,246
	Libia	,645	1,218	,189	,529	,650
	Nigeria	1,817	,615	1,359	2,955	,098

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5933,788	9	659,310	2,696	,442[b]
	Residual	244,506	1	244,506		
	Total	6178,294	10			

a. Dependent Variable: oilprice

b. Predictors: (Constant), Venezuela, Ecuador, Kuwait, Indonesia, Saudi Arabia, United Arab Emirates, Iran, Iraq, Algeria

Source: Author's own editing based SPSS calculations

Table 18: Pearson correlation between oil price and CO2 emission in EU countries

Correlations

		oilprice	Belgium	France	Germany	Denmark	Italy	Luxemburg	Netherlands	Ireland	United Kingdom
oilprice	Pearson Correlation	1	-,284	,332	,389	,373	,228	,619*	,307	-,558	-,242
	Sig. (2-tailed)		,371	,292	,211	,232	,476	,032	,332	,060	,449
	N	12	12	12	12	12	12	12	12	12	12
Belgium	Pearson Correlation	-,284	1	,047	-,305	,094	-,111	,103	,066	,277	,209
	Sig. (2-tailed)	,371		,885	,335	,771	,731	,749	,838	,383	,515
	N	12	12	12	12	12	12	12	12	12	12
France	Pearson Correlation	,332	,047	1	,712**	,952**	,930**	,798**	,924**	-,790**	-,843**
	Sig. (2-tailed)	,292	,885		,009	,000	,000	,002	,000	,002	,001
	N	12	12	12	12	12	12	12	12	12	12
Germany	Pearson Correlation	,389	-,305	,712**	1	,553	,633*	,394	,753**	-,655*	-,566
	Sig. (2-tailed)	,211	,335	,009		,062	,027	,206	,005	,021	,055
	N	12	12	12	12	12	12	12	12	12	12
Denmark	Pearson Correlation	,373	,094	,952**	,553	1	,866**	,897**	,863**	-,775**	-,830**
	Sig. (2-tailed)	,232	,771	,000	,062		,000	,000	,000	,003	,001
	N	12	12	12	12	12	12	12	12	12	12
Italy	Pearson Correlation	,228	-,111	,930**	,633*	,866**	1	,675*	,823**	-,776**	-,868**
	Sig. (2-tailed)	,476	,731	,000	,027	,000		,016	,001	,003	,000

	N	12	12	12	12	12	12	12	12	12	12
Luxemburg	Pearson Correlation	,619*	,103	,798**	,394	,897**	,675*	1	,756**	-,756**	-,668*
	Sig. (2-tailed)	,032	,749	,002	,206	,000	,016		,004	,004	,018
	N	12	12	12	12	12	12	12	12	12	12
Netherlands	Pearson Correlation	,307	,066	,924**	,753**	,863**	,823**	,756**	1	-,777**	-,764**
	Sig. (2-tailed)	,332	,838	,000	,005	,000	,001	,004		,003	,004
	N	12	12	12	12	12	12	12	12	12	12
Ireland	Pearson Correlation	-,558	,277	-,790**	-,655*	-,775**	-,776**	-,756**	-,777**	1	,910**
	Sig. (2-tailed)	,060	,383	,002	,021	,003	,003	,004	,003		,000
	N	12	12	12	12	12	12	12	12	12	12
United Kingdom	Pearson Correlation	-,242	,209	-,843**	-,566	-,830**	-,868**	-,668*	-,764**	,910**	1
	Sig. (2-tailed)	,449	,515	,001	,055	,001	,000	,018	,004	,000	
	N	12	12	12	12	12	12	12	12	12	12

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Author's own editing based SPSS calculations

Table 32: Pearson's correlation between oil price and the key indicators between 2008 and 2019

Pearson Correlation	oilprice	infl_oilexport	infl_OPEC	infl_EU	Hhexp_EU	Hhexp_opec	Hhexp_oilexp	Unempl_EU	Unemp_opec	Unempl_oilexp	CO2_oilexp	CO2_OPEC	CO2_EU	AnGPD_oilexp	ANGPD_OPEC	ANGDP_EU
oilprice	1	0,263	0,608	0,643	0,656	-0,927	-0,847	0,43	-0,571	-0,366	-0,171	-0,433	0,222	0,526	0,343	-0,142
infl_oilexport	0,263	1	0,711	0,437	0,467	-0,461	-0,578	0,029	-0,695	0,057	-0,629	-0,664	0,295	0,089	0,497	-0,288
infl_OPEC	0,608	0,711	1	0,724	0,589	-0,725	-0,754	0,098	-0,631	-0,158	-0,579	-0,673	0,515	0,234	0,605	-0,344
infl_EU	0,643	0,437	0,724	1	0,3	-0,672	-0,697	-0,213	-0,186	-0,271	-0,24	-0,376	0,527	0,573	0,702	0,015
Hhexp_EU	0,656	0,467	0,589	0,3	1	-0,828	-0,851	0,591	-0,881	0,366	-0,779	-0,906	0,46	0,125	0,425	-0,635
Hhexp_opec	-0,927	-0,461	-0,725	-0,672	-0,828	1	0,967	-0,498	0,738	0,106	0,467	0,692	-0,451	-0,522	-0,576	0,276
Hhexp_oilexp	-0,847	-0,578	-0,754	-0,697	-0,851	0,967	1	-0,365	0,75	-0,025	0,609	0,8	-0,529	-0,478	-0,61	0,342
Unempl_EU	0,43	0,029	0,098	-0,213	0,591	-0,498	-0,365	1	-0,653	0,061	-0,145	-0,295	0,098	0,229	0,123	-0,111
Unemp_opec	-0,571	-0,695	-0,631	-0,186	-0,881	0,738	0,75	-0,653	1	-0,158	0,684	0,807	-0,295	-0,072	-0,343	0,533
Unempl_oilexp	-0,366	0,057	-0,158	-0,271	0,366	0,106	-0,025	0,061	-0,158	1	-0,632	-0,501	0,328	-0,367	0,175	-0,524
CO2_oilexp	-0,171	-0,629	-0,579	-0,24	-0,779	0,467	0,609	-0,145	0,684	-0,632	1	0,957	-0,558	0,157	-0,466	0,724
CO2_OPEC	-0,433	-0,664	-0,673	-0,376	-0,906	0,692	0,8	-0,295	0,807	-0,501	0,957	1	-0,551	-0,014	-0,522	0,689
CO2_EU	0,222	0,295	0,515	0,527	0,46	-0,451	-0,529	0,098	-0,295	0,328	-0,558	-0,551	1	0,466	0,8	-0,105
AnGPD_oilexp	0,526	0,089	0,234	0,573	0,125	-0,522	-0,478	0,229	-0,072	-0,367	0,157	-0,014	0,466	1	0,595	0,63
ANGPD_OPEC	0,343	0,497	0,605	0,702	0,425	-0,576	-0,61	0,123	-0,343	0,175	-0,466	-0,522	0,8	0,595	1	0,033
ANGDP_EU	-0,142	-0,288	-0,344	0,015	-0,635	0,276	0,342	-0,111	0,533	-0,524	0,724	0,689	-0,105	0,63	0,033	1

Source: Author's own editing based on WDI

Table 33: Pearson's correlation between oil price and the key indicators between 2008 and 2013

Pearson Correlation	oilprice	infl_oilexport	infl_OPEC	infl_EU		Hhexp_EU	Hhexp_opec	Hhexp_oilexp	Unempl_EU	Unemp_opec	Unempl_oilexp	CO2_oilexp	CO2_OPEC	CO2_EU	AnGPD_oilexp	ANGPD_OPEC	ANGDP_EU
oilprice	1	0,049	0,487	0,699		-0,893	-0,895	-0,568	0,237	0,048	-0,924	0,789	0,697	0,043	0,587	0,414	0,567
infl_oilexport	0,049	1	0,801	0,669		-0,326	-0,232	-0,665	-0,897	-0,492	-0,202	-0,484	-0,6	0,283	0,125	0,448	0,099
infl_OPEC	0,487	0,801	1	0,828		-0,566	-0,541	-0,682	-0,718	-0,535	-0,652	-0,124	-0,226	0,098	0,107	0,383	0,039
infl_EU	0,699	0,669	0,828	1		-0,791	-0,874	-0,958	-0,444	-0,032	-0,715	0,16	0,01	0,364	0,596	0,799	0,51
Hhexp_EU	-0,893	-0,326	-0,566	-0,791		1	0,843	0,729	-0,016	0,07	0,9	-0,632	-0,535	-0,378	-0,767	-0,553	-0,767
Hhexp_opec	-0,895	-0,232	-0,541	-0,874		0,843	1	0,83	-0,033	-0,288	0,79	-0,558	-0,425	-0,269	-0,729	-0,762	-0,649
Hhexp_oilexp	-0,568	-0,665	-0,682	-0,958		0,729	0,83	1	0,428	-0,148	0,555	-0,084	0,069	-0,537	-0,72	-0,925	-0,632

Unempl_EU	0,237	-0,897	-0,718	-0,444		-0,016	-0,033	0,428	1	0,524	-0,006	0,764	0,819	-0,226	0,197	-0,253	0,267
Unemp_opec	0,048	-0,492	-0,535	-0,032		0,07	-0,288	-0,148	0,524	1	0,216	0,261	0,234	0,26	0,475	0,489	0,401
Unempl_oilexp	-0,924	-0,202	-0,652	-0,715		0,9	0,79	0,555	-0,006	0,216	1	-0,62	-0,568	-0,182	-0,491	-0,328	-0,458
CO2_oilexp	0,789	-0,484	-0,124	0,16		-0,632	-0,558	-0,084	0,764	0,261	-0,62	1	0,979	-0,086	0,52	0,065	0,576
CO2_OPEC	0,697	-0,6	-0,226	0,01		-0,535	-0,425	0,069	0,819	0,234	-0,568	0,979	1	-0,078	0,433	-0,073	0,491
CO2_EU	0,043	0,283	0,098	0,364		-0,378	-0,269	-0,537	-0,226	0,26	-0,182	-0,086	-0,078	1	0,697	0,633	0,626
AnGPD_oilexp	0,587	0,125	0,107	0,596		-0,767	-0,729	-0,72	0,197	0,475	-0,491	0,52	0,433	0,697	1	0,791	0,979
ANGPD_OPEC	0,414	0,448	0,383	0,799		-0,553	-0,762	-0,925	-0,253	0,489	-0,328	0,065	-0,073	0,633	0,791	1	0,682
ANGDP_EU	0,567	0,099	0,039	0,51		-0,767	-0,649	-0,632	0,267	0,401	-0,458	0,576	0,491	0,626	0,979	0,682	1

Source: Author's own editing based on WDI

Table 34: Pearson's correlation between oil price and the key indicators between 2014 and 2019

Pearson Correlation	oil price	infl_oilexport	infl_OPEC	infl_EU	Hhexp_EU	Hhexp_opec	Hhexp_oil exp	Unempl_EU	Unemp_opec	Unempl_oil exp	CO2_oil exp	CO2_OPEC	CO2_EU	AnGPD_oil exp	ANGPD_OPEC	ANGDP_EU
oilprice	1,000	-0,260	0,093	0,115	0,671	-0,927	-0,939	0,243	-0,227	-0,899	0,362	-0,275	-0,642	0,722	-0,735	0,201
infl_oilexport	-0,260	1,000	0,067	-0,893	0,232	0,059	0,079	0,545	-0,793	-0,038	-0,401	-0,420	-0,392	-0,676	0,002	-0,708
infl_OPEC	0,093	0,067	1,000	-0,416	0,544	-0,369	-0,298	0,629	-0,412	-0,033	-0,640	-0,677	0,383	0,421	0,374	0,546
infl_EU	0,115	-0,893	-0,416	1,000	-0,561	0,191	0,094	-0,850	0,939	0,090	0,703	0,770	0,268	0,340	-0,105	0,327
Hhexp_EU	0,671	0,232	0,544	-0,561	1,000	-0,869	-0,745	0,861	-0,766	-0,614	-0,417	-0,872	-0,448	0,529	-0,279	0,272
Hhexp_opec	-0,927	0,059	-0,369	0,191	-0,869	1,000	0,970	-0,571	0,504	0,884	-0,014	0,605	0,568	-0,726	0,626	-0,261
Hhexp_oilexp	-0,939	0,079	-0,298	0,094	-0,745	0,970	1,000	-0,435	0,419	0,950	-0,188	0,461	0,601	-0,682	0,735	-0,149
Unempl_EU	0,243	0,545	0,629	-0,	0,861	-0,571	-0,435	1,000	-0,915	-0,329	-0,756	-0,989	-0,237	0,194	-0,028	0,120

				850												
Unemp_opec	-0,227	-0,793	-0,412	0,939	-0,766	0,504	0,419	-0,915	1,000	0,414	0,559	0,848	0,497	0,094	0,185	0,274
Unempl_oilexp	-0,899	-0,038	-0,033	0,090	-0,614	0,884	0,950	-0,329	0,414	1,000	-0,342	0,327	0,776	-0,486	0,900	0,124
CO2_oilexp	0,362	-0,401	-0,640	0,703	-0,417	-0,014	-0,188	-0,756	0,559	-0,342	1,000	0,771	-0,381	0,029	-0,566	-0,314
CO2_OPEC	-0,275	-0,420	-0,677	0,770	-0,872	0,605	0,461	-0,989	0,848	0,327	0,771	1,000	0,159	-0,316	0,013	-0,255
CO2_EU	-0,642	-0,392	0,383	0,268	-0,448	0,568	0,601	-0,237	0,497	0,776	-0,381	0,159	1,000	0,036	0,815	0,566
AnGPD_oilexp	0,722	-0,676	0,421	0,340	0,529	-0,726	-0,682	0,194	0,094	-0,486	0,029	-0,316	0,036	1,000	-0,266	0,800
ANGPD_OPEC	-0,735	0,002	0,374	-0,105	-0,279	0,626	0,735	-0,028	0,185	0,900	-0,566	0,013	0,815	-0,266	1,000	0,345
ANGDP_EU	0,201	-0,708	0,546	0,327	0,272	-0,261	-0,149	0,120	0,274	0,124	-0,314	-0,255	0,566	0,800	0,345	1,000

Source: Author's own editing based on WDI

9.3. Appendix 3: List of Figures

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9.4. Appendix 4: List of Tables

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