

UNIVERSITA' CA'FOSCARI VENEZIA
DIPARTIMENTO OF ECONOMICS



Università
Ca'Foscari
Venezia

Degree course in Economics and Finance

Thesis in Commodity Markets

Thesis title

**Economics and financial aspects of commodity markets during
COVID pandemic crisis: focus and forecast on crude oil prices and
renewables evolution**

Student:
Cristin Decolli
MAT. 877607

Thesis supervisor:
Maria Bruna Zolin

Accademic year 2019-2020

Index

1. Sanitary definition and contextualization	8
1.1 General economic situation during COVID.....	9
1.2 Commodity markets.....	13
1.2.1 Crude oil.....	14
1.2.2 Metals	14
1.2.3 Agricultural commodities.....	15
1.2.4 Brief outlook on international commodity contex.....	16
2. 2008 and 2020 crisis: overview.....	18
2.1 2008 financial crisis summary.....	18
2.2 Commodity markets in 2008.....	20
2.3 similarities and differences: coronavirus and 2008 crisis	23
3.0 Classification of commodities	29
3.1 Energy	30
3.2 Non-energy	32
3.3 Precious metals	38
4.0 Crude oil market.....	41
4.1 Shale oil.....	45
4.2 OPEC.....	48
5.0 Oil wars and international agreements.....	52
5.1 Russia-Saudi Arabia oil war.....	52
5.2 Other oil wars or sanctions to countries	54

6.0 Renewables.....	59
7.0 The model	68
8.0 Conclusions.....	77

INTRODUCTION

The aim of this work is to investigate possible evolutions of crude oil price in the short and long run after the pandemic situation which represented an economic hit to the whole world. More generally, the interaction between global oil demand and supply will be studied deeply, focusing in the determinants that can affect both sides.

The first chapter explains the expansion of the pandemic illustrating the danger of COVID and why lockdown measures were necessary. Moreover, economics effects are considered, and a general overview of the geopolitical environment is proposed to the reader.

Second chapter focuses on a comparison between financial crisis in 2008 and the COVID crisis in 2020. The comparison is articulated in similarities and differences on responses by authorities, economic impact, and nature of the crisis.

The third chapter focused on the classification of all the elements that compose commodity markets, grouped on energy, non-energy and precious metals; a graphical representation of the price trend for each element is provided even with a brief description of the different features.

Chapter number four introduces the characteristics of the crude oil markets, which are the benchmarks with a description explaining their origin and how markets technically deals with them. Shale oil is discussed, and OPEC organization is illustrated focusing on his central role for international negotiation of petroleum price.

Oil wars and international agreements is the title of chapter number five. The most important recent oil conflict between Russia and Saudi Arabia has reflected itself in the drop in oil price, and all economic and political aspects and consequences are explained. Other recent conflicts are discussed too.

Renewable chapter number six illustrates renewable energy components as the real alternative to fossil fuels. Reduced costs and etic issues influenced government and international organizations in adopting new policies and agreements.

Chapter number 7 contains an econometric model representing a possible future forecast on WTI prices in the short-medium term. The factors determining the model are discussed and even the implementation of the model using software R. Results are reported.

In the last chapter, conclusions are drafted taking into consideration the results on the model and all the elements so far analyzed in the previous chapters.

1. SANITARY DEFINITION AND CONTESTUALIZATION

Year 2020 has been very troubled on different reason: the most iconic and painful was the epidemic outbreak explosion of the SARS-CoV-2 disease, well-known as Coronavirus, all around the world. Most people infected with the virus will experience moderate and/or severe cardiovascular/respiratory problems or neither feel ill (asymptomatic people) and recover without requiring special sanitary treatment. Older people, and those who contract the virus while already having underlying medical problems as respiratory problems, diabetes, chronic pathologies, and cancer are more likely to develop serious illness and are in life threatening. The most warning feature of the Coronavirus is its highly infectious nature: according to the World Health Organization (WHO) (2020) the COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes, that is why in many countries the citizens were (and are)forced to wear a heath mask as a measure to contain the diffusion.

The COVID started to appear in China, more precisely in Wuhan by the end of the 2019: the first certificated hospital case was ascertained on December 16, 2019 and the patient had no relationship with the Huanan Seafood Wholesale Market of Wuhan, where the virus originated according to the collective imagination. Many studies carried out by experts showed that the virus was hidden in different samples of sewage collected in Spain, Brazil and France, so it is difficult to define the exact origin of the Covid-19, but the trend is to attribute it to China even because of the evolution it had in that country. On December 27a COVID affected man was identified coming from the famous Wuhan's Seafood Market. On 20 January, after two medical staff were infected in Guangdong, China National Health Commission confirmed that the virus was human-to-human transmissible and some first cases started to appear in USA and Korea. A crucial date to remember is Jan the 23 because it is the day when the Chinese Government announces quarantine measures cancelling all flights and public transportation service and then extending these measures to the whole Hubei province days later, with millions of people locked in their houses. China was the first country for obvious reasons to apply measures of freedom restriction to a sample of its population and in the following weeks many other nations will adopt similar or however some sort of quarantine application.

On January 30, 2020 the World Health Organization declared the Covid-19 outbreak a Public Health Emergency (PHE) on an international perspective, meaning that the situation causes potential risk to other states overcoming national borders (in fact in Italy the first two cases where confirmed at the same date), while basically the whole world is dealing with the virus;. As a result, almost all countries around the world blocked any kind of transaction with China, for example, USA president Donald Trump on the 31 banned foreign nationals from entering the US if they had been in China within the prior two weeks.

Another iconic date to remember is March 8, 2020: the Italian government with its Prime Minister Giuseppe Conte decided to lockdown the entire nation. Public transport was granted only for some specific activities, industrial and commercial sector in most of the cases was shutdown except of supermarkets, which were open but just for a restricted period during the day. Millions of people were (and are) helped by state subsidies and nobody could hang out or get far from its home without a certificate attesting the reasons for going out.

As said, some sort of these measures was taken in most of the European countries between March, April and May and right now are still applied where the situation is still getting even worse respect to before. Of course, the global lockdown had not negligible effects in the global economy.

1.1 General economic situation during COVID

The sanitary emergence represents the largest economic shock the world economy has experienced in decades, causing a collapse in global activity. Global economy was subject to a huge contraction due to the pandemic measures of lockdown taken from all around the world. Trades and travels limitations, restrictions in commercial activities, cancellation of public transportation, social distancing, closure of schools and non-necessary businesses and all the other enforcements had a considerable impact on GDP forecast for second half of 2020 and 2021. According to the World Bank (WB) (2020), a 5.2 contraction of the GDP is the world economic indicator that explains how the COVID disrupted financial wealth. The data below shows the percentage changes from 2017 to 2021 values of the GDP divided by countries belonging to “Advanced economies” and “Emerging market and developing economies” (EMDE)¹. The most relevant hit is taken by the first group of nations whose Central Banks provided for cut policy rates and committed into undertaking further steps to inject liquidity in the markets and to maintain investor confidence. The problem of EMDEs that have large domestic COVID outbreaks is that these countries have limited health care capacity and not an appropriate sanitary system to control the contagion and do not have an economy strong enough to afford a prolonged lockdown. Moreover, their economies deeply rely on integrated in global value chains that are heavily dependent on foreign financing; International trade, commodity exports, and tourism are hit the most and represent the highest percentage of economic activity.

1. Factors considered are income (leading factor) export earnings, net debtor economies, and economies with arrears. Fantom, Serajuddin 2016, p.38

Table 1.1 Real GDP of selected countries (2017-2021) (% change)

	2017	2018	2019	2020(f)	2021(f)
<i>World</i>	3.3	3.0	2.4	-5.2	4.2
<i>advanced economies</i>	2.5	2.1	1.6	-7.0	3.9
US	2.4	2.9	2.3	-6.1	4.0
EU	2.5	1.9	1.2	-9.1	4.5
Japan	2.2	0.3	0.7	-6.1	2.5
<i>Emerging market and developing economies</i>	4.5	4.3	3.5	-2.5	4.6
Commodity-exporting EMDEs	2.2	2.1	1.5	-4.8	3.1
Other EMDEs	6.1	5.7	4.8	-1.1	5.5
China	6.8	6.6	6.1	1.0	6.9
Russia	1.8	2.5	1.3	-6.0	2.7
Turkey	7.5	2.8	0.9	-3.8	5.0
Brazil	1.3	1.3	1.1	-8.0	2.2
Mexico	2.1	2.2	-0.3	-7.5	3.0
Saudi Arabia	-0.7	2.4	0.3	-3.8	2.5
Iran	3.8	-4.7	-8.2	-5.3	2.1
India	7.0	6.1	4.2	-3.2	3.1
Pakistan	5.2	5.5	1.9	-2.6	-0.2
Nigeria	0.8	1.9	2.2	-3.2	1.7
South Africa	1.4	0.8	0.2	-7.1	2.9

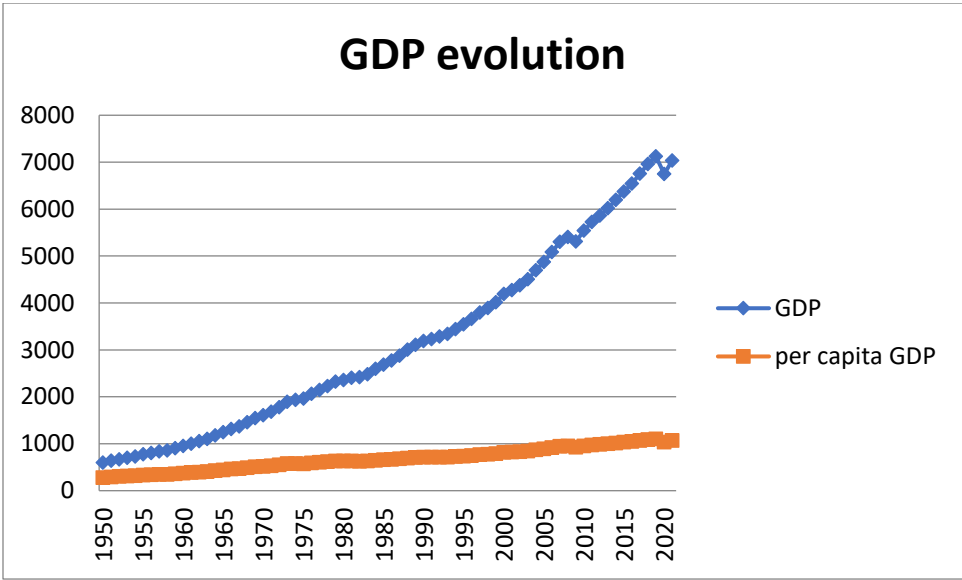
Source: Author's elaboration on World Bank data

From the table we can observe the huge drop in the 2020 GDP figure for all of the countries selected; the only nation to be maintain a non-negative estimation is China, despite of the big fall. 2021 forecast show general optimism since it is expected to start again with “normal” economic activities.

The economic aspect of the pandemic would be the deepest global recession since World War II and almost three times as steep as the 2009 global recession². Global growth forecasts have been downgraded at an unusually rapid pace over March, April and June (Word Bank, 2020). In the following graphs we can compare GDP evolution during time including all recessions happened during the timeline starting from 1950 to 2021.

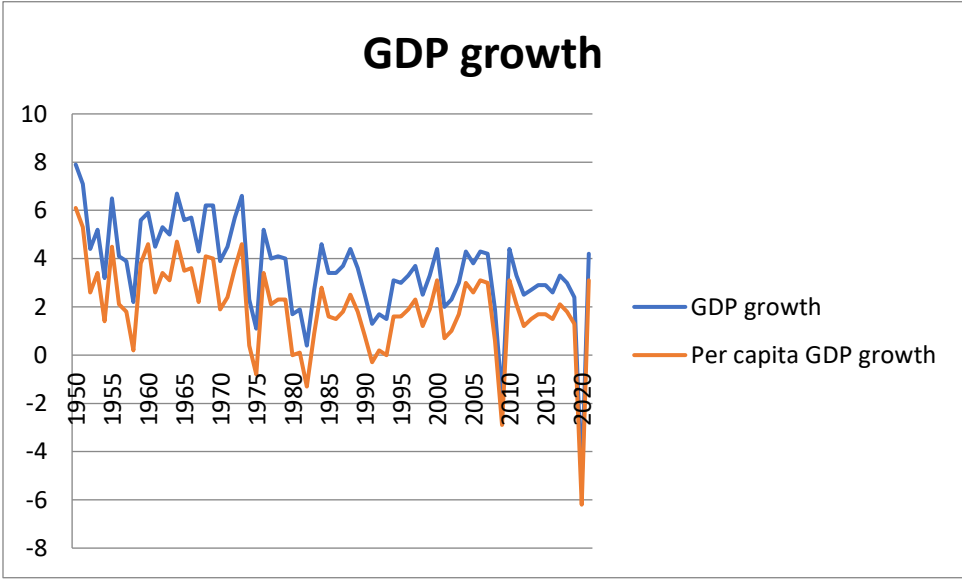
2. “The short-term collapse in global output now underway already seems likely to rival or exceed that of any recession in the last 150 years” (World Bank June, 2020)

Graph 1.2 Annual GDP growth (1950-2020) (million units of economic activity)



Source: Authors elaboration on World Bank data

Graph 1.3 Annual GDP percentage growth (1950-2020) (% change)



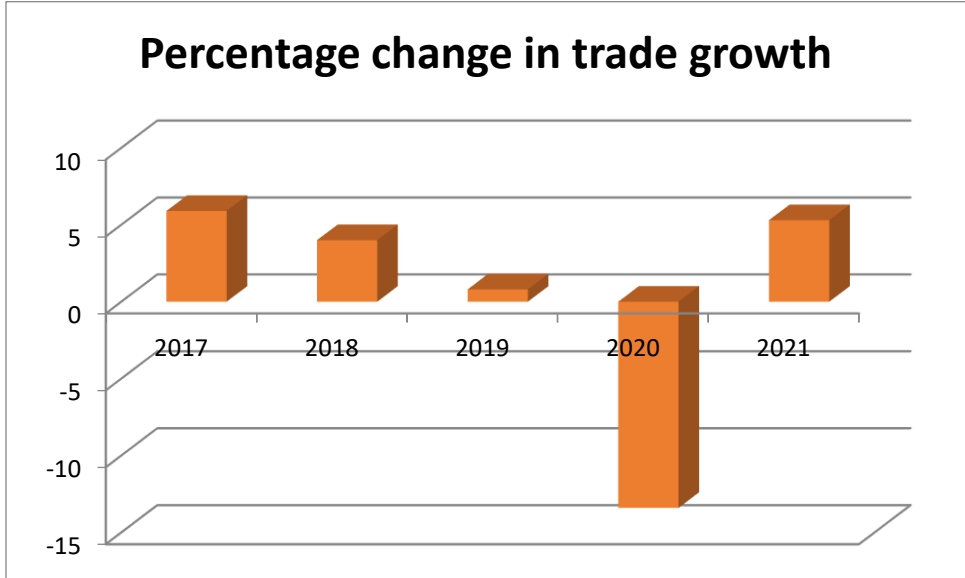
Source: Authors elaboration on World Bank data

The series covers up to 183 economies, 36 advanced economies and 147 EMDEs, over the period 1950-2021. The graphs give an idea on the contraction output of the GDP during the recession periods, in particular during 2008 and 2020. The GDP growth is subject to the biggest fall in recent history with the pandemic emergency, even worse than with the financial crisis.

However, the COVID-19 recession has some characteristics that make it differentiate respect to the others: it is the first crisis leading to an economic downturn to have been triggered just by a pandemic during the past 150 years. Advanced economies haven't faced a situation like this since 1945, the end of World War II, while for EMDEs is the first output contraction in 60 years.

An interesting data that contributed to the lowering world GDP is global trade. Especially during the first quarter of 2020, services sectors that usually do not waver too much in crisis had to note a fall in the demand due to travel restrictions and concerns about COVID corresponding to a fall in tourism. The collapse of air traffic has resulted in an increasing air costs, putting more pressure on those type of industrial activities that rely on in time delivery, meaning that the consignments were subject to conspicuous delays. The sharp fall in activity in the first half of this year is expected to contribute to a contraction in global trade of about 13.4 percent in 2020 (World Bank, 2020). The following graph explains the percentage change in the world's trade growth in recent years.

Graph 1.4 Trade growth in recent years (% change)



Source: Author's elaboration on World Bank data

As we can see, 2020 is the only year when we have a negative percentage growth of global trade with a drop corresponding to -13.4%.

For what concerns financial markets, global equity valuations took an unprecedented falling the first months of the year, while market volatility reached a peak similar to the one in 2008. The increasing level of indebtedness for EMDEs with a rise in sovereign borrowing spreads, a situation that creates financial distress for countries with high government debt. To monitor it, central banks injected liquidity into financial markets using a mix of direct credit provision to large investment-

grade companies by first expanding the range of assets they accept as collateral and second purchasing a large quantity of assets from them, including corporate debt in some countries.

Capital outflows from EMDEs were subject to a stabilization after April, while equity market valuations have recovered an important share of their previous losses. Spreads on high-yield debt have increased substantially amid widespread corporate bond downgrades: this means that investors must perform a detailed screening before accepting to finance a borrower, in a situation of high risk.

1.2 Commodity Markets

The effects of the recent economic developments in the commodity markets is crucial in this work. During the period of lockdowns global trade slowed down and of course, the commerce of commodities (with a huge hit for importing and exporting countries) suffered in term of demand and supply.

The United Nations conference on Trade and Development (UNCTAD)³ defines a country as dependent on commodities when these account for more than 60% of its total merchandise exports in value terms. An economy is defined as commodity exporter when, on average total commodities exports accounted for 30 percent or more of total goods exports or exports of any single commodity accounted for 20 percent or more of total goods exports.

“In addition to the devastating human toll, the economic impact of the pandemic will dampen demand and cause supply disruptions, negatively affecting developing countries that rely heavily on commodities,” said CeylaPazarbasioglu⁴, World Bank Group Vice President for Equitable Growth, Finance & Institutions in the press release (World Bank, 2020).

Considering a rough subdivision in Energy and Metals, these commodities are the most affected by the sudden stop to economic activity and the fall in GDP. Commodities associated with transportation, the most important is oil, have experienced the hardest falls. Energy commodities are mostly hard commodities that are mined or extracted. They include fossil fuels like coal, oil and natural gas while metal commodities are divided in two categories: base metals and precious metals. Base metals involve all metals, mainly used for industrial purposes.

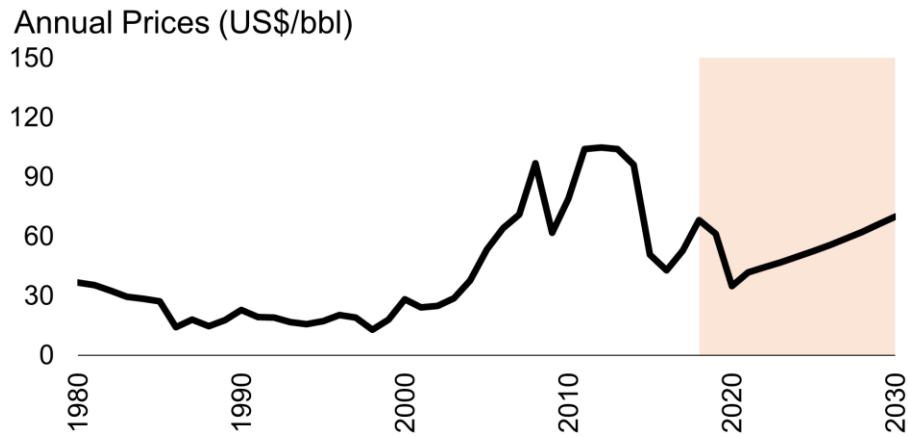
3. Is a permanent intergovernmental body established by the United Nations General Assembly in 1964. Headquarters are located in Geneva, Switzerland, and we have offices in New York and Addis Ababa. UNCTAD is part of the UN Secretariat. The organization reports to the UN General Assembly and the Economic and Social Council but has its own membership, leadership, and budget. (UNCTAD) available at <https://unctad.org/en/Pages/aboutus.aspx>

4. CeylaPazarbasioglu was Vice President for Equitable Growth, Finance and Institutions (EFI) at the World Bank Group (WBG) from October 2018 to September 2020; (World Bank, 2020)

1.2.1 Crude Oil

In the energy sector the most iconic prices to which markets are very sensitive are the crude oil ones. They had a big drop in March 2020 and the International Energy Agency (IEA) expects world oil demand to decline by nearly 10% in 2020; Mitigation measures to stem the pandemic and a global recession coincided with the collapse of the manufacturing agreement by oil producers in early March. Oil has a relatively high-income elasticity of demand, which suggests that declining economic growth can lead to declines in oil demand. The graph below shows a general evolution of yearly prices for Crude Oil from 1980 to 2030 (forecast from 2020 to 2030, colored area).

Graph 1.5 Crude Oil annual prices (\$/bbl)

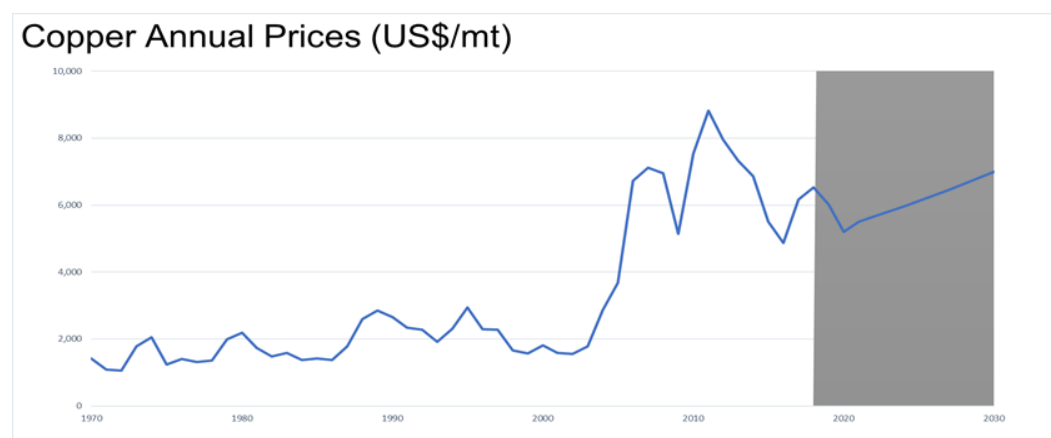


Source: World bank

1.2.2 Metals

Metal prices also fell in early 2020. The biggest declines were in copper and zinc, which are particularly associated with global economic activity. Metal prices are projected to drop 13 percent overall in 2020 as slowing demand and the shutdown of key industries weigh heavily on the market. China's output contracted sharply in the first quarter and exports plunged, more than imports, as a result of temporary factory closures; this situation affected the industrial metal market since China's share accounts for more than half of total global demand. Below the Copper's prices since 1970 and 10 years forecast (shaded area).

Graph 1.6 Copper annual prices



Source: World Bank

1.2.3 Agricultural commodities

The commodities deriving from crops have also feel the hit but in a different manner: agriculture prices have a weaker relationship to economic growth since they have a low-income elasticity (these products are usually are needed to satisfy population needs for food), so they experienced only a minor reduction in the first quarter of 2020. The only exception is rubber just because used in transportation and then its demand declined rapidly. Production levels and stocks of agricultural commodities are present at very high quantities, so the relative prices are supposed to stay quite stable during the remaining of the year. However, there could be some negative aspects, as for example the fact that the workforce available for the production of goods could be reduced if large numbers of people are subject to movement restrictions, even across borders. Another problem is related to the disruptions of supply chains that have already affected emerging market and developing country exports of perishable products such as flowers, fruits, and vegetables. This situation questions the issue of food security: in EMDEs, which have a larger number of people living under the poverty line respect to developed countries, income losses from disruptions in economic activity could increase food insecurity. Some countries have announced temporary restrictive trade policies such as export bans, like those that contributed to spikes in international food prices in 2007-08 (Russia for wheat and Vietnam for rice).

According to the Organization for Economic Co-operation and Development (OECD)⁵, travel bans, air freight costs have risen by about 30% between China and North America and by over 60% on some important Europe-North America routes.

An example from the supply chain: Shipments to Western European markets, including the UK, the Netherlands and Germany, fell from 60 to 15 tons per day. (World Bank, 2020).

5. International organization that works to build better policies for better lives in collaboration with governments, policy makers and citizens, we work on establishing evidence-based international standards and finding solutions to a range of social, economic and environmental challenges. (OECD,2020)

1.2.4 Brief outlook on international commodity context

The following list summarizes several questions affecting commodity markets: most of the issues are related to the interactions between US and China which consequences are reflected to the global economy.

- A trade agreement has been negotiated between China and USA and its “phase 1” started and was signed on January 15⁶. The agreement was a necessary act because of the trade war started in March 2018 with the announcement of the US Trade Act⁷: US imposed additional tariffs to Chinese products and imposed restrictions on the transfer of technology to China. The Asian country answered reducing US market share in China. For obvious reasons the war has been slowed (with repercussions on the market); According to the deal, China to purchase additional US products worth US \$ 12.5 billion in 2020 and another US \$ 19.5 billion in 2021. The sanitary emergence followed by the lockdown measures taken by Chinese government in Hubei province has created enormous problems for Chinese agricultural producers.
- The COVID issue arises in an already bruised situation in terms of food, in fact Chinese meat market was undermined by African swine fever, which has reduced the production of pork by 25%, which is the most eaten meat in the country. All this means that the pork is imported in part from the US.
- On June 29, 2020, the US Department of Commerce withdrew the customs territory status separated from mainland China due to recent tensions between China and the US. Hong Kong, as the largest re-export port in the world, plays an intermediary role in trade between the United States and China, and the lifting of its special status can lead China to take economic and political retaliatory action. The withdrawal itself is unlikely to directly affect the prospects for US-China agricultural trade if neither China nor the US responds with further action.
- Political context: Trump's "America First" corresponds to a protectionist push; Furthermore, Trump directly blames China as responsible for the health disaster leading to the global recession; From the US President's point of view, for decades the United States has opened its own with few conditions, access to foreign goods from all over the world to flow freely across the borders of the United States, while other countries, such as China, have not granted the same access. A crucial role in the commodity global scenario will be played by the 2020 USA elections in November.

6. “economic and trade agreement between the united states of America and the people’s republic of china available at <https://ustr.gov/countries-regions/china-mongolia-taiwan/peoples-republic-china/phase-one-trade-agreement/text>

7. United States Trade Representative (USTR) available at <https://ustr.gov/about-us/policy-offices/press-office/fact-sheets/2018/june/section-301-investigation-fact-sheet>

2. 2008 AND 2020 CRISIS: OVERVIEW

When scenarios like the one we are living happens, it is normal to look for a comparison with previous similar situations. If the aim is to confront the Coronavirus crisis on a sanitary point of view (with all economic consequences that derive from it) then the most appropriate matches are SARS in 2003, Swine Flu 2009 and Ebola in 2014. The crucial issue is that none of the three pandemics mentioned had the financial impact of the COVID, which in this term is comparable with the economic crisis of 2008 as indicators like S&P 500, Dow Jones, NASDAQ and other market indexes suggest and for the extent it had in the global GDP.

The aspect I want to deepen regards how different commodity markets responded to in the two cases taken in examination and what similarities we have, but let's start first by a general description of 2008 crisis;

2.1 2008 Financial Crisis summary

The signs of the imminent disaster started to show up in the summer of 2007 when many big financial institutions began to have troubles: Bear Sterns, BNP Paribas, Northern Rock and many others. When the financial and economic collapse was evident through the default of Lehman Brothers in September 2008, it marked the largest bankruptcy in U.S history and it was considered a symbol of the devastation caused by the global financial crisis. That same month, financial markets were in free fall, with the major US indexes suffering some of their worst losses on record and as consequence many ordinary people their jobs and retirement accounts. The reason why the crisis emerged was clear: the seeds of the financial crisis were planted during years of rock-bottom interest rates that fueled a housing bubble in the US. There were early signs of distress. From 2004 to 2007, US homeownership had reached its maximum (US Bureau of Labor Statistics, 2018)⁸, while during the last quarter of 2005, home prices started to fall, which led to a 40% decline in the US Home Construction Index⁹ during 2006. The biggest hit was to new homes, but many subprime borrowers with adjustable interest rates couldn't afford the higher rates and started defaulting on their loans decreased at annual rates of 5.4 percent in the 4th quarter of 2008 and 6.4 percent in the 1st quarter of 2009 (The Journal of Business Inquiry, 2009).

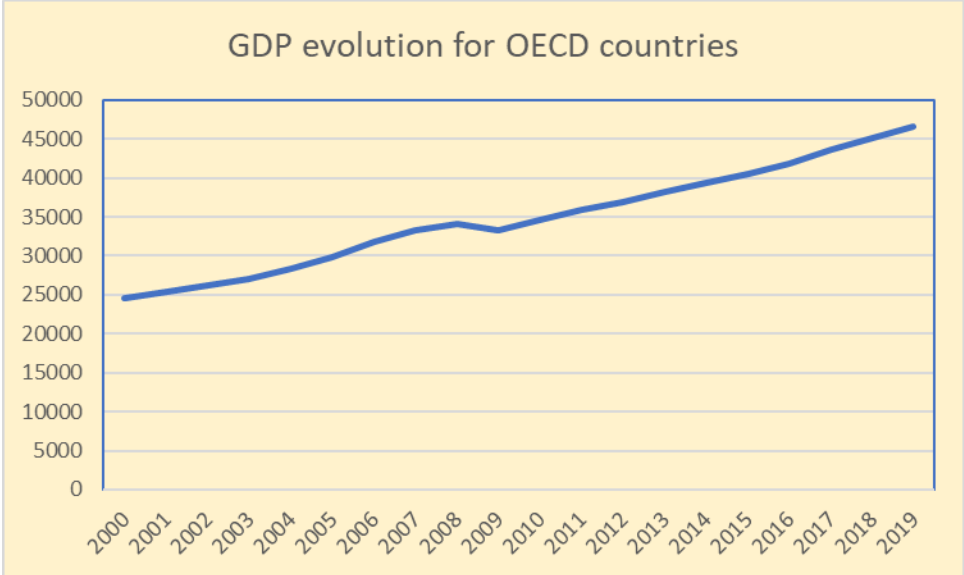
The economic catastrophe spread all around the world leading many credit institutions to default and creating bank panic (facing liquidity problem) in the financial sector, so that banks applied limitation of credit to their borrowers with an effect of contracting the economy.

8. Article by Geoffrey Paulin (BLS) 2008 , "Housing and expenditures: before, during, and after the bubble", p. 3

9. The Dow Jones U.S. Select Home Construction Index is designed to measure the performance of U.S. companies in the home construction sector (S&P Global)(2006) available at <https://www.spglobal.com/spdji/en/indices/equity/dow-jones-us-select-home-construction-index/#overview>

The two following collections of data give an idea of the fall in economic productivity in the biennium 2008/2009.

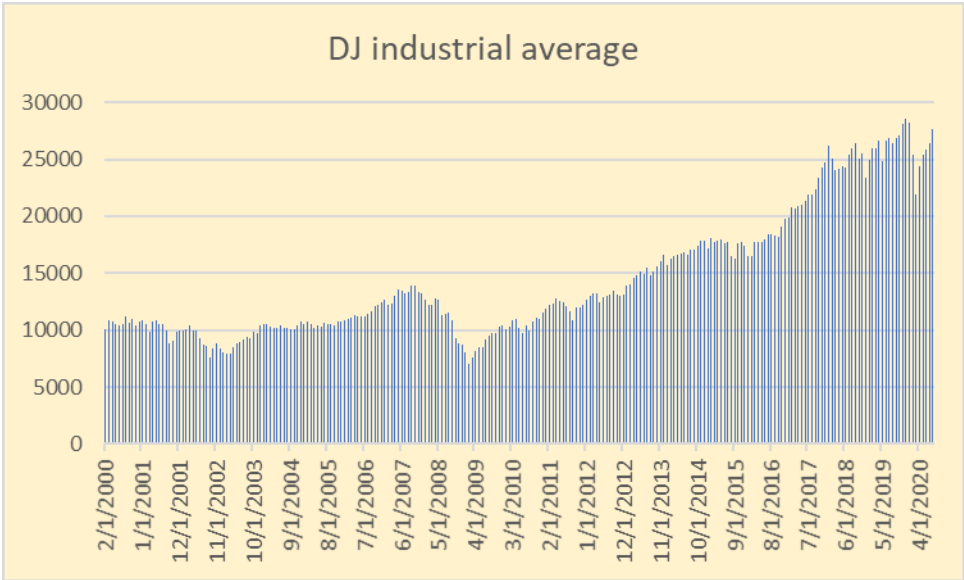
Graph 2.1 GDP of OECD countries from 2000 to 2019 (units of economic output)



Source: Author’s elaboration on OECD data

OECD countries (graph 6) in the period between 2008/2009 faced a partial contraction of global output. It is clear even looking at other market indexes; for a better comprehension of the impact of financial crisis on markets, the Dow Jones industrial average is an index to take into consideration (graph 7): even in this case the fall is evident with the average going under 10,000.

Graph 2.2 Monthly Dow Jones Industrial Average (01/2000-06/2020) (DJIA points)



Source: Author’s elaboration on Yahoo Finance data

The index in 2008/2009 suffered a collapse, one of the hardest in history in terms of percentage fall; then in the following ten years it increased on average and in the first months of 2020 it sharply collapsed again due to the COVID crisis.

2.2 Commodity markets in 2008

Prior to the crisis, commodity prices were growing up in a bull market until summer 2008 when they reached their peak because of a shortage fear. The commodity bust began in the first days of October characterized by broad market declines and the panic has exacerbated the pressure on commodities. The scenario immediately after in time saw wheat and corn prices (two cereals at the base of the human food chain) dropping more than 40 % while another important element as crude oil has dropped about 44 % (The New York Times, 2008).

In the year corresponding from June 2007 to same month in 2008, according to the data provided the research of three US university professors¹⁰ the real price of crude oil increased by almost 100 percent.

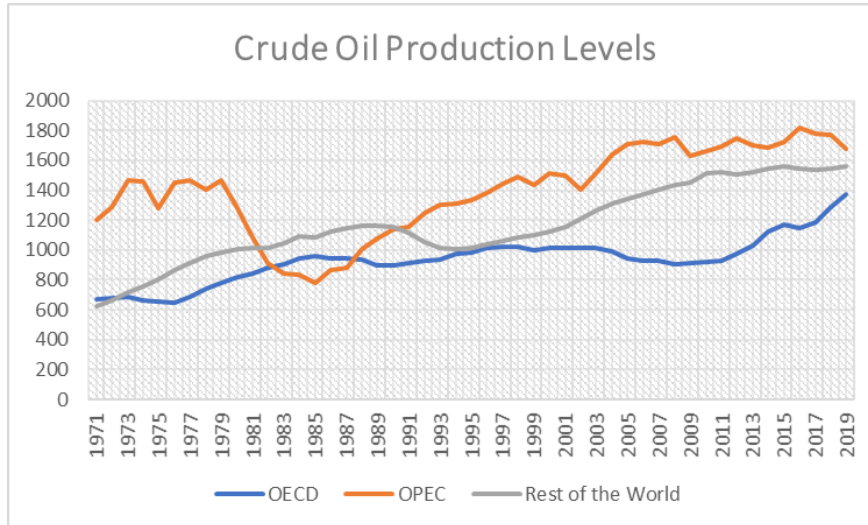
As soon as the economy faced a slowdown due to the financial troubles in the markets, commodity prices suffered a dramatic collapse. Between July 2008 and October 2008, the real crude oil price declined by almost 53 %, bringing it back to its level of June 2007. In order to have a longer time horizon, Oil prices fell from a high of \$147 in July 2008 to a low of \$33 in February 2009. Over the same time period, liquid natural gas prices fell from \$14 to \$4 (Investopedia, 2008). In general, the diminishing demand for energy sector occurred at the same time of the contraction of credit, creating a situation in which companies had difficulties to generate earnings leading to layoffs and increased unemployment.

Gasoline prices in the USA were declining very fast by about 24 cents in a week. Even metals used for industrial production like aluminum, copper and nickel have declined by a third or more.

10. Caballero, Farhi, Gourinchas 2008, "Financial Crash, Commodity Prices, and Global Imbalances" , p.8,9

The following charts describe some important features of crude oil market in terms of production levels and spot prices in the futures market but even considering a general outlook some other important elements of the commodity market during the crisis:

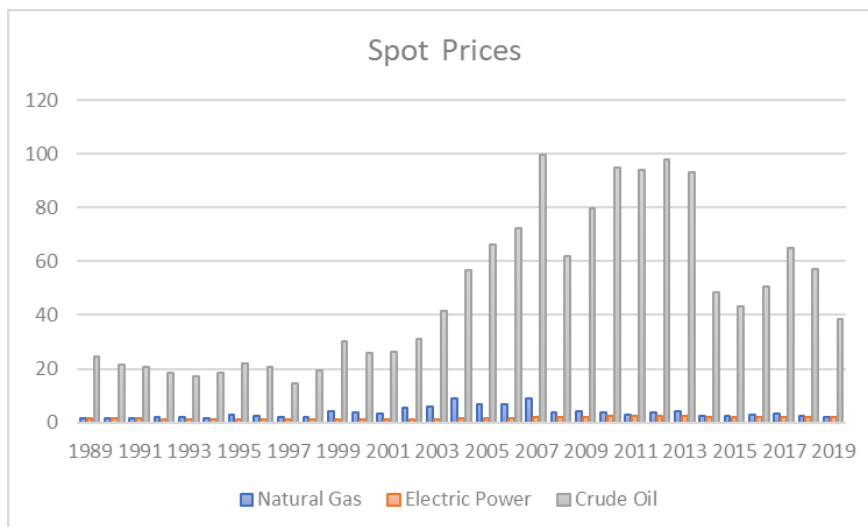
Graph 2.3. Monthly Crude Oil Production (1971-2019) (million tons)



Source: Author's elaboration on Energy International Agency (EIA) data

Graph 2.3 illustrates the crude oil level (in million tons) of production from 1971 to 2019 for three groups: OECD countries, Organization of Petroleum Exporting Countries (OPEC) and “Rest of the World” (ROW). As we can see during 2007-2009 for OPEC and ROW the production increased since there was no problem on the supply sector of oil. For OECD there is a small decline but not that much significant.

Graph 2.4. Annual Futures Spot Prices (1989-2019) (\$/bbl)

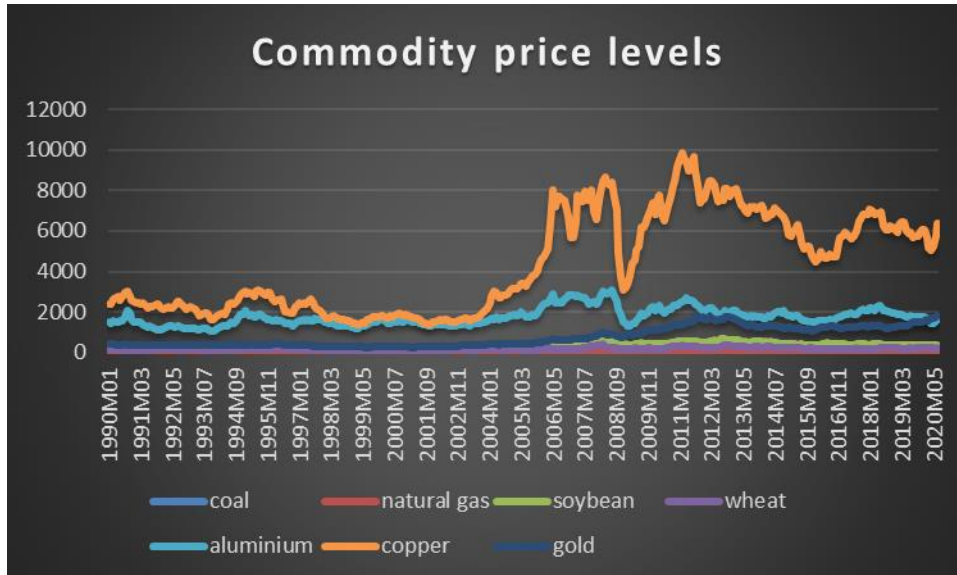


Source: Author's elaboration on NYMEX data

The “Spot Prices” chart illustrates the drop in 2008 of crude oil prices respect to the previous year in terms of dollars per millions of btu¹¹. The blue histogram represents the natural gas spot price which itself was subject to a decline in the period in question, while the orange histogram represents electric power in dollars per millions of btu. Data is taken from NYMEX which is the world's leading market for futures and options on energy products, such as oil and natural gas; The decline was subsequent to the drastic fall in demand, so the sport prices reflect exactly the situation in the real world.

Here in the next chart I have grouped some of the most important commodities in the market and the graph shows the evolution of their prices in time: the aim is to illustrate that most of prices declined during the financial crisis; The elements in question are in order: coal, natural gas, soybean, wheat, aluminum, copper, gold.

Graph 2.5. Commodity monthly prices (01/1990-05/2020) (\$)



Source: Author’s elaboration on World Bank data

In the x axis the typing “1990M01” represents the year and the month of the observation; at first glance what you notice immediately it the huge fall of copper (one of the commodities that most was hit)and of the aluminium, both used in the industry sector.

11. BTU stands for “British thermal unit” and is a measure of heat. it is defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. It is also part of the United States customary units. Its counterpart in the metric system is the joule (US Department of Commerce, 2008)

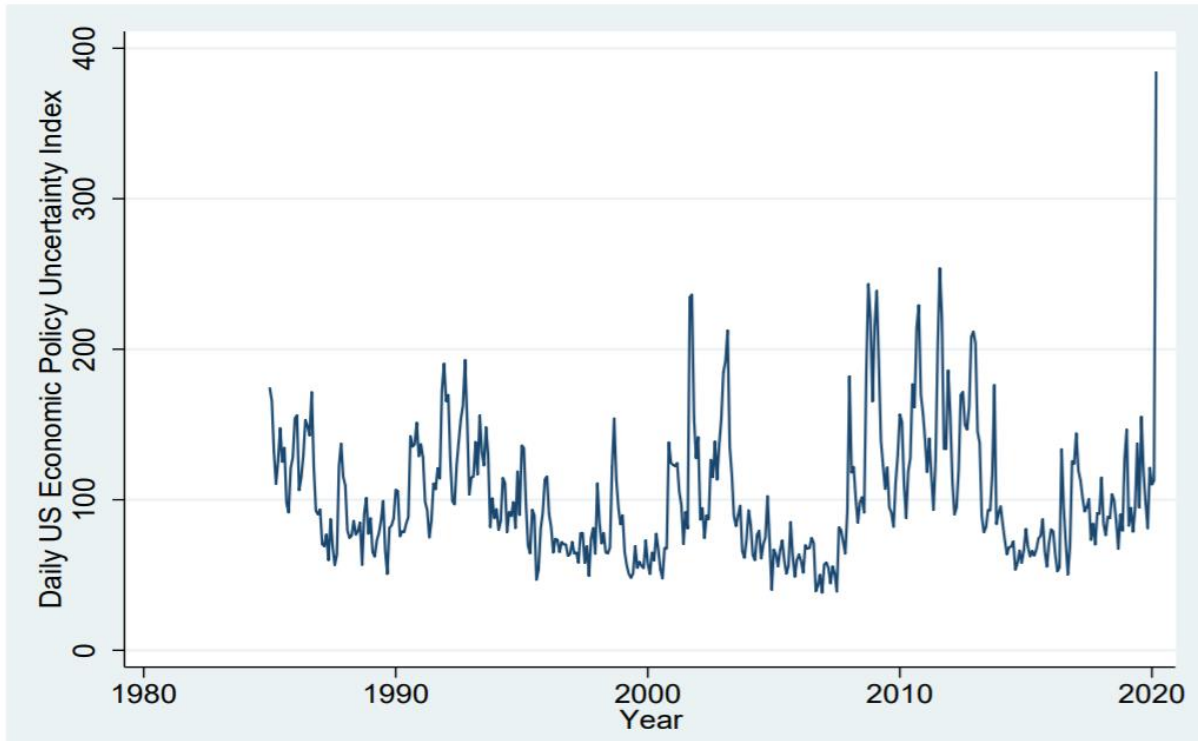
2.3 Similarities and differences: Coronavirus and 2008 crisis

When we compare the two crisis, first of all we look at the origin of them and then analyze the consequences: in this case three major points in common summed by a single world can be individuated and explained and consist in “Uncertainty”, the second is “Collapse” and the last one is “Reactions”. A deeper analysis is required.

Uncertainty: this word is defined by the Merriam-Webster dictionary as doubt, dubiety, skepticism, suspicion, mistrust mean lack of sureness about someone or something; uncertainty may range from a falling short of certainty to an almost complete lack of conviction or knowledge especially about an outcome or result. Uncertainty reduces the willingness of firms to hire and invest because of no accurate prediction of profits and of course consumers are not willing to spend. The problem is that it reflects uncertainty in the minds of consumers, managers, and policymakers about future events (that may or may not happen). The two crises in consideration, detect uncertainty as a relevant factor that occurred in both cases in one of the two most important economies of the world: first in US and then in China, but then spread all around the globe. In 2008 the result was a credit crunch due to the unknown possibility for borrower to repay their debts to the banks, and the bank panic generated by the default of big institutions. The economic situations of many financial institutions were on the razor’s edge, similarly with COVID disaster the most uncertain issue regards the possibility of a comeback in autumn/winter that would affect again economies of countries and how the governments will respond: other measures of lockdown. It is not possible to predict. The World Pandemic Uncertainty Index (WPU)¹², built by the International Monetary Fund (IMF), and the Index of Global Economic Policy Uncertainty index¹³ (GEPUI, computed at PPP exchange rates) now are at their highest.

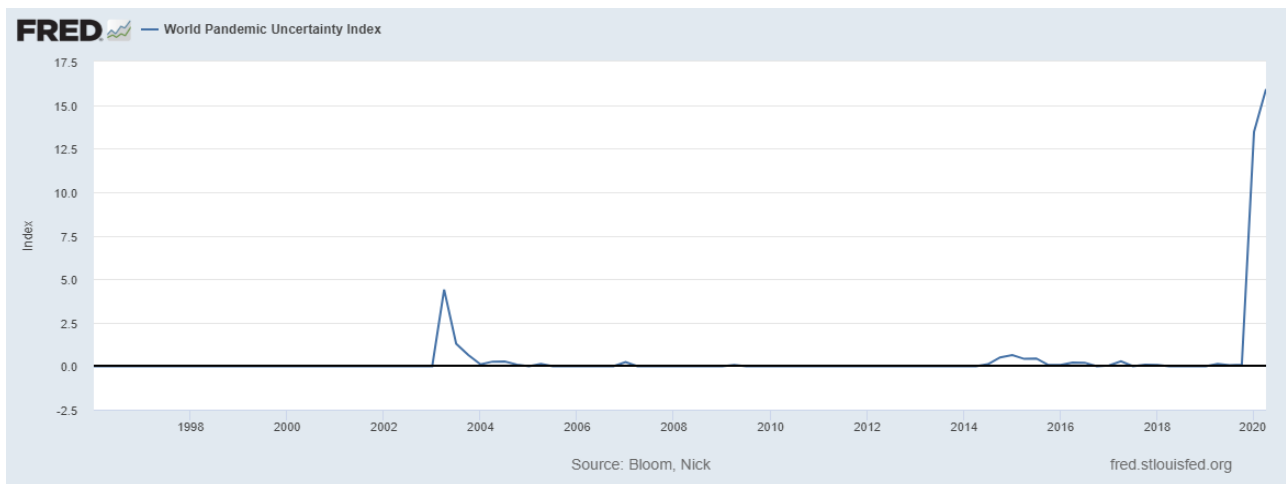
12. It covers 143 countries (all countries in the world with a population of at least 2 million). It goes back in time, providing data for the past 60 years. The index uses a single source for all countries, which allows us to compare the level of uncertainty across countries. And it captures uncertainty related to economic and political events, regarding both near-term (for example, uncertainty created by the United Kingdom’s referendum vote in favor of Brexit) and long-term (for example, uncertainty engendered by the impending withdrawal of international forces in Afghanistan, or tensions between the Democratic People’s Republic of Korea and the Republic of Korea) concerns. (Free Economic Data, 2020)
13. Index developed from a collaboration of universities of “Northwestern university”, “Stanford” and “University of Chicago” in USA. To measure policy-related economic uncertainty, they construct an index from three types of underlying components. One component quantifies newspaper coverage of policy-related economic uncertainty. A second component reflects the number of federal tax code provisions set to expire in future years. The third component uses disagreement among economic forecasters as a proxy for uncertainty. The first component is an index of search results from 10 large newspapers. The newspapers included in the index are USA Today, the Miami Herald, the Chicago Tribune, the Washington Post, the Los Angeles Times, the Boston Globe, the San Francisco Chronicle, the Dallas Morning News, the New York Times, and the Wall Street Journal. From these papers, they construct a normalized index of the volume of news articles discussing economic policy uncertainty. The second component of the index draws on reports by the Congressional Budget Office (CBO) that compile lists of temporary federal tax code provisions. They create annual dollar-weighted numbers of tax code provisions scheduled to expire over the next 10 years, giving a measure of the level of uncertainty regarding the path that the federal tax code will take in the future. The third component of the policy-related uncertainty index draws on the Federal Reserve Bank of Philadelphia’s Survey of Professional Forecasters. they utilize the dispersion between individual forecasters’ predictions about future levels of the Consumer Price Index, Federal Expenditures, and State and Local Expenditures to construct indices of uncertainty about policy-related macroeconomic variables. (Economic Policy Uncertainty, 2020)

Graph 2.6. World Pandemic Uncertainty Index (WPUI)



Source: WUIP

Graph 2.7. Global Economic Policy Uncertainty Index



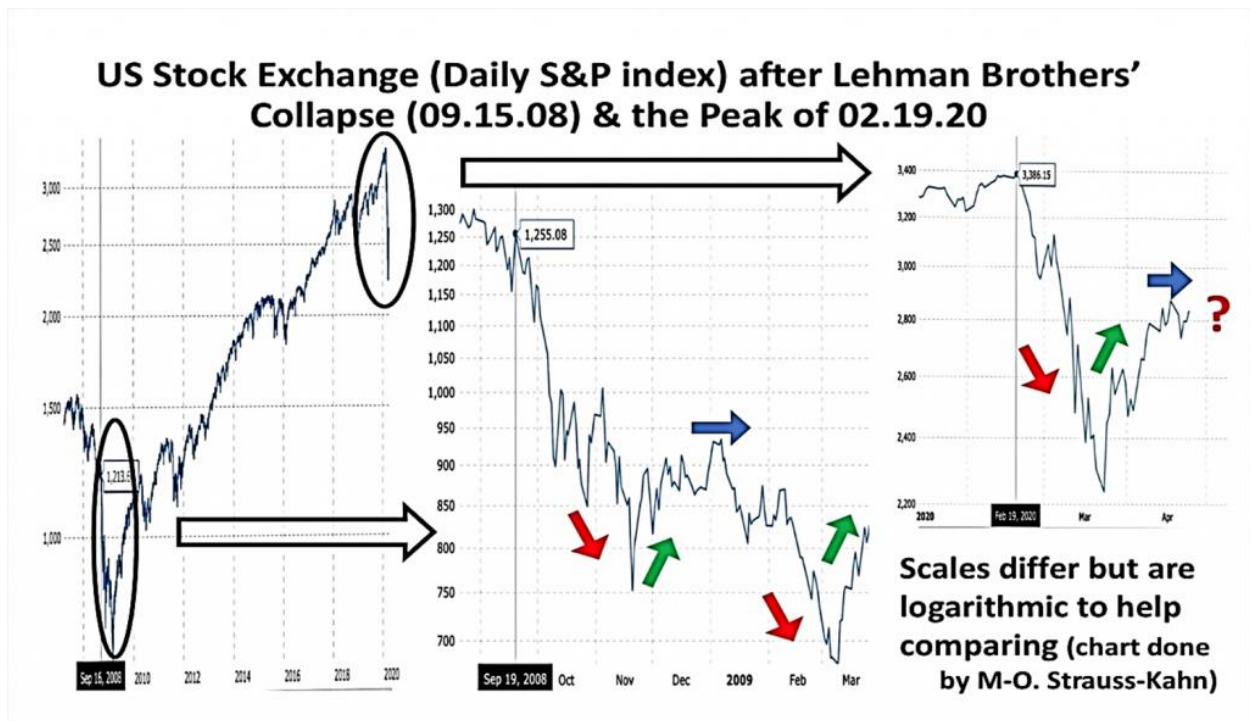
Source: FRED

The first chart is a picture of the GEPU index where we can see that the highest peaks are during the dot-com bubble, the 2008 financial crisis and the 2020 Coronavirus pandemic.

In the second graph we can have a look at the WPU index where the peaks correspond to the SARS pandemic in 2003, the Ebola issue in 2015 and the Coronavirus situation.

Collapse: the impact the two economic catastrophes had on the market was similar, in fact both have been labeled as the biggest collapses after the 1929 Great Depression. The subsequent graph¹⁶ is a representation of S&P 500 index comparing 2008 and 2020;

Graph 2.8. S&P evolution during the pandemic



Source: Atlantic Council

Graph 2.8 is composed by three charts. The first chart starting from the left explains the general trend of the S&P index, year by year. The chart in the middle illustrates the day by day evolution of the S&P 500 index and on the right, there is a comparison with the day by day situation of the index fall due to the pandemic. Even if the scales are different the kind of drop is analogous.

Considering another stock index, the Dow Jones has declined by about 28% between February and March 2020, driven by the Coronavirus pandemic and turmoil in the crude oil markets while during the hardest months (16 months) of the financial crisis of 2007-08 it declined by -49%.

Reactions: considered in term of regulation were taken after the occurrence of the global financial crises (GFC). These measures were related to “Global Systemic Important Banks” (G-SIB) whose

size in terms of assets and liabilities in case of default would trigger a contagion across borders and Basel rules for banks and credit institution as for example minimum capital requirements in order to avoid as much as possible the default of banks and the consequent bail-out. In the same way, the COVID pandemic has revealed the dependence of mature economies on some inputs produced in other countries, it means that it highlighted how globalization amplifies to other nations the economic troubles of an economically important country as China; However, in both situations the role of regulation is crucial and in Coronavirus crisis case international agreements are needed to control the spread of the virus and consequently avoid another economic disaster. So, in 2008 insolvent banks were part and the cause of the problem while in today's situation financial institutions shall be part of the solution through easing credit liquidity. This is possible thanks to a better regulated financial system as stated before.

There are many differences comparing the two crisis: first of all, the most evident difference between 2020 and 2008 is that the last one was credit driven so it was purely financial, largely from questionable underwriting standards and excess leverage in the sub-prime mortgage market. Nowadays economic troubles are led by a pandemic, so a health threat for the whole world that derives into financial problems. Lockdown measures caused a shutdown of economic activity for many countries of the globe, something never happened in history.

Another difference is the fact that Coronavirus speediness of contagion accelerates the reactions of the markets and the authorities' response. By contrast, the global financial crisis was "preparing" itself for the burst much before 2008 and the economic consequences did not stop in few months, in fact the rebound felt at least till 2010, and reached EU in the following two years.

Among the possible public intervention to stem financial problems, some experts argue that EU and USA should adopt "helicopter money"¹⁴. De facto, it is what they are doing: make large purchases in order to provide the system with liquidity and avoid increase of interest rates in order to ease credit lending, the so called "Quantitative easing".

A kind of this approach was used after 2008 disaster while in 2020 regulators, as mentioned before have a very restricted margin of action and the interest rates were already very low compared to the previous crisis. Central Banks and ECB reacted immediately not providing more liquidity but instead rechanneling the existing one.

While there are many current illustrations of international coordination between central banks (including swap agreements), this is less so between governments at the global and European levels. This is a major and worrying contrast with the follow-up of the GFC. The momentum and even the spirit of global leadership seem now to have faded.

14. Monetary policy used as an extreme attempt to revive the economy and which literally consists in "throwing money from a helicopter". The proposal is to pour money directly into the pockets of citizens and businesses by creating money and / or cutting taxes. Operation that can be financed through the creation of money by central banks aimed at incremental purchases of public debt (Borsa Italiana, 2016)

One last difference consists in how international cooperation was conducted in the two periods. In 2009 the G20, including international organizations, took the lead to heal the financial system and the whole world seemed to go to the same direction. Impediments persist on the appropriate financing or room for maneuver given to international organizations, for instance the IMF that had issued 250 billion of Special Drawing Rights (SDRs) in 2009, but none have been agreed upon in 2020. The same applies to the financing or functioning of other institutions like the World Trade Organization and the World Health Organization. And the difficulties of European leaders to agree on any “Coronabond” or on a Recovery Fund demonstrates how much the European process is at stake.

3. CLASSIFICATION OF COMMODITIES

In this chapter I will focus on the classification and evolution of the different commodities traded in the market during the Coronavirus crisis analyzing the membership group and in order to get a classification by sector and industry.

First of all, the term commodity represents economic goods that are fungible: it means that can be freely brought and sold (The Balance, 2020). The commodities produced by a country include the raw materials and/or primary agricultural products mined, grown, or in any way created within the country. They depend largely on what the country is provided with as for example natural resources available and the capability to extract them.

The roughest classification of commodities consists in “hard” commodities and “soft” ones. The first one comprises natural resources that must be mined or extracted, such as metal ores, oil reserves and so on. Hard commodities are waiting in the earth for extraction and can also be found in similar geological deposits around the world. They form the basis of the economic health of a country, and demand/supply and import/export for such resources should be controlled to assess the future stability of an economy since they widely impact the GDP. In the metals we find Gold, which is extremely valuable, especially during times of a slowdown as it is used by investors as an inflation hedge or a wealth-preservation asset. Other products include silver, steel, copper, iron, aluminum, which also make up for a large part of government revenue.

The second one consists of products that must be grown and cared for, such as agricultural produce, livestock, and related primary products. They are more volatile as their price-setting mechanism relies on multiple external factors. The production of such goods depends largely on the environmental conditions of a country and to the fiscal support in term of taxes by the government. Those nations which rely for a big share of their total economy mechanism on agriculture and farming suffer particularly climate change.

A further subdivision in energy, non-energy and precious metals is conducted by the World Bank. The following table shows the grouping with the different elements composing them:

Table 3.1 Energy, non-Energy and Precious Metals

Energy	Non-energy										Precious Metals
	Agriculture								Fertilizers	Metals & Minerals	
	Beverages	Food	Oils & Meals	Grains	Other Food	Raw Materials		Base Metals (ex. iron ore)			
					Timber	Other Raw Mat.					

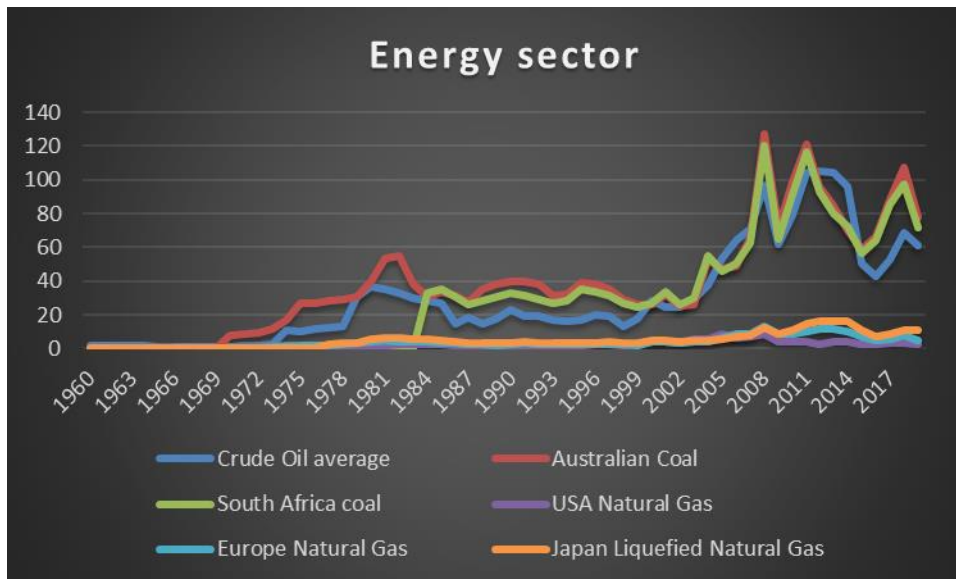
Source: Author’s elaboration on World Bank data

3.1 Energy

With the term “energy commodities” we refer to a variety of coal, crude oil, fuel oil, gasoil, heating oil, unleaded gasoline and natural gas. However, the three biggest categories identified by the World Bank are coal, crude oil and natural gas. These commodities are often used in different industrial sectors and investing in them is always considered an optimal way to spend money. They have the feature to react in a very short time horizon to increases/decreases in demand and supply. Energy sector is considered an important component of inflation indices around the world, this means that efficient investments in energy can be used in order to hedge against a rise in prices.

Investors in the energy sector can adopt different means: ETFs, futures contracts in the NYMEX¹⁵, option contracts and company stocks. In the following table we have a detailed list of energy sector commodities with the evolution of prices over time:

Graph 3.2 Annual energy price (1960-2019) (\$/bbl and \$/metric ton)



Source: Author’s elaboration on World Bank data

The crude oil average is computed involving different oils drilled from specific geographic areas that give to the product of those zones some special features and denomination: this argument will be part of the fourth chapter.

15. It is the world’s leading market for futures and options on energy products, such as oil and natural gas; on precious metals, such as silver, gold, palladium and platinum; and on industrial metals, such as aluminum and copper. Trading at NYMEX takes place with the Open Auction system, which is a continuous auction carried out by operators in a physical location, combined with the most advanced electronic trading systems (CME Group, 2020)

World Bank identifies two different types of coal according to its origin: Australia and South Africa; While three different classification of natural gas are considered, involving US, Europe and Japan.

Australia's largest energy source is coal (4th largest producer globally): we are talking about 60% of the nation's electricity requirements is produced in coal-fired power stations according to the Geoscience department of the Australian government (last update 2013). The primary resources are located in New South Wales, Queensland, South Australia, Tasmania and Western Australia. Black coal¹⁶ is the most used variety of coal applied to industry and is a main ingredient for blast furnaces that produce iron and steel. Black coal is used also in other metallurgical applications, cement manufacturing, alumina refineries and paper manufacture. Almost 80% of coal is produced from open-cut mines while in the rest of the world open-cut mining only accounts for 40% of coal production. This kind of mining is cheaper than underground mining and enables up to 90% recovery of the resource.

For what regarding South African coal according to the Mineral resources & energy department of the Republic, about 77 % of South Africa's primary energy needs are provided by extraction of it. The most famous site of extraction in the country is Richards Bay Coal Terminal from which the combustible is exported in the world. About 51 % of South African coal mining is done underground and the remaining percentage is obtained through open-cast methods for a total of 11 mines that account for 70% of total coal output. The importance of South Africa's coal reserves in the economic sector is easy to understand if we look at the Eskom¹⁷ published ranking where the country in question is positioned 1st in the world as a steam coal user and 7th as an electricity generator.

Shifting our attention to natural gas, it is a fossil energy source that formed under the earth's surface. Natural gas is composed mainly by methane: in chemical terms the structure is one carbon atom and four hydrogen atoms. Natural gas also contains smaller amounts of natural gas liquids (NGL, which are also hydrocarbon gas liquids), and non-hydrocarbon gases, such as carbon dioxide and water vapor. Usually natural gas is used as a fuel and for making materials and chemicals¹⁸.

16. Black coal is so called because of its color. It varies from having a bright, shiny lustre to being very dull, and from being relatively hard to soft. The term 'black coal' is used in Australia to refer to anthracite, as well as bituminous and sub-bituminous coals. Black coal is higher in energy and has lower moisture content than brown coal. Brown coal, also called lignite, is a low-ranked coal with high moisture content that is used mainly to generate electricity (Australian Government, 2013)

17. Public electric company in South Africa, available at <https://www.eskom.co.za/Pages/Landing.aspx>

18. Definition available at <https://web.archive.org/web/20140709040340/http://naturalgas.org/overview/background/>

Most of the natural gas consumed in the United States is produced in the United States. Some natural gas is imported from Canada and Mexico in pipelines. A small amount of natural gas is also imported as liquefied natural gas (LNG). According to EIA data of 2018, the most important gas producing states in USA are Texas, Pennsylvania, Oklahoma, Louisiana and Ohio with respectively a percentage share of production corresponding to 22, 20, 9, 9 and 8 and in total they account for 30.6 trillion cubic feet (Tcf). In the futures market, the “Henry hub” natural gas is the crucial point from which the general pricing of natural gas futures in the NYMEX occurs: it’s considered as a benchmark. Physically, Henry Hub is a natural gas distribution pipeline located in Louisiana; it gives access to many of the major gas markets in the US, that’s why it is so important. The hub connects to four intrastate and nine interstate pipelines, including the Transcontinental, Acadian and Sabine pipelines, all located in the Gulf.

In Europe there is a distinction between EU members and non-members, Russia was the largest supplier of natural gas to the EU in 2018-19 while the other countries with significant trade quantities were Norway, Algeria, Qatar, Nigeria and the United Kingdom.

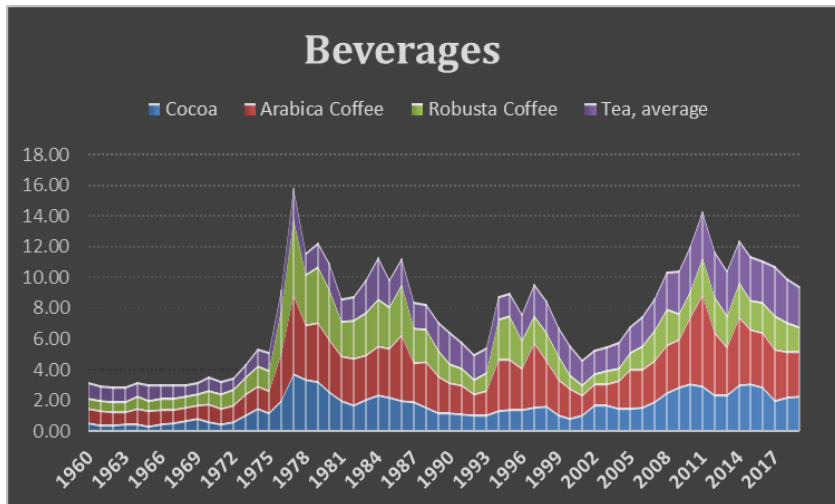
Japan’s situation is somewhat particular: the country lacks significant domestic reserves of fossil fuel, exception made for coal, and must import substantial amounts of crude oil, natural gas, and other energy resources. The intention of the government, through the Institute of Energy Economics, Japan (IEEJ), is to adopt a specific LNG strategy declared in May 2016 with the aim of the creation of a liquid market and an international LNG hub in the Asian country. In the same years almost 260 million of tons of LNG were produced and a part of them exported to Australia. Since the Asia Pacific region is the widest LNG market, through the creation of a hub, the development of a reliable price index is feasible, and it is expected to become real in 2020. Briefly, Japan, which buys about one-third of global LNG shipments, is trying to cut fuel costs and gain more control over prices.

For what concerns 2020, energy prices dropped drastically in the first quarter due to the evident problem of COVID. Crude oil prices averaged \$32/bbl in March according to the Commodity Market Outlook (CMO) 2020 of April, corresponding to a fall of 50% compared with January. Prices reached a historic low in the same month when the CMO was published, with some benchmarks trading at negative levels.

3.2 Non-Energy

Agriculture, fertilizers and metals&minerals are the elements that compose the non-energy sector, it means they are not used in the same industry as for example crude oil. Starting from the first mentioned, agriculture commodities comprise many different elements in turn grouped in beverages, food (oil and meals, grains and other food) and raw materials. In the following pages, I will provide different charts representing the afore explained classification with the relative prices over time:

Graph 3.3. Beverage annual price evolution (1960-2019) (\$/kg)



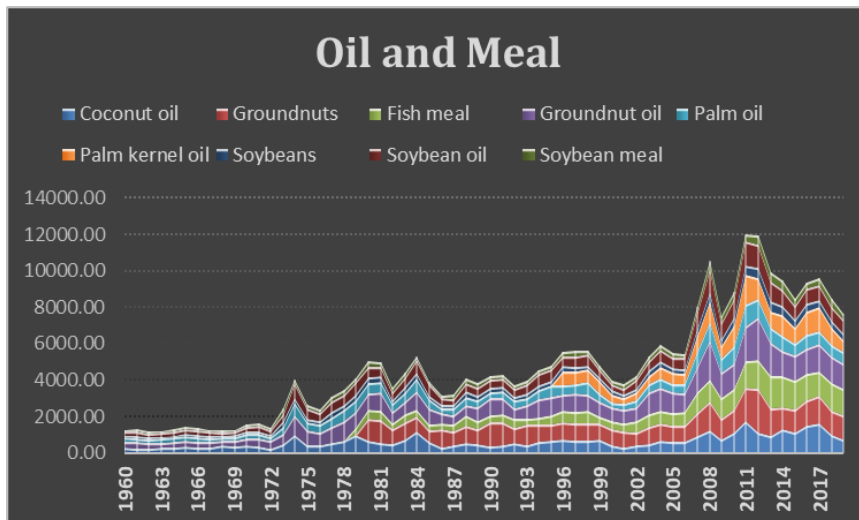
Source: author's elaboration on World Bank data

Ivory Coast is the world's largest Cocoa exporter followed by Ghana and Ecuador. Arabica coffee instead is produced from the robusta bean and makes up most of the remaining coffee production. Arabica coffee has a more delicate and sweet taste, is lighter (it contains less caffeine) and more aromatic. Robusta coffee (native to West Africa), on the other hand, has a more intense flavor, is stronger (contains more caffeine), less aromatic but has more body and allows you to create a more creamy and foamy espresso. The largest coffee exporter in the world is Brazil followed by Vietnam and Colombia.

The tea average involves in the computation tea from Sri Lanka, from Kolkata and from Mombasa/Nairobi. China is the largest tea exporter, then we have India, Sri Lanka and Kenya.

In the food category we find oil and meals(\$/mt):

Graph 3.4. Oil & Meal annual price evolution (\$/mt)

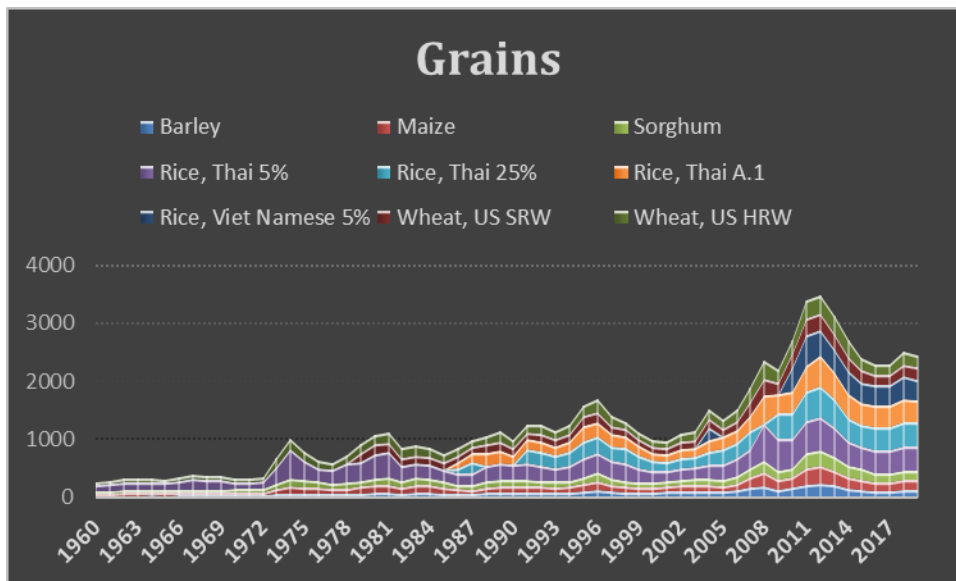


Source: author's elaboration on World Bank data

A special consideration on soybean must be elaborated: it is a species of legume native to East Asia and approximately 85% of the world's soybean crop is processed into soybean meal and soybean oil (Oilseed & grain news)¹⁹. It is so important because it represents the largest agriculture product exported by US.

It was a key element during the “Trade War” between China and United States: U.S. soybean exports to China in 2019 (middle of the conflict) were planned to be one-third of the quantities exchanged in the previous years since the demand from the Asian country plummeted. Before the starting of the dispute the share Chinese soybean market respect to total American export of this product was around 60% (CNBC, 2018). Then soybean acquires political connotations in a turbulent dynamic of relations between the two biggest economic powers the globe.

Graph 3.5. Grains annual price evolution (1960-2019) (\$/mt)

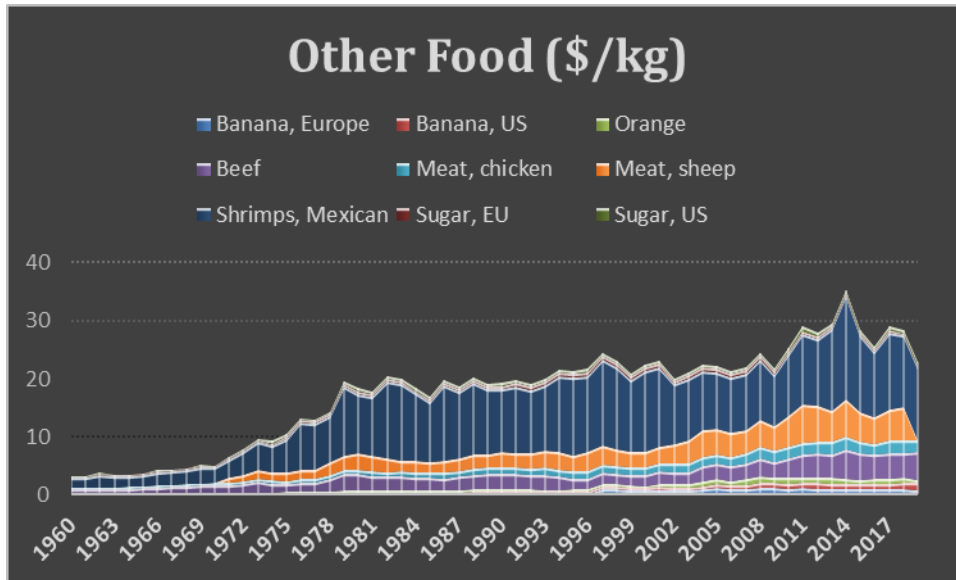


Source: Author’s elaboration on World Bank data

“Broken” rice consists in the rice grains fragmented according to a percentage. Rice is broken in the field, during drying, during transport, or by milling. A grain of broken rice gives a low fiber texture and low nutrient level, while retaining its high energy content. Mechanical separators are used to separate the broken grains from the whole grains and sort them by size. Instead, “Thai” means Thailand origin from which three different variety of rice are quoted in the NYMEX.

19. Available at <https://www.oilseedandgrain.com/soy-facts>

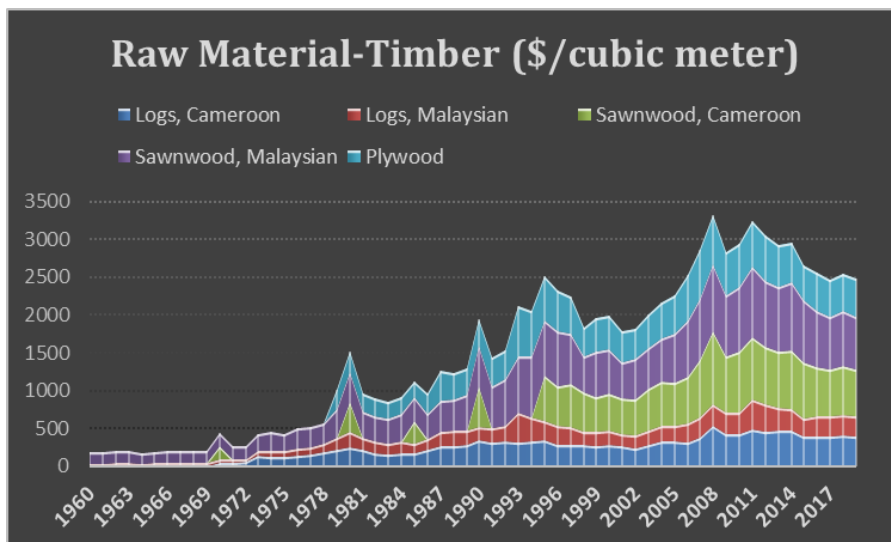
Graph 3.6. Other food annual price evolution (1960-2019) (\$/kg)



Source: Author's elaboration on World Bank data

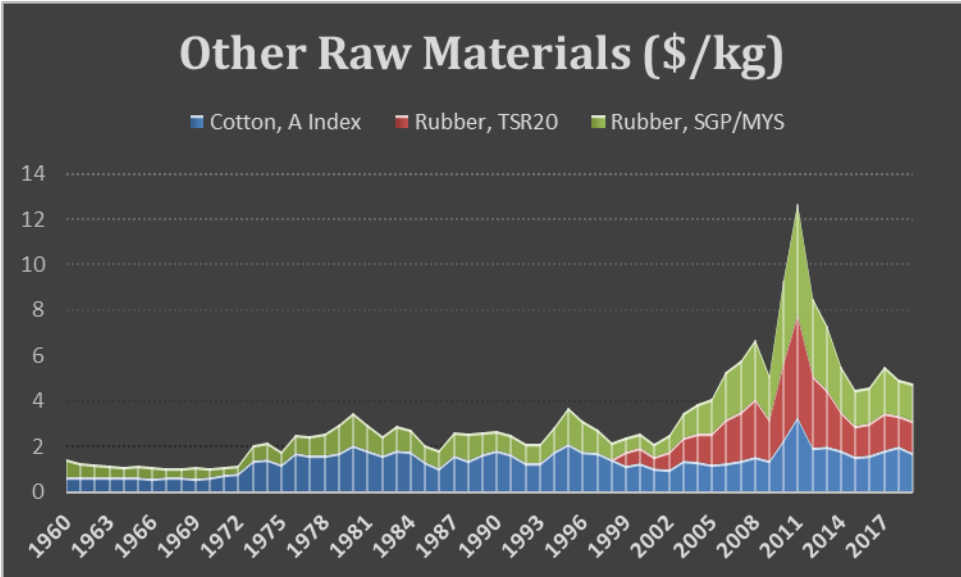
According to the macro-area of origin (EU or US) we have a quotation in the market. “Other food” is the last class of food commodities, now the second big group of agriculture ones. The last component is raw materials:

Graph 3.7. Raw materials-timber annual price evolution (1960-2019) (\$/ cubic meter)



Source: Author's elaboration on World Bank data

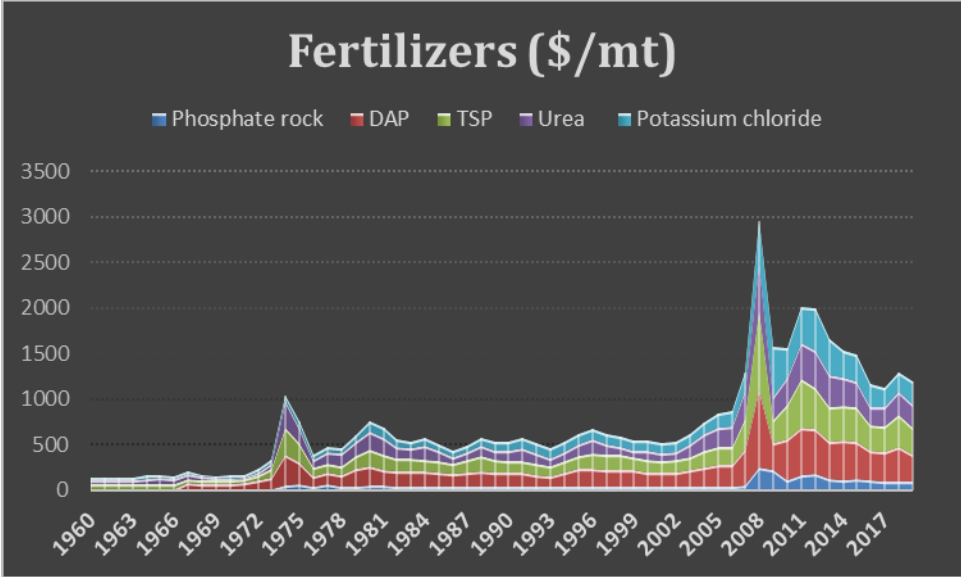
Graph 3.8. Other raw materials annual price evolution (1960-2019) (\$/kg)



Source: Author’s elaboration on World Bank data

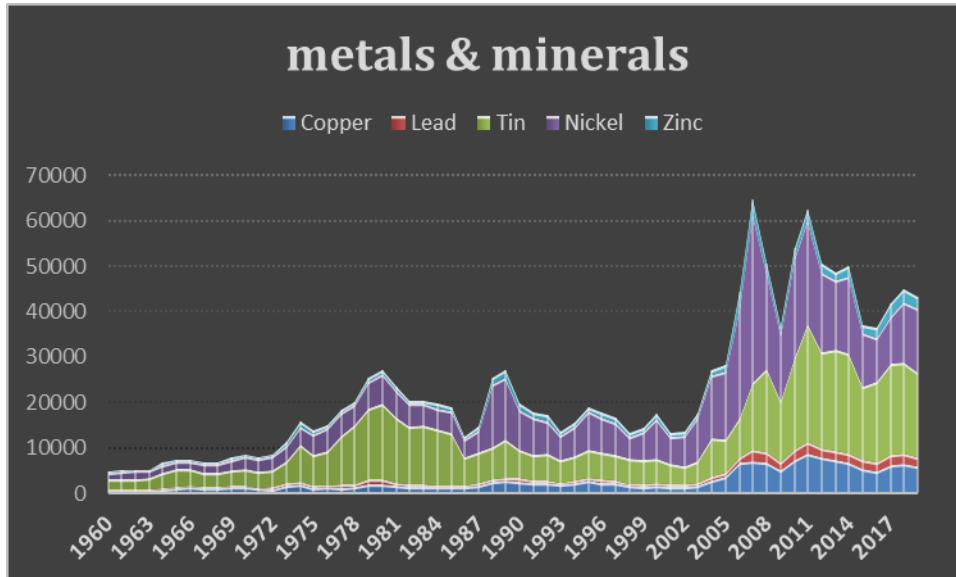
Fertilizers, metals and minerals are the last components of the non-energy subdivision, here they are presented:

Graph 3.9. Fertilizers annual price evolution (1960-2019) (\$/mt)



Source: Author’s elaboration on World Bank data

Graph 3.10. Metals & minerals annual price evolution (1960-2019) (\$/mt)



Source: Author's elaboration on World Bank data

According to the United States Geological Survey²⁰, copper reserves are estimated at 790 million tons. It is divided into two categories: primary copper is the one extracted from mines, which can be refined in the same place of the extraction or shipped to refineries in the form of concentrates. The second type is refined copper and as the name suggests, is the final product after refinement process. Chile, Peru, China, the United States, Australia, the Democratic Republic of the Congo, Zambia, Mexico, Russia, and Kazakhstan. Chile, the world's leading copper producer, the first country mentioned has an output estimate of 5.6 million metric tons of copper in 2019. It is a major industrial metal because of its high ductility, malleability, thermal and electrical conductivity and resistance to corrosion. Just to give an idea of the importance, an average conventional car contains 20-25 kilograms of copper, whereas no less than 75-80 kilograms are used in the average electric car.

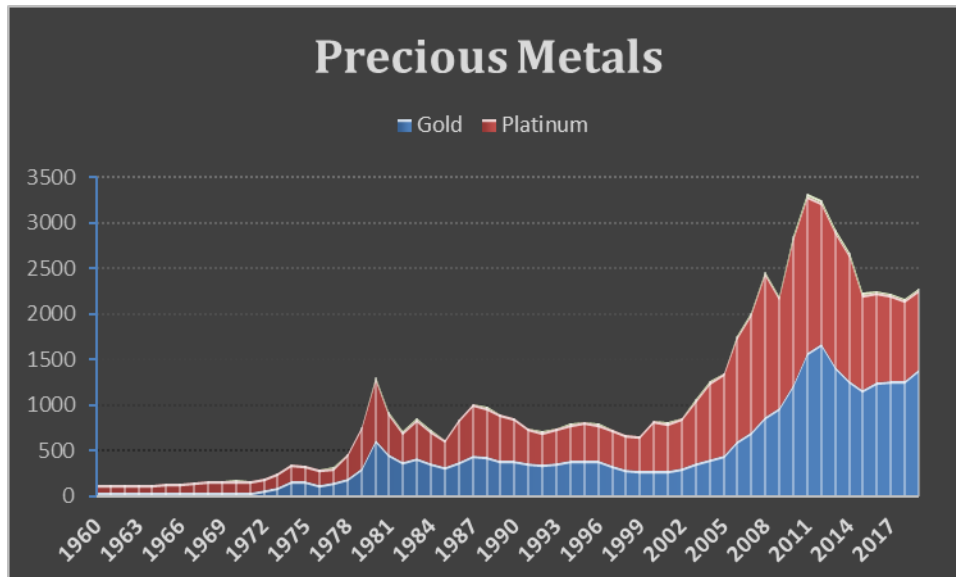
For what concerns 2020 and the crisis, the metals and minerals price index fell 5 percent on the first quarter with the biggest hit to copper and zinc prices which declined by almost 15% (WB) (2020) to the starting month of the year in question, reflecting the strong correlation with global economic activity.

20. It's science agency for the US Department of the Interior. It is sought out by thousands of partners and customers for its natural science expertise and its vast earth and biological data holdings (USGS, 2019)

3.3 Precious Metals

The main elements composing the partition are gold, platinum and silver. After presenting the historical data in a chart, the focus will shift particularly on gold.

Graph 3.11 Precious metals annual price evolution (\$/troy oz)



Source: Author's elaboration on World Bank data

Gold's feature that makes it different from other commodities is that it doesn't get consumed. It gets mined from the ground: the country with most gold mines is Australia followed by South Africa; nonetheless the nation producing more is China. A large quantity of gold extracted time ago is still circulating in the form of jewelry and the other uses of gold consists in the industrial (thanks to its thermal and electrical conductivity), dental and medical sectors.

The precious metal has always been considered a "safe haven" using futures and derivatives when there is turmoil in the financial markets and where the economy is in recession in fact, as we can see from the graph, during 2008 the price increased.

Central Banks play an important role in the gold market: in 2009 China's government decided to improve its returns in gold reserves by incrementing the quantity held. Chinese investors began pursuing investment in gold as an alternative to investment in the Euro after the beginning of the Eurozone crisis in 2011. And that's why the Asian country has become the world's top gold consumer in 2013 (Financial Times, 2014).

Moreover, gold maintains a special position in the market with many tax regimes. For example, in the European Union the trading of recognized gold coins and bullion products are free of VAT. Silver and other precious metals or commodities do not have the same allowance.

In 2020 precious metals, in detail gold and platinum, behaved in a different way respect to each other. Gold price rose modestly thanks to its condition of “safe-haven”, while platinum prices dropped sharply reflecting their heavy use in the production of catalytic converters in the transportation industry.

4. CRUDE OIL MARKET

According to World Bank, in the 2020 first months (January – April), prices of crude oil fell dropping 70% (at the time of the recording of the first human-human contagion). Initially the drop in the demand was driven by the worry about the evolution of the virus in China, the second world's oil consumer. Then the turmoil in this market kept going since travel restrictions were imposed in many countries.

The way crude oil prices are organized in the financial markets reflects some characteristics of the location where the oil is extracted, in fact the lower the cost to deliver the oil extracted, the lower the price to the consumer, so that's why we can have differences in the price of benchmarks. The current oil pricing system emerged in the period 1986-1988 and the benchmarks recognized were three: Brent Crude Oil, WTI (West Texan Intermediate) and Dubai/Oman.

The most widely used crude oil is the Brent one, which represents two thirds of the total global futures contracts; It refers to the oil extracted from four different places in the North Sea in the Baltic regions: Brent, Forties, Oseberg, and Ekofisk. Crude from this region is light and sweet, making them ideal for the refining of diesel fuel, gasoline, and other high-demand products (S&P Global, 2020). Each NYMEX Brent Crude Oil futures contract represents 1,000 barrels of Brent crude oil, with a minimum tick price of \$.01 in a very liquid market (CME Group). Brent is considered very reflective of oil demand in Europe and Asia.

Here is a table containing the most important features of Brent Future Contract taken from Intercontinental Exchange (ICE)²¹:

21. Is a US financial company founded in 2000 that operates in Internet-based markets that trades in futures and energy, commodities and financial derivative products in over the counter markets. While the main focus of the company in the beginning were energy products (crude and refined oil, natural gas ...) with the recent acquisitions it has extended its activities in commodities such as sugar, cotton and coffee, foreign exchange (ICE) available at <https://www.theice.com/index>

Table 4.1. Futures contract main elements

Contract Unit	1000
Price Quotation	US dollars and cents per barrel
Minimum price fluctuation	0.01 per barrel = \$10.00
Listed contracts	Monthly contracts listed for the current year and the next 10 calendar years and 2 additional contract months. List monthly contracts for a new calendar year and 2 additional contract months following the termination of trading in the December contract of the current year.
Termination of trading	Trading terminates 3 business day prior to the 25th calendar day of the month prior to the contract month. If the 25th calendar day is not a business day, trading terminates 4 business days prior to the 25th calendar day of the month prior to the contract month.
Delivery procedure	<p>Delivery shall be made free-on-board ("F.O.B.") at any pipeline or storage facility in Cushing, Oklahoma with pipeline access to Enterprise, Cushing storage or Enbridge, Cushing storage. Delivery shall be made in accordance with all applicable Federal executive orders and all applicable Federal, State and local laws and regulations.</p> <p>At buyer's option, delivery shall be made by any of the following methods: (1) by interfacility transfer ("pumpover") into a designated pipeline or storage facility with access to seller's incoming pipeline or storage facility; (2) by in-line (or in-system) transfer, or book-out of title to the buyer; or (3) if the seller agrees to such transfer and if the facility used by the seller allows for such transfer, without physical movement of product, by in-tank transfer of title to the buyer.</p>

Source: Author's elaboration on NYMEX data

The first three elements listed in the table explain simple data while the others illustrate how the procedures for trading are carried on.

The following description of benchmark represents the second most used oil in the world which is the WTI. The geographical area of extraction for this type of oil is US, more precisely it is exchanged in Cushing, Oklahoma where the whole amount of US oil converges. Cushing is a small town with almost 8 thousand of inhabitants but represents a transshipment point with an intersection of pipelines and storages. It is even the location of the "Cushing Oil Field" discovered

in 1912. However, WTI is not associated with a specific area of origin, as for Brent. The two most highlighted features of this oil are the lightness and the sweetness: the first one is due to the oil gravity²², while the second characteristic is given by the presence of sulfur; these features make WTI very suitable for production of gasoline. WTI is used as a benchmark for other types of crude oil produced in the United States, such as Mars, a medium, sour crude produced in the Gulf of Mexico, and Bakken, a light, sweet crude produced in North Dakota. WTI is also used as a benchmark for imported crude oil that is produced in Canada, Mexico, and South America (EIA,2014).

The last benchmark is Dubai/Oman: the region of reference as the name suggests is the Persian Gulf and the shipping destination is mainly represented by the Asian market. Saudi Arabia's state-owned oil company, Saudi Aramco²³, uses the Dubai/Oman benchmark when determining the price of its crude oil sold for delivery to Asia. The composition of the Dubai oil is of medium light and sour and unlike the other two benchmarks which are traded in dollars, this one is exchanged in yens since the trading platform of reference is the Tokyo Commodity Exchange.

In graph 4.2 the origin of the benchmarks and the oils that they comprise are presented:

Graph 4.2 Geographical crude oil benchmark origin



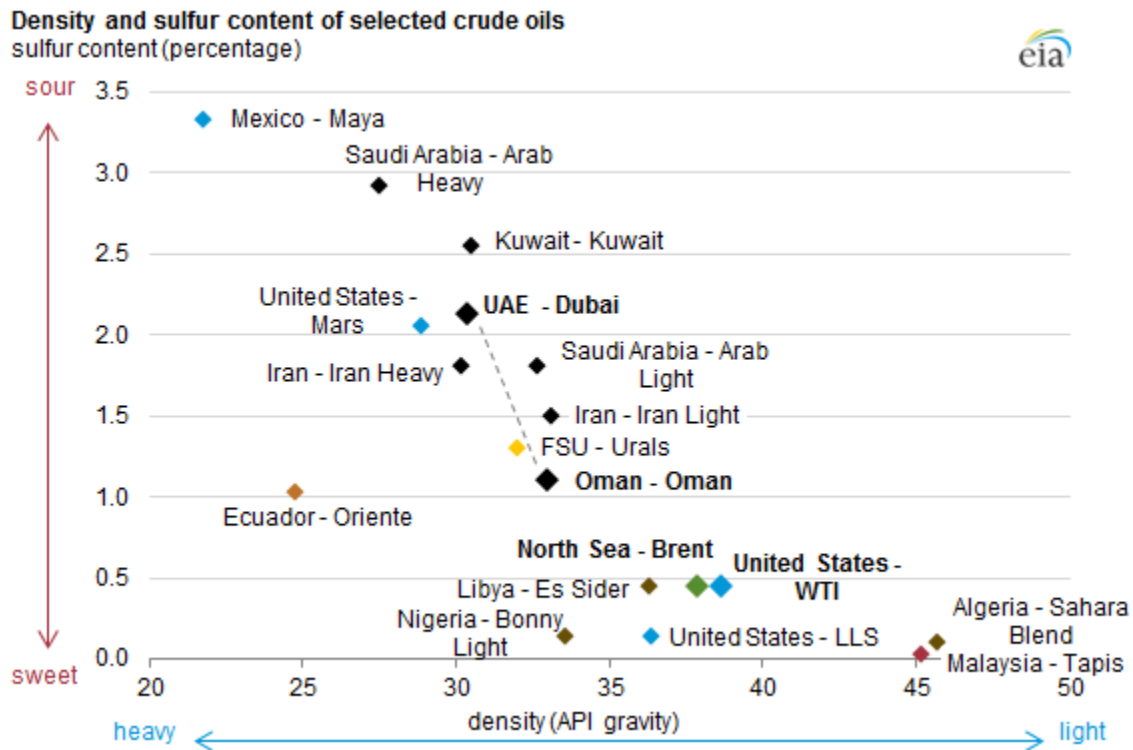
Source: EIA

22. "Oil gravity" is measured by American Petroleum Institute gravity (API) which consists in a measure of how heavy or light a petroleum liquid is respect to water. The less dense a liquid is compared to water, the higher the gravity (Energy Toolbox, 2020)
23. is the Saudi national hydrocarbon company. With a production of more than 10 million barrels per day, Saudi Aramco is among the largest oil companies in the world and the largest financier of the Saudi government (Saudi Aramco,2016)

We can see how Brent dominates the North of Europe, Dubai the Persian Gulf with the countries bordering the Indian Ocean and finally the WTI concentrated in America.

Since the different crude oils have their own particular composition, then the following graph describes the relation on the three benchmarks respect to their compositions in terms of oil gravity and sweetness/sourness.

Graph 4.3. Chemical composition of oil benchmarks

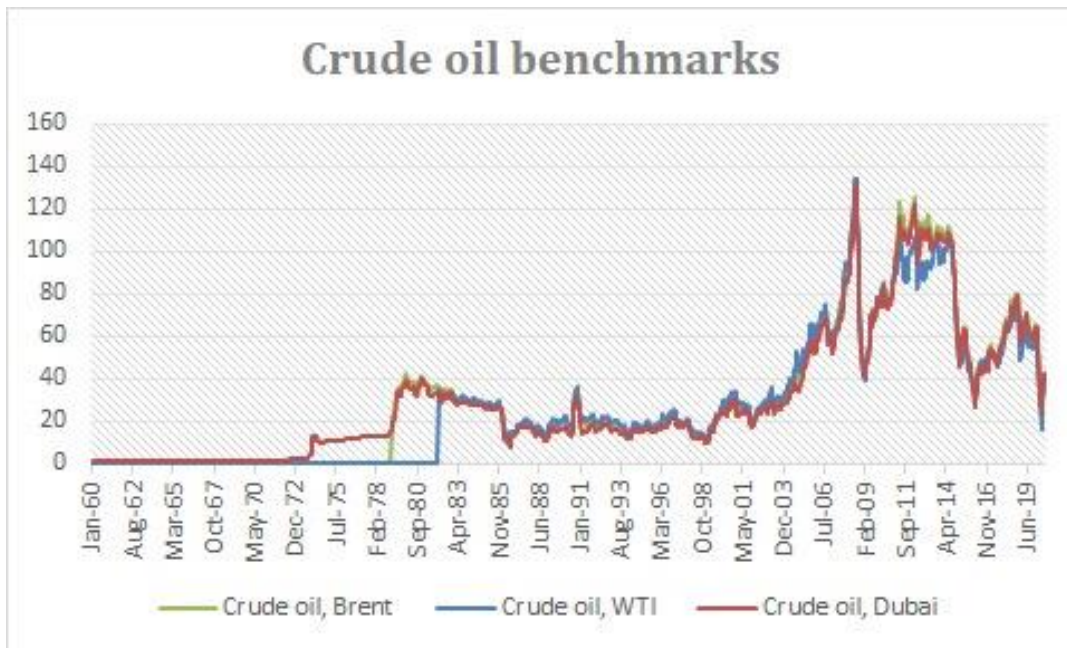


Source: EIA

The y axis indicates where the different oils position themselves in a scale of sweetness, while the x axis classifies the oils according to a heavy/light relationship measured by the API gravity density. We can see that the benchmarks are those in bold written: WTI and Brent are nearly on the same level of sweetness and of density; instead, the Dubai oil behaves like a stand-alone element, since as described before, it is pretty sour and heavier than the other two.

Graph 4.4 describes the relation between the benchmarks and how their prices had evolved over time till May 2020.

Graph 4.4. Monthly price evolution of crude oil benchmarks (01/1960-05/2020) (\$/bb)



Source: author's elaboration on World Bank data

I selected a range of monthly prices from January 1996 to July 2020 to have a better vision of the trend in the last two decades considering a unit of measure of \$/bbl. The first thing to notice is that the lines follow the same path, sometimes there are price differences due to costs of production. The biggest crashes in the market are evident and are temporally located in 2008/09; in 2014/15 due to oversupply of production in USA and the more recent caused by the sanitary emergence. The last one is represented by the fall in the first months of 2020 and a rapid recovery in the following months.

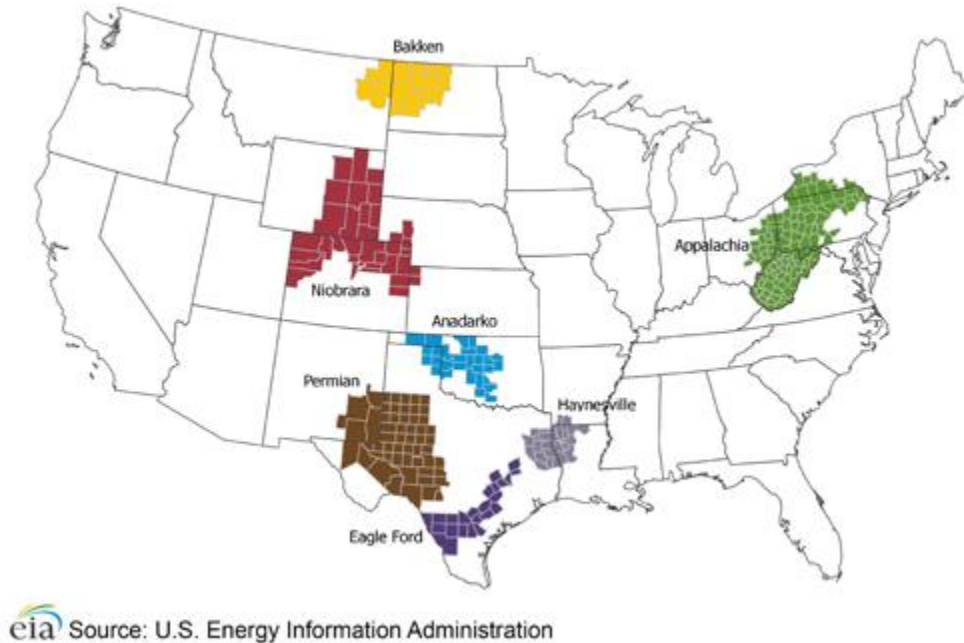
4.1 Shale Oil

Shale oil is obtained from a sedimentary rock that presents organic material (kerogen). These elements can be elaborated to extract oil in three different processes: pyrolysis, hydrogenation, or thermal dissolution. In each of the three cases, the final result consists in a conversion of the organic part of the rock fragments into synthetic oil and gas. The possibilities of utilization of the resulting product are multiple, in one case it can be used immediately as a fuel, in other cases it can be upgraded to meet refinery feedstock specifications by adding hydrogen and removing impurities such as sulfur and nitrogen. Utilization of oil shale is technically and economically feasible only if can at least 20% of its kerogen be converted into oil by thermal processing (Estonian Academy Publisher) (2015). There are some rocks that already contain oil, which are

called “oil-bearing” rocks. From these rocks is possible to obtain raw natural oil and must not be confused with shale oil obtained through the process previously described.

The drilling activity conducted for shale oil in America is concentrated in some specific areas of the country; According to the 2020 “Drilling Productivity Report²⁴” (DPR) of EIA, the regions where the extraction is conducted are: Anadarko, Appalachia, Bakken, Eagle Ford, Haynesville, Niobrara and Permian.

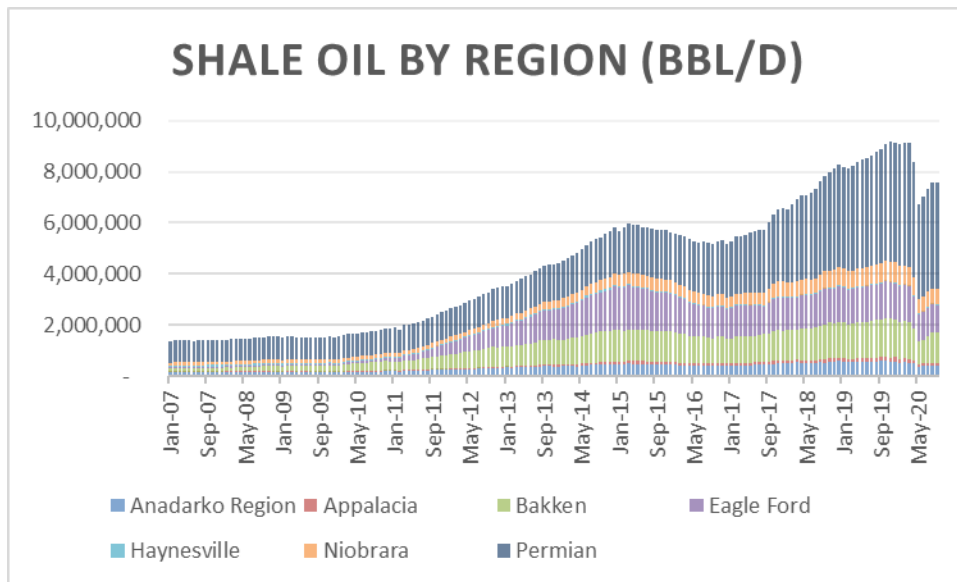
Graph 4.5. Shale oil US regions



In graph 26 all the regions listed before are collocated on the US map which is linked to the graph below since it illustrates the barrels per day produced each month in the colored areas starting from the beginning of 2007.

24. The Drilling Productivity Report uses recent data on the total number of drilling rigs in operation along with estimates of drilling productivity and estimated changes in production from existing oil and natural gas wells to provide estimated changes in oil and natural gas production for seven key regions. EIA’s approach does not distinguish between oil-directed rigs and gas-directed rigs because once a well is completed it may produce both oil and gas; more than half of the wells produce both (EIA, 2020)

Graph 4.6. Monthly shale oil production by region (01/2007-09-2020) (bbl/day)



Source: Author's elaboration on EIA data

The most productive area of drilling by far is Permian, mostly composed by Texan and New Mexican territory. Shale oil started its climbing in 2011 and lasted till the fall in price in 2015 due to the overproduction. Then, after a cut in the quantity drilled it started rising again till a sharp drop between March and April 2020.

The boom in shale production of 2011 has made the US the world's largest oil producer and consequently an exporter of crude oil. Of course, this situation brought bad news for Russian and Saudi Arabian producers, since the market share of each saw a resizing. Prices for energy products became cheaper in the United States than in the rest of the world. After the cut in production of 2016, a second wave of enthusiasm for shale oil production characterized the US market, reaching 63 % of total U.S. crude oil production in 2019 (EIA) (2019); the reason was the increasing productivity of new wells, in fact more effective drilling techniques were developed.

Nowadays, due to the situation caused by the pandemic, shale oil is at a crucial point: the price level (WTI) reached in March was not sufficient for shale oil companies to guarantee profits. When the benchmark reached \$30 dollars (or even down to zero), companies saw the color of their income statement turning red, but even with a price level of less than \$60 dollars there could be problems for drillers due to the high costs (Oilprice, 2020)²⁵.

25. Oilprice.com is the most popular energy news site in the world composed by editors and journalists, more info available at oilprice.com/about-us

Rystad Energy (2020)²⁶ has published some data considering that almost 170 companies will be subject bankruptcy procedures in 2021, and if the price will reach again the figure reached in March, more firms will face further problems. In essence, the collapse in the price of crude oil makes extractions in the US no longer convenient, as they must return to supply in the Middle East.

As a consequence, two alternative benchmarks debuted simultaneously on June 26, both with the promise of more faithfully and reliably reflecting the prices of shale oil and more generally of US crude oil for export: volumes that now exceed 3 million barrels per day (Routers)(2020). To launch the new references (in open challenge to the CME Group, which controls NYMEX) are S&P Global Platts²⁷ and Argus Media: companies that already publish price lists and indices referring to dozens of energy and non-energy products. Platts, in particular for years, based on physical exchanges in the North Sea, has determined the value of Brent Dated . "The US market will finally have its Brent", said Vera Blei, Global director of oil of the subsidiary of Standard & Poors, specifying that the Platts American Gulf Coast Select (AGS)²⁸ "will reflect the value of the US crude oil sea, connected to international markets and free from the distortions of the domestic infrastructure economy ». The two alternative references could still struggle to establish themselves and certainly will not be able to undermine futures on the WTI, traded in a very liquid market, as it is also frequented by financial subjects. The latter could possibly favor Brent, but they certainly will not convert to the new price indices, designed rather for commercial operators.

4.2 OPEC

The acronym stays for “Organization of the Petroleum Exporting Countries” and was founded in 1960 by the first five members composed by Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela. The current members of the OPEC are Algeria, Angola, Equatorial Guinea, Gabon, Iran, Iraq, Kuwait, Libya, Nigeria, the Republic of the Congo, Saudi Arabia, the United Arab Emirates and Venezuela; for a total of 13 nations. The idea behind the creation of such an important organization is “the coordination and unification of the petroleum policies of Member Countries and the determination of the best means for safeguarding their interests, individually and collectively” as stated by the second article of the OPEC Statue. The object is to unify oil policies, stabilize markets based on an adequate supply for consumers and facilitate investors who focus on the oil sector.

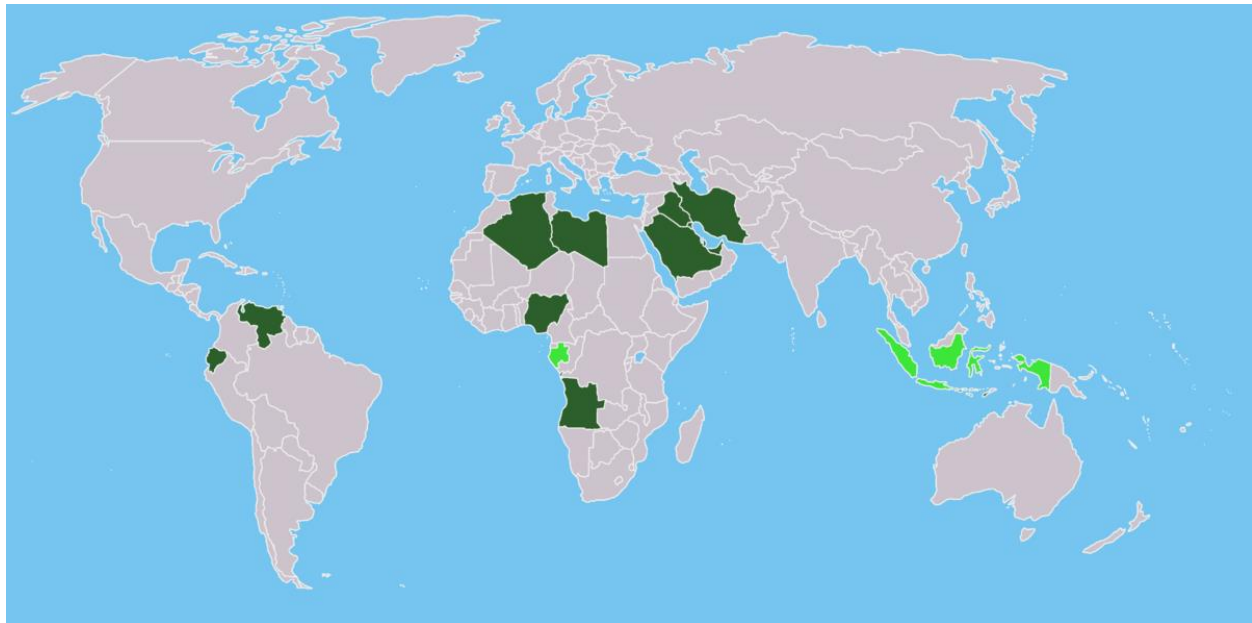
26. Is an independent analysis and consulting firm in the upstream oil and gas sector founded in Oslo in 2004 by Jarand Rystad available at <https://www.rystadenergy.com/newsevents/news/press-releases/us-bankruptcies-and-how-to-avoid-them-the-costs-and-benefits-of-saving-eps-via-royalty-exemptions/>

27. S&P Global Platts is a division of S&P Global, the world's foremost provider of ratings, benchmarks and analytics in the global capital and commodity markets available at <https://www.spglobal.com/en/>

28. A new oil benchmark ideated by S&P Global

The picture below illustrates the MS (member states) on the World Map in 2020:

Graph 4.7 OPEC countries



Source: OPEC

The countries highlighted with light green left the organization.

OPEC has its oil benchmark, the “OPEC Reference Basket” (ORB) which consists in a weighted average of the price of the oil production of the member states and has remained unchanged since its introduction in 2005. It has a very important role since from its variation market investors capture the signs of new trends or the effect of new policies as well as price wars between OPEC member and not.

In the countries participating to the organization decided to form a further group called “OPEC+”. The new organization was feasible through an agreement between OPEC members and other countries considered allies as Russia. The nation admitted in the agreement are characterized by a pursuing of petroleum cuts in their political programs.

OPEC+ was fundamental in the period of sanitary emergence of March/April of 2020, in fact the organization pushed for production cuts to increase prices and to create a block against Donald Trump who strongly wanted a drop in crude oil price. The agreement for oil production cut should have been signed in March, but there were many obstacles during the paths, as for example some OPEC countries were afraid of being crushed by an alliance of two super powers such as Saudi Arabia and Russia; another factor that affected the sign of agreement was the legislation NOPEC²⁹,

29. Designed to remove the state immunity shield and to allow the international oil cartel, OPEC, and its national oil companies to be sued under U.S. antitrust law for anti-competitive attempts to limit the world's supply of petroleum and the consequent impact on oil prices (Huffington Post, 2012)

agreed in Washington by the US Congress to tighten antitrust regulation and counter OPEC domination. Russia did not accept to reduce its oil production in March, ending de facto the collaboration with OPEC countries. Saudi Arabia responded to Russia by increasing the production and discounting the price, causing the huge fall in oil prices in the market in March/April. The agreement for oil cuts was reached only in July. The following table shows oil production in terms of figures in recent years for OPEC:

Table 4.8 OPEC oil production in recent years (tb/d)

	2018	2019	1Q2020	2Q2020	April	May	June
Algeria	1,042	1,022	1,018	877	1006	819	809
Angola	1,505	1,401	1,388	1,271	1,313	1,275	1,224
Congo	317	324	295	291	293	285	295
Equatorial Guinea	125	117	122	110	125	90	114
Gabon	187	208	194	198	196	194	204
Iran	3,553	2,356	2,059	1,958	1,973	1,954	1,947
Iraq	4,550	4,678	4,560	4,129	4,505	4,165	3,716
Kuwait	2,745	2,687	2,741	2,470	3,118	2,198	2,103
Libya	951	1,097	348	85	82	80	93
Nigeria	1,718	1,786	1,800	1,624	1,777	1,592	1,504
Saudi Arabia	10,311	9,771	9,796	9,218	11,642	8,479	7,557
United Arab Emirates	2,986	3,094	3,208	2,885	3,841	2,478	2,349
Venezuela	1,354	796	730	512	624	555	356
Total OPEC	31,344	29,337	28,259	25,628	30,495	24,164	22,271

Source: Author's elaboration on OPEC data

The unit of measure is tb/d (thousands of barrels per day); all countries except for Gabon, have cut their production between Q1 and Q2 of 2020. An increase in the production has been recorded between March and April due to the not reached agreement.

5. OIL WARS AND INTERNATIONAL AGREEMENTS

The oil wars are political and economic conflicts concentrated on petroleum and how it is transported, consumed, elaborated and so on. It can be that a war between two or more states involves geographical region where oil reserves are located; these conflicts must be worry crude oil investors with the same degree of dangerousness. These wars have huge impact on production, extraction, drilling, consumption and of course price. They are an important determinant in the demand/supply interaction for crude oil. The country involved in the following analysis are selected according to the effects which have repercussions in 2020.

5.1 Russia-Saudi Arabia oil war

The most recent and relevant oil war involved two crude oil international powers: Russia and Saudi Arabia. It started in March 2020 by Saudi Arabia in response to Russia's refusal to reduce oil production in order to keep prices for oil at moderate level. Russian government decided to not join the agreement of OPEC+ to cut together with the all countries participating to the deal de facto triggering the reaction of the middle-east country and leading to the dissolution of OPEC+. China's demand fell due to COVID in markets was interpreted by oil exporting countries as a valid reason for organizing an OPEC summit in Vienna on 5 March 2020. At the summit, OPEC agreed to cut oil production by an additional 1.5 million barrels per day through the second quarter of the year to get a total production cut of 3.6 million bpd with all the members expected to apply the policy and review it on 9 June during their next meeting. OPEC called on Russia and other non-OPEC members of OPEC+ to fulfill the requirements for abiding the agreement. On 6 March 2020, Russia refused to apply the production cuts marking the end of the agreement with a consequent drop of oil prices falling 10% after the announcement (CNBC) (2020).

On 8 March 2020, Saudi Arabia initiated a price war with Russia, facilitating a 65% quarterly fall in the price of oil. In the first few weeks of March, US oil prices fell by 34%, crude oil fell by 26%, and Brent oil fell by 24% (Business Insider, 2020). The huge fall in prices is pumped not only by the unsuccessful result of the agreements, an important contribution was given by the COVID effects on the oil market which was already in trouble before the war. The move played by Saudi Arabia consisted in an announcement of an unexpected price discounts of \$6 to \$8 per barrel to customers in Europe, Asia, and the US. The news affected the oil price causing a drop bringing Brent crude to a 30% fall, the largest drop since the Gulf War (Business Insider) (2020). WTI fell by 20% while On March 9, 2020, stock markets worldwide reported major losses thanks in part to a combination of price war and fears over the Coronavirus pandemic. Consequences of the Saudi Arabian decision reached even the currency market, in fact after the announcement, the Russian ruble fell 7% to a 4-year low against the US dollar (RadioFreeEurope, 2020).

In the days after the announcement, oil prices and markets recovered somewhat, with oil prices increasing by 10% (BBC, 2020), and most stock markets recovering the day after Black Monday. On 10 March, Saudi Arabia declared that an imminent increase in production from 9.7 million

barrels per day to 12.3 million, while Russia planned to increase oil production by 300,000 barrels per day (The Guardian, 2020). At the time, Aramco's³⁰ short term oil production capacity was around 12 million bpd (sustained at 10.5 million bpd), and the firm has been told by the authority to expand to 13 million (OilPrice.com) (2020). With the demand swooping, oil prices went down further, reaching a 17-year low on 18 March where Brent was priced at \$24.72 a barrel and WTI at \$20.48 a barrel (Financial Times, 2020).

In the critical month of April prices of crude oil futures per barrel reached negative levels. Negative prices in commodity markets are very rare, but when they occur, they typically indicate high transactions costs and significant infrastructure constraints. The problem was that it is impossible to stop production of crude oil, it can be just slowed down and in the recent situation due to COVID and oil war the minimum level of production becomes an overproduction and so excess of supply respect to the demand, keeping prices low. Oil production can be slowed, but not stopped completely, and even the lowest possible production level resulted in greater supply than demand; The 2nd and the 3rd of April were two crucial days since American president Donald Trump and Russian president Vladimir Putin committed themselves to find a solution with Saudi Arabia and an new extraordinary OPEC meeting was announced few days later in which Saudi Arabia and Russia have agreed on 9th of April to oil production cuts in a new agreement. According to data provided by the Financial Times (2020), the announcement by former soviet country triggered an immediate 10% increase in oil prices. According to Reuters, the agreed amount of cut corresponded to 9.7 million barrels per day (about 10% of global output) and the reductions took effect in May/June.

A similar situation in terms of oversupply respect to demand occurred in the beginning of 2014, when US shale oil producer increased the barrels per day gaining more market share; the consequences were reflected on the prices, which crashed from above \$100 per barrel in 2014 to about one third of the 2014 price in 2016 (The Guardian, 2014). In September 2016, Saudi Arabia and Russia agreed to cooperate in managing the price of oil with the aim of avoiding huge price crashes and this cooperation lead to the creation of an informal alliance of OPEC and non-OPEC producers that was named "OPEC+."

Russian' reasons for reaching an agreement were that Russia needed high oil prices for its GDP to increase. Moreover, Ukraine conflicts had been a disastrous factor for crude oil demand of the former soviet country. By January 2020, OPEC+ had cut oil production by 2.1 million barrels per day (bpd), with Saudi Arabia making the largest reductions in production (ETEnergyWorld, 2019).

30. Saudi Arabia national company for petroleum and natural gas, more info available at <https://www.aramco.com/>

The governments of both the countries involved in the oil price war confirmed that Russian and Saudi officials deny the existence of a price war against each other or against any other country. Russian Presidential Press Secretary Dmitry Peskov said that Russia is open to stipulate new agreements and new planned contracts can be implemented immediately if necessary. During the negotiations, Russian officials have argued that it was too early for cuts before understanding the full impact the virus outbreak has on oil prices, and that an existing shortfall of about one million barrels a day, caused by the political turmoil in Libya, was helping to offset a slump in demand at the time (RT, 2020). According to Bloomberg calculations based on data from the Russian Energy Ministry and BP Plc's Statistical Review. Russia agreed to continue smaller cuts until May 2022, though it did manage to hold onto one concession by keeping condensate, a light fuel of which it is a major producer, out of the quotas.

5.2 Other oil wars or sanctions to countries

Iran and Venezuela are still nowadays subject to sanctions imposed by US, other countries and international bodies in the field of crude oil import/export.

The middle-east country's oil exports have been limited 2018 and 2019 by US, because of Iranian nuclear program deal considered too advantageous for Iran. According to crude oil monthly data provided by IHS Markit³¹ after May 2019 during a situation of prohibition for Iran in terms of imports of crude oil. The only two countries importing from Iran were China and the Netherlands. In 2020 sanctions imposed by US are still in force but the Iranian government expected Chinese demand for oil to be constant, but due to COVID it was sharply reduced. HIS Markit provides also the figures explaining the difference before and after the sanctions, consisting in 2.224 billion metric tons (44.7 million barrels per day) in 2018. Iran was the ninth-largest country in global crude oil exports with a share of 4.2% in terms of volume in 2018. After the sanctions imposed by the US, Iranian crude oil revenues from exports declined from \$47.862 billion in 2018 to \$14.157 billion in 2019.

The United States sanctions imposition on Iranian crude oil exports were applied in two different temporal moments. The first wave in November 2018, when imports of oil from Iran were banned, with some temporary exemptions granted to countries such as China, India, Italy, Greece, Japan, South Korea, Taiwan, and Turkey, to ensure a well-supplied oil market. The second wave in May 2019, when the sanctions against Iran were tightened and the ban on Iranian crude oil imports was introduced for all countries without any exemptions.

31. IHS Markit Ltd is a London-based global information provider formed in 2016 through the merger of IHS Inc. and Markit Ltd, for more info <https://ihsmarkit.com/index.html>

Table 5.1. Iranian exports (2014-2018) (value of exports in \$)

	2014	2015	2016	2017	2018
Europe	-	-	4.4	2.3	1.2
North America	-	-	-	-	-
Asia and Pacific	469.3	513.6	510.1	267.7	270.7
Latin America	-	-	-	-	-
Africa	0.6	0.7	0.5	0.2	0.2
Middle East	-	-	-	-	-

Source: Author's elaboration on OPEC data

By looking at table 5.1 figures are expressed in 1,000 barrels per day, there is a strong reduction in 2017/2018 (almost halved) in oil exported in Asia and Pacific, with China leader country of Iranian imports; even in Europe exports are reduced. The table shows the impact of the first wave. The final aim of US government lead by Trump is to reduce Iranian exports to zero with a strategy of “maximum pressure”.

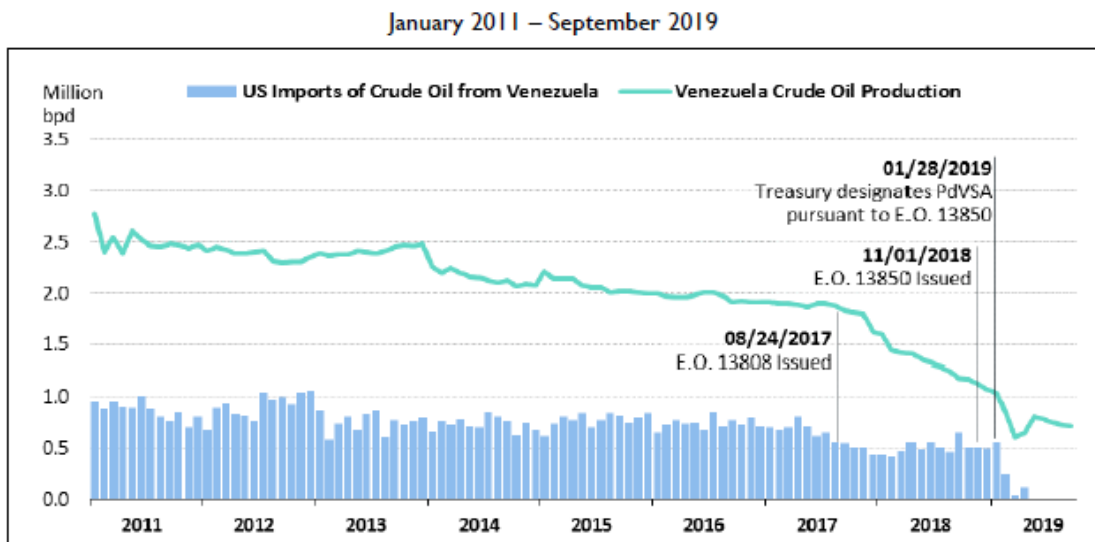
For what concerns Venezuela, economic sanctions affecting Venezuela's oil trade are the product of Executives Orders (EO) and U.S. Department of the Treasury designations in 2019 prohibiting transactions with Petroleos de Venezuela S.A. (PdVSA)³². Venezuela holds the largest oil reserves in the world, estimated by BP³³ in its annual statistical bulletin at 303 billion barrels as of the end of 2018. The country is a founding member of OPEC and Venezuela has produced oil commercially since 1914. The tension between the two nations were triggered by political reasons: US did not recognize President Maduro as the legitimate head of the government.

With the overall US objective to pressure President Maduro to transfer government control, the United States recognized Juan Guaidó as interim president of Venezuela and imposed sanctions in January 2019 aimed at reducing Venezuela's oil revenues. These measures de facto terminated US-Venezuela petroleum trade and made it more difficult for PdVSA to sell crude oil to and obtain petroleum products from non-US entities. Petroleum trade between the US and Venezuela has been eliminated. As a result, Venezuela has sought alternative buyers of crude oil previously destined for the United States and alternative suppliers of petroleum products previously sourced from US exporters. Although US economic sanctions do not explicitly prohibit non-U.S. entities from trading oil and petroleum products with PdVSA, Treasury has discretion to take action against foreign entities that provide material support to PdVSA.

32. It is the Venezuelan state oil company, more info available at <http://www.pdvs.com/index.php?lang=es>

33. It is a UK company operating in the energy sector and above all in the oil and natural gas sector, sectors in which it is one of the four largest players in the world, info at <https://www.bp.com/>

Graph 5.2. Venezuela’s impact of the US sanctions in crude oil production (millions of barrels per day)



Source: BP

Graph 5.2 shows the drastic fall in production between 2017 and 2019 and the reduction almost to zero of US imports from Venezuela in 2019.

Rosneft³⁴, a Russian controlled oil company, has reportedly facilitated Venezuelan crude oil trade with independent oil refiners in China and has provided Venezuela with petroleum products previously sourced from U.S. suppliers (BP, 2019).

U.S. sanctions targeting Venezuela’s oil trade are a function of PdVSA being designated to be subject to U.S. sanctions. This designation prohibits U.S. companies from engaging in transactions with PdVSA, including petroleum trade, oilfield service operations, and oil production operations in Venezuela. To date, Congress has not enacted legislation that specifies and requires oil sanctions be imposed on Venezuela. Rather, the sanctions framework is a result of EOs issued under national emergency authorities, and Treasury designations and general licenses based on that emergency that allow for the wind down or continuation of certain activities.

In Syria, the civil war started in 2011 by the rebels against the dictator Assad has lasted for 9 years; During the civil war, US intervened by sending military troops. Donald Trump said he expects the United States to benefit by millions of dollars per month from Syria's oil revenues while US troops remain in the country (BBC, 2019).

The Syrian President was convinced that the only reason for the presence of US troops in Syrian territory is that the American country wanted to “steal oil” from Syria and Russia (Syrian main partner).

34. is an oil company owned mostly by the Russian government, more info at <https://www.rosneft.com/>

The oil and gas sector have been a crucial contributor to Syrian government revenues. Even though its reserves are small compared with those of other countries in the Middle East, in fact in 2018, according to an article by BCC published in 2019, Syria had an estimated 2.5 billion barrels of oil reserves, compared with Saudi Arabia's 297 billion, Iran's 155 billion and Iraq's 147 billion barrels. Of course, the production collapsed since the start of civil war; too many troubles caused by the bombs, as for example on 27 January 2020 some bombs exploded near an important oil factory. Syria is important for the international chessboard in terms of alliances and oil.

In the international contest of oil wars and sanctions, there are even decision of governments for their own country that affect other nations to be considered: US president has declared to impose tariffs on American companies that refuse to move jobs back to the country from overseas, if he's re-elected with the election date in November 2020.

“We will give tax credits to companies to bring jobs back to America, and if they don’t do it, we will put tariffs on those companies, and they will have to pay us a lot of money,” Trump said during a campaign event on 20 August 2020 (Bloomberg, 2020).

The dynamic between US and China in the context of the Trade Deal stipulated on 15 January 2020 for what regards crude oil are also affecting global economy. Under phase one of the agreement China committed to about \$52 billion of US energy purchases over two years according to Bloomberg data. Some diplomatic problems arose because Trump accused China to have hidden the Coronavirus danger till it exploded.

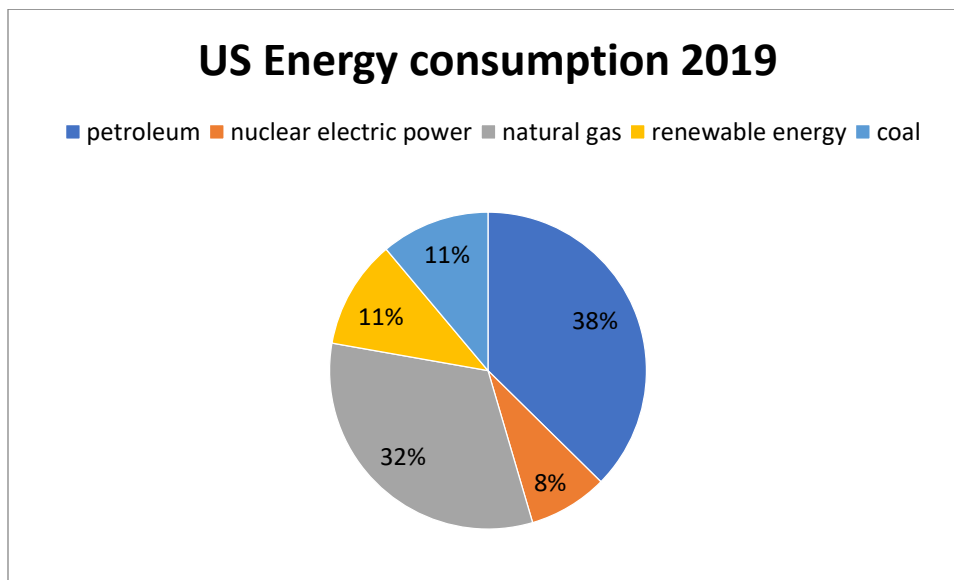
Yet, China’s purchases have lagged the target. US benchmark crude futures prices were in the \$60-a-barrel range in January but plummeted to negative territory in April. Since then, prices have moderated near \$40 a barrel (Bloomberg, 2020). The agreement must be reviewed considering the evolution of the crude oil market. In general, China had stepped up the process of crude oil acquisition from US. Another reason China has stepped up purchases is to help fill their new Strategic Petroleum Reserve site in Zhanjiang, which will have a storage capacity of 32 million barrels, said Yuntao Liu, an analyst at Energy Aspects Ltd (Yahoo Finance, 2020). Despite China’s increased purchases, U.S. crude prices have remained broadly steady, with Chinese demand filling the void left by weak U.S consumption. WTI crude prices along the Gulf Coast are at 80 cents a barrel above NYMEX oil futures, unchanged in April and May.

The trade relations between the two countries can be completely changed by the result of the US elections in November, with a consequent reflection on markets in general.

6. RENEWABLES

EIA defines renewable energies as energy obtained from sources that are naturally replenishing but flow-limited; renewable resources are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. It is the most important alternative to petroleum and natural gas which are limited resources in terms of quantity. How is the world considering the use of this energy production? Take for example US: the following chart represents US energy consumption in 2019

Graph 6.1. US Energy consumption 2019

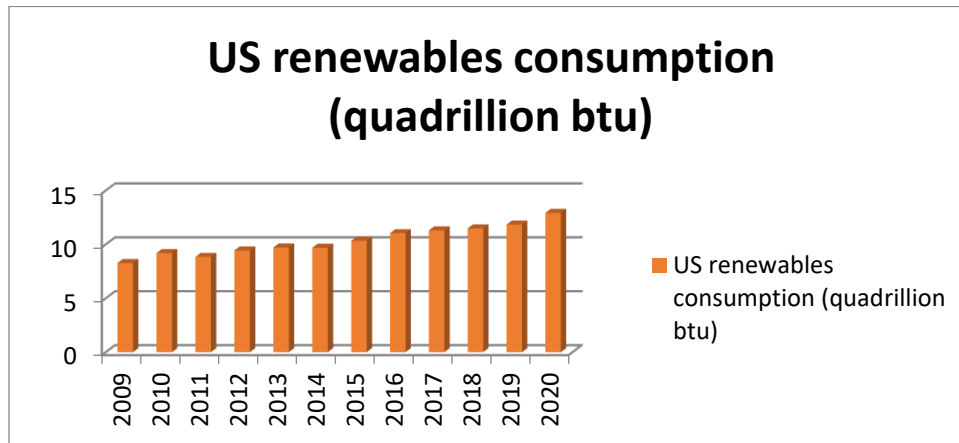


Source: Author's elaboration on EIA data

Renewable energy plays a consistent role in the economy for United States with 11% of all the energy consumed in the country. In 2019, renewable energy provided about 11.5 quadrillion btu. The electric power sector accounted for about 56% of total US renewable energy consumption in 2019, and about 17% of total U.S. electricity generation was from renewable energy sources (EIA) (2019).

The following graph illustrates the consumption of crude oil and renewable energy in the United States from the period after the financial crisis to 2020.

Graph 6.2 Renewables consumption by year (2009-2020) (quadrillion btu)



Source: author's elaboration on EIA data

The trend evinced from the graph is a growing consumption of renewable energy.

The main components representing the category of renewable energy are geothermal, hydroelectric power, solar, biomass (wood, agricultural products, solid waste, gas and bio gas, ethanol and biodiesel) and wind.

However, nuclear energy represents in the US a conspicuous share of total energy production/consumption. 96 nuclear reactors are distributed in the American territory accounting for 809,409 million kilowatt/hours of electric power.

The first one is heat derived from the sub-surface of the earth. Water and/or steam carry the geothermal energy to the Earth's surface. Depending on its characteristics, geothermal energy can be used for heating and cooling purposes or be harnessed to generate clean electricity. However, for electricity generation, high or medium temperature resources are needed, which are usually located close to tectonically active regions (International Renewable Energy Agency³⁵, 2020). This source is very important in terms of demand for the following: countries like Iceland, El Salvador, New Zealand, Kenya, and Philippines, with a peak of usage in Iceland covering more than 90% of heating demand. Geothermal energy does not depend on whether conditions and geothermal power plants are capable of supplying base load electricity.

For what concerns hydropower, it is derived from flowing water. Examples of how this force is used are located in Norway where 99% of electricity comes from hydropower. The world's largest hydropower plant is the 22.5 Gigawatt Three Gorges Dam in China. It produces 80 to 100 terawatt-hours per year, enough to supply between 70 million and 80 million households (IRENA, 2020).

35. IRENA is an international organization aimed at encouraging the growing and widespread adoption and use of renewable energies in a sustainable development perspective, more info available at <https://www.irena.org/>

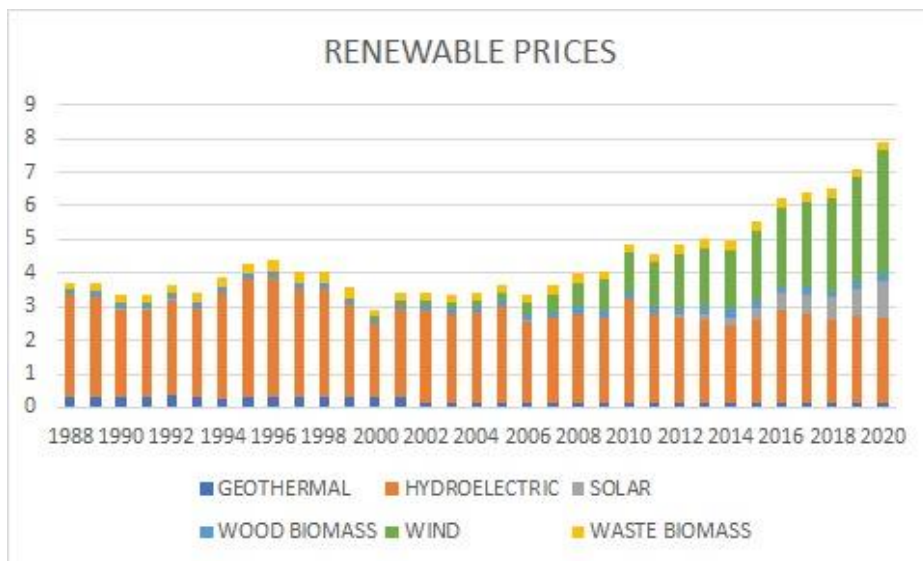
Solar energy is used for generating electricity or heating and desalinating water. There are two main ways to obtain and work it even in cloudy days: the first method involves Photovoltaics devices (also called solar cells), they are composed by electronic elements that convert sunlight directly into electricity. This method allows to produce energy even for personal use in a home.

The way is called Concentrated Solar Power (CSP) and uses mirrors to concentrate solar rays. These rays heat fluid, which creates steam to drive a turbine and generate electricity. CSP is used to generate electricity in large-scale power plants.

Biomass: is renewable organic material that comes from plants and animals

Biological conversion to produce liquid and gaseous fuels Wind power is one of the fastest-growing renewable energy technologies. Usage is on the rise worldwide, in part because costs are falling. Global installed wind-generation capacity onshore and offshore has increased by a factor of almost 75 in the past two decades, jumping from 7.5 Gigawatts in 1997 to some 564 GW by 2018, according to Renewable capacity statistics published in 2019. Production of wind electricity doubled between 2009 and 2013, and in 2016 wind energy accounted for 16% of the electricity generated by renewables. Many parts of the world have strong wind speeds, but the best locations for generating wind power are sometimes remote ones.

Graph 6.3 Renewables prices per year (1989-2020) (quadrillion btu)



Source: Author's elaboration on EIA data

What stands out at first sight is the rapid growth of wind energy prices starting from 2006. Of course, during the first months of the 2020 when the economic hit of the pandemic was at its top, also renewable energy was affected, but in a lighter way. For example, U.S. biodiesel production has seen smaller reductions in 2020 compared with other transportation fuels, according to EIA's 2020 data, Petroleum Supply Monthly; and its production through May 2020, has not changed much respect to previous years because biodiesel is not constrained by the same blending limits as ethanol. This result was possible because of the lack of significant blending restraints and the presence of incentives for producing and blending biodiesel have helped support biodiesel demand so far in 2020. To explain better, the figures representing the situation presented by EIA in 2020, say that in the period March-April biodiesel production averaged 114,000 barrels per day (b/d), compared with 116,000 b/d during the same period in 2019.

US growth of solar and wind energy was the result of green-oriented policies consisting in tax incentives: Production Tax Credit (PTC)³⁶ for new wind build expires and the solar Investment Tax Credit (ITC)³⁷.

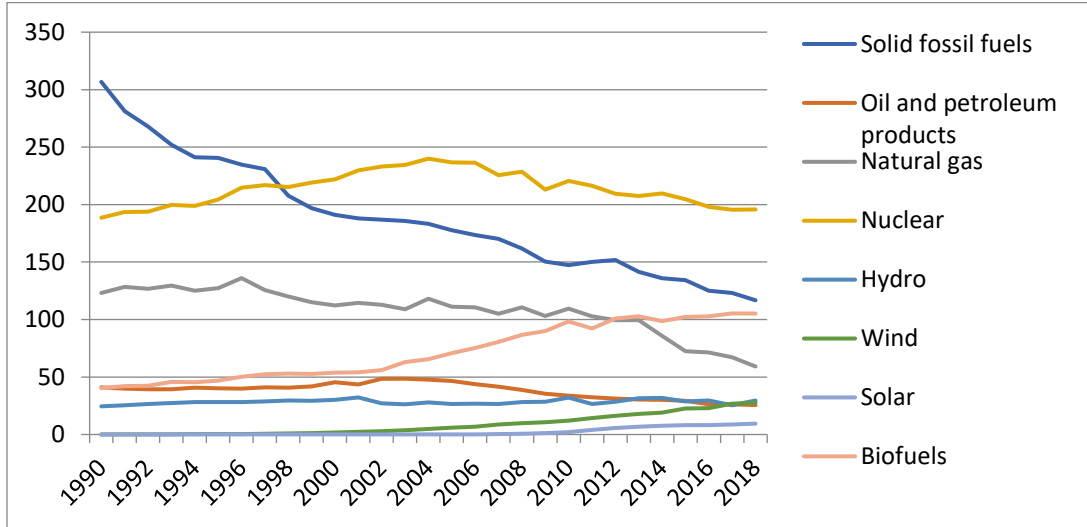
Both the incentives are expiring in 2020 but ITC is required by the industry to continue. Imported panel costs have fallen rapidly and are likely to offset the impact of existing tariffs by the end of 2019 (Deloitte) (2020). EIA forecasts that renewable energy will be the fastest-growing source of electricity generation in 2020. Thanks to the diminishing cost for investing and producing renewables, EIA expects the electric power sector will add 23.2 gigawatts (GW) of new wind capacity and 12.9 GW of utility-scale solar capacity in 2020.

36. PTC is a per-kilowatt-hour tax credit for electricity generated by qualified energy resources and sold by the taxpayer to an unrelated person during the taxable year (EIA, 2017)

37. ITC is one of the most important federal policy mechanisms to support the growth of solar energy in the United States (SEIA, 2020)

Not just in the US, but in many countries renewable energy is growing in term of production and consumption thanks to government policies; take into consideration the 27 members of EU:

Graph 6.4 EU energy production (1990-2018) (Thousand tons of oil equivalent)



Source: Author's elaboration on Eurostat data

Solar, wind and biofuels are increasing with the last mentioned growing exponentially, while natural gas and petroleum are decreasing. This situation in energy market depicts the tendency of EU members to search for renewable alternatives.

The fact is that renewable energy has become cheaper than any new electric capacity based on fossil fuels. This observation is confirmed by a report by IRENA published in 2020 and shows that more than half of the renewable energy added in 2019 achieved lower costs than the new cheaper coal plants. On average, new solar photovoltaics and onshore wind energy cost less than keeping many existing coal-fired power plants running and auction results show that this trend is accelerating, strengthening the possibility of phasing out coal. IRENA predicts that coal-fired power plants producing up to 1,200 GW of electricity to operate could cost more than the cost of new public solar PV in 2021. The report shows that replacing the more expensive 500 GW of coal with solar PV and onshore wind next year would reduce energy system costs by up to \$ 23 billion per year and reduce annual dioxide emissions. of carbon (CO₂) of about 1.8 gigatons, equal to 5% of global CO₂ emissions in 2019. It would also produce an investment stimulus of 940 billion dollars, equal to about 1% of global GDP.

The report notes that in the last 10 years the costs of renewable electricity have fallen sharply, driven by improved technologies, economies of scale, increasingly competitive supply chains and the growing experience of developers". Since 2010, large solar PV plants have had the strongest cost drop, 82%, followed by concentrated solar power at 47%, onshore wind at 39% and offshore wind at 29%. Recent auctions and power purchase agreements (PPAs) show that the downward trend continues even for new projects commissioned in 2020 and beyond. To Irena they say that

"Solar PV prices based on competitive procurement could reach an average of \$ 0.039 / kWh for projects commissioned in 2021, down 42% compared to 2019 and over a fifth less than the cheapest competitor of the fossil fuels, or coal-fired power plants ». Record auction prices are recorded for solar photovoltaics in Abu Dhabi and Dubai (United Arab Emirates), Chile, Ethiopia, Mexico, Peru and Saudi Arabia which confirm that even lower values of 0.03 dollars / kWh are already possible.

In Europe, the crisis has hastened the change towards a cleaner energy resource as we saw in graph 32 showing of production per year; Onshore wind and solar have become the cheapest new units of power generation for EU and most of the globe (Bloomberg, 2020). EU will for the next years is to invest and develop clean energy technologies and ensure the lowest costs possible also to reduce energy imports. Different instruments have been adopted by EU to promote renewable energy: feed-in tariffs (FiT); feed-in premiums (FiP), quota obligations, tax exemptions, tenders and investments aids. FiT work by guaranteeing continuous retail prices for renewable resources plant operators for a given period. The cost for FIT can be funded through tax revenues (the public budget), or be placed on market participants such as electricity suppliers or network operators and quantities are not subject to restrictions; FiP is different in the sense that plant operators have to distinguish and market the electricity generated directly at the electricity market and receive an additional payment on top of the electricity market. Quotas are governments fix quantities and the market decides price. The choice depends on the market instrument considered and to the specific conditions of each country since the supporting scheme is always in evolution; according to the European Commission, already in 2013, many instruments were adopted by country members for green economy:

Table 6.5 EU countries green policies

Country	Instrument
Austria	FiT, Subsidy
Belgium	Quota, Subsidy
Denmark	Loan, Premium tariff, Subsidy
Finland	Premium tariff, Subsidy
France	FiT, Tax regulation mechanism
Germany	FiT, Loan, Premium tariff
Italy	Quota system, Premium tariff, Tax regulation system
Netherlands	Loan, Premium tariff, Subsidy, Tax regulation
Slovenia	FiT, Loan, Premium tariff, Subsidy
Spain	FiT, Premium tariff, Tax regulation
Sweden	Quota system, Subsidy, Tax regulation system

Source: Author's elaboration on European Commission data

The first acts in terms of renewables were presented in 2009 with the Renewable Energy Directive (2009/28/EC) which set targets corresponding to a 20% share of energy from renewable energy sources (RES) in the final energy consumption in 2020 (temporal deadline). The 20% EU-wide target is allocated among the MS, with national targets ranging from 10% for Malta to 49% for Sweden. In October 2014, however, the European Council adopted the EU's 2030 Energy and Climate framework (EU)(2020) establishing a RES target of 27% at EU level by 2030 but no longer binding RES targets at the national level (then in the same year the target was modified and set to 32%). The RES Directive of 2009 intervenes with supporting policies for the transport sector which has to be sustainable using biofuel production.

On December 11th, 2019 the European Commission presented the “Green Deal” (EU) (2019), a plan signed by all EU member (except of Poland) with the aim of Propose a green and inclusive transition that will help improve people's well-being and a pass on a healthy planet to future generations. In 2050 EU's goal is to be a zero-climate impact entity, becoming the first continent to do so. The COVID situation created an important financial disease in markets consequent to a reduction of economic activity and a possible further reduction caused by another wave of the pandemic. This is not a fertile ground for the European Green Deal. Furthermore, public and private funds for policy, as well as EU GDP affected by COVID are, within the budget, an obstacle to action (CEPS, 2020). However, the treaty has been signed, and the plan includes possible carbon taxes for countries that do not reduce their greenhouse gas emissions and involves even a revision of the way renewables are taxed and closely examination of fossil fuel subsidies and tax exemptions (air transport, shipping).

The direction towards Europe is clear: make renewable energy become the most important energy source in the continent. An example of the result of the directives and incentives mentioned before is “HollandseKust Zuid”, one of the biggest offshore wind farm. It is located in the Netherlands, developed on the country coasts and has the capacity to power millions of homes. Investors have traditionally favored offshore wind farms not just because of their green profile, but also their steady flow of returns guaranteed by government subsidies; in fact some of the biggest oil producers in Europe look with interest in renewables and want to increase power production in that sector (Bloomberg, 2020).

Another example that involves the US is the “Revolution wind farm” which would generate electricity about 22 km from the shore of Martha's Vineyard Island, in Massachusetts. The project would have the capacity to generate 144 megawatts of wind power, or enough electricity to power 80,000 homes, and will be stored in large batteries built by Tesla (The Marsican Bear). The state of Massachusetts hopes to generate clean energy to meet its climate goals by cutting greenhouse gas emissions.

In the case of the use of biomass in Europe, the advantage is not just reducing emissions, in fact thanks to the European Emission Trading³⁸ which states that polluting plants can't work without allowance to emit greenhouse gas: the rights to pollute are "sold" through public auctions. This system favors a creation of prices for emissions quotas that investors can internalize in the managing of the plants. Quotas are defined according to the RES, and this mechanism represents an application of the Coase theorem³⁹ which states that if the parties can negotiate the allocation of resources without costs, the market it is able to solve the problem of externalities by allocating resources in an efficient way. The theorem is valid considering no costs of transaction and whatever the initial distribution of the rights, the parties in case may negotiate an agreement which the result is efficient for both. The theorem applied to renewables considers that a reduction of CO₂ emissions from the plant leads on the one side to purchase costs in terms of rights to pollute, but also the possibility, if the emissions are lower than those assigned, to sell the rights to pollute, allowing a company.

38. is a cornerstone of the EU's policy to combat climate change and its key tool for reducing greenhouse gas emissions cost-effectively, more info available at https://ec.europa.eu/clima/policies/ets_en

39. legal and economic theory developed by economist Ronald Coase, Nobel prize in 1991 in Economic Sciences , theory available at <https://www.law.uchicago.edu/files/file/coase-problem.pdf>

7. THE MODEL

All the information and data collected and explained in the previous chapters help to answer the question: how crude oil market is going to evolve in the next years. Central banks and private sector forecasters view the price of oil as one of the key variables in generating macroeconomic projections and in assessing macroeconomic risks (Federal Reserve, 2011). The determinants affecting crude oil market are multiple and the possible factors influencing the price in the immediate future are infinite; the data used and elaborated have been obtained from EIA database and S&P historical data from Yahoo Finance. In both cases the information is presented in the form of excel sheet containing the values of each determinant with the relative month/year observation. The time span starts from January 1990 to July 2020 with monthly frequency and the reason behind the choice of 1990 as starting year is in order to have a large enough population for testing and because it captures two very consistent fluctuations corresponding in years to 2008 and 2020. The spread sheets have been modified on excel respect to the originals downloaded in order to adapt them and make them more understandable in statistical terms.

All data obtained from EIA are referred to US economy, while from Yahoo Finance dataset is taken the S&P economic indicator that references to a global point of view. The reason for focusing on US case is that price evolution of its crude oil benchmark reflects the trend Brent and Dubai/Oman., so from its study a global view can be obtained.

To answer the question asked at the beginning of the chapter, the implement of a statistical model is helpful to make predictions and forecasts. A possible trend of the price evolution of WTI oil can be forecasted through the application of statistical instruments elaborated with R software program. R has a variety of commands and functions for statistical applications described in a pdf available on the R site with all details of how to use the software. From US data collected so far, the elements to consider in the model are: WTI oil production, stock oil inventories, futures prices on NYMEX, S&P price, GDP implicit price deflator⁴⁰ and renewables production (represented by biomass). The reason for choosing the determinants is based on the degree of correlation between each determinant and WTI price; moreover production, futures and oil reserves are an obligated choice to do when considering crude oil price forecast, while S&P indicator has been selected to understand the dynamics and relation between oil benchmark and global performance. GDP deflator is a measure of the level of prices of all new domestic goods and services in an economy and it has a degree of correlation with WTI benchmark. The last determinant considered is biomass production; it is important to investigate a possible correlation between WTI prices and renewable production in fact in the last years as described in chapter six by graph 6.4 renewables production are increasing and since they represent substitutes for crude oil in specific sectors, the correlation must be high.

There are two different approaches that can be followed when deciding which model to implement (Halleh Bostanchi, 2017) considering a forecast in the short term period: the first one consists in elaborating structural multivariable linear regression model by considering the vector of WTI prices obtained through the product of the matrix of determinants (composed by oil production, stock of inventories, futures prices, S&P index, GDP implicit price deflator and biomass). The second approach consists in managing the time series of WTI prices and fitting an ARIMA model using the Box Jenkins Approach (BJA). This kind of model uses auto-regression and moving averages of past events to predict future applying similarity in trends (California State University) (2017).

production) and the vector Beta of coefficients to be found, plus a vector of error terms. The equation representing the model is $Y = X\beta + \epsilon$;

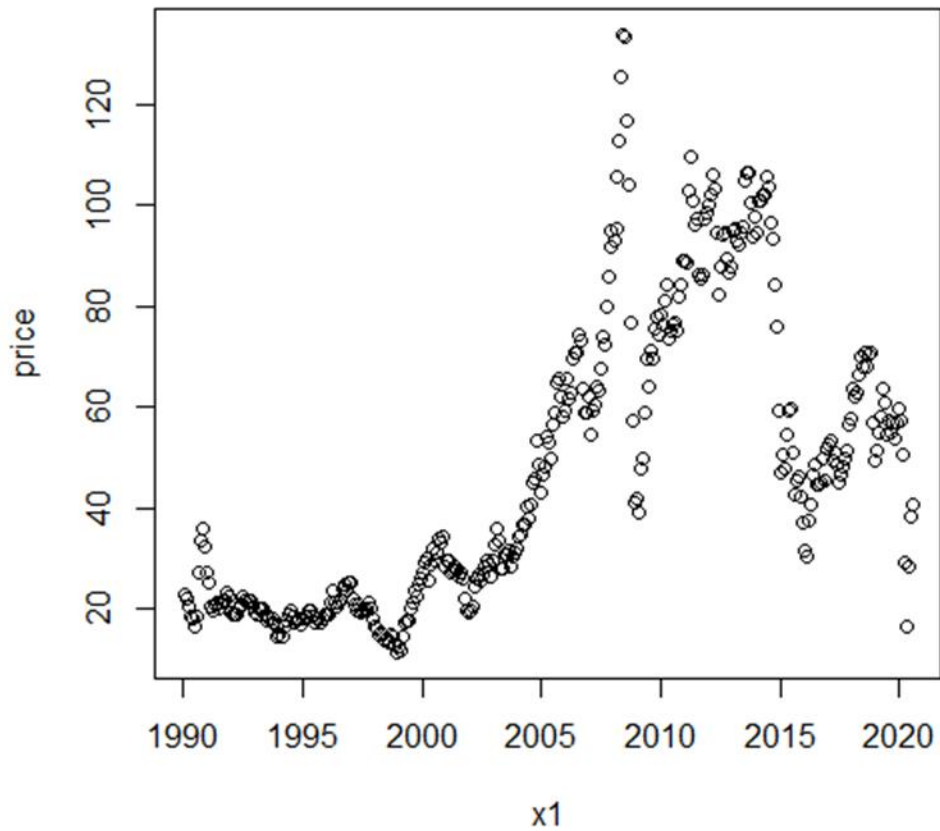
More precisely, this kind of model is mathematically composed by the vector Y of WTI prices in terms of dollars per barrel, by X which is a matrix elaborated through the creation of a further excel sheet containing a table with six columns representing the determinants and 367 rows representing the observations for each month of the timeline selected at the beginning. β is the regression coefficient vector we are looking for with 367x1 dimension that will be obtained through multiplication and division of vector/matrix with specific R commands. ϵ represents the error vector of the model and it is an unobservable error term which encompasses the sources of variability in Y that are not included in the vector of inputs X. By using this model we assume linearity but we assume also that ϵ has a multivariate normal distribution conditional on the input matrix meaning that the elements of the error vector are mutually independent and have constant variance (M. Taboga ,2017).

The second approach consists in managing time series which are series of data points indexed in time order. In the case of WTI prices, to get time series from the excel the data must be loaded and then using `ts()` R function we get time series to work with. Even in this case there are assumptions to be understood before entering in details: the approximating model representing the time series must present serial autocorrelation, heteroskedasticity in the errors, lagged dependent variables and trending regressors (A.Focacci, 2017). There are many model to be fitted for time series, and all of them are grouped in the Auto Regressive Integrated Moving Average (ARIMA) class. This kind of model uses auto-regression and moving averages of past events to predict future applying similarity in trends. ARIMA techniques are used to analyze time series data as crude oil prices because they have been mainly used for loading forecast due to its accuracy, mathematical soundness and flexible due to inclusion of AR and MA terms over a regression analysis (J.Jaya Selvi1 , R.Kaviya Shree , J.Krishnan, 2018). The procedure consisted in finding the parameters of the model to be decided and then perform on R the forecast computation. A deeper explanation of which approach to follow and what procedure to apply in order to obtain parameters is provided.

In this work the second option was considered more reliable since the structural approach is not able to fully capture periods of high volatility and in the case of crude oil price high volatility happens very often, as for example in 2009, and assumptions of the structural approach are too difficult to verify.

After selecting the approach to follow, the next step consists in analyzing graphically and mathematically the time series and the correlation between price and the other elements must be checked;

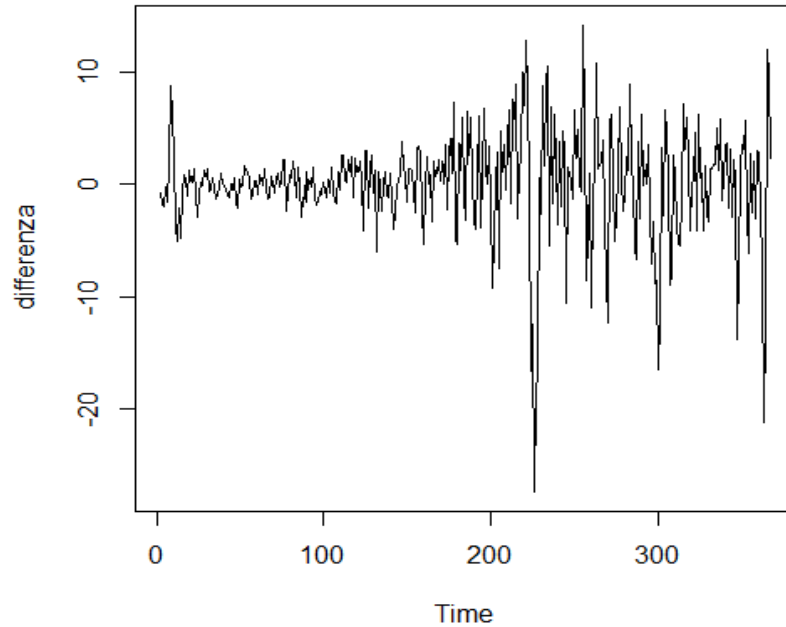
Graph 7.1 WTI price time series (Jan 1990-Jul 2020)



Source: Author's elaboration on EIA data

Graph 7.1 illustrates the features of the time series: it does not appear to be stationary since no constant mean is detected and it is characterized by high volatility in time. In the software R, to apply the Arima function three parameters must be known: p , d and q . The first one is the parameter referred to the AR component of an ARIMA, the second is referred to the degree of non-stationarity, it means that the d number represents the number of differentiations needed to make the time series stationary; the last one represents the MA parameter of the model. To find d , a first differentiation of WTI is needed, and if the result shows stationarity, then $d=1$.

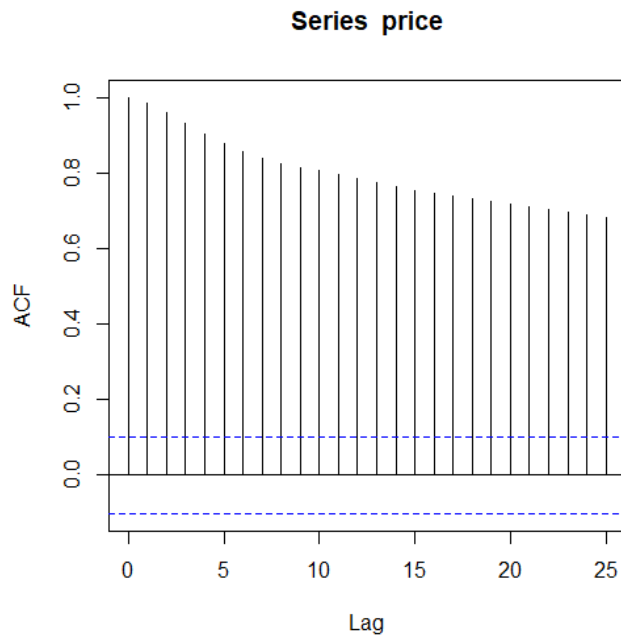
Graph 7.2 WTI time series differentiated



Source: Author's elaboration on EIA data

In this case the time series is stationary since constant mean approximated to zero is evident. Then we can assume WTI to be a Random Walk process. For p and q a further focus is needed, in particular on Autocorrelation (ACF) and Partial Autocorrelation functions (PACF) of the time series.

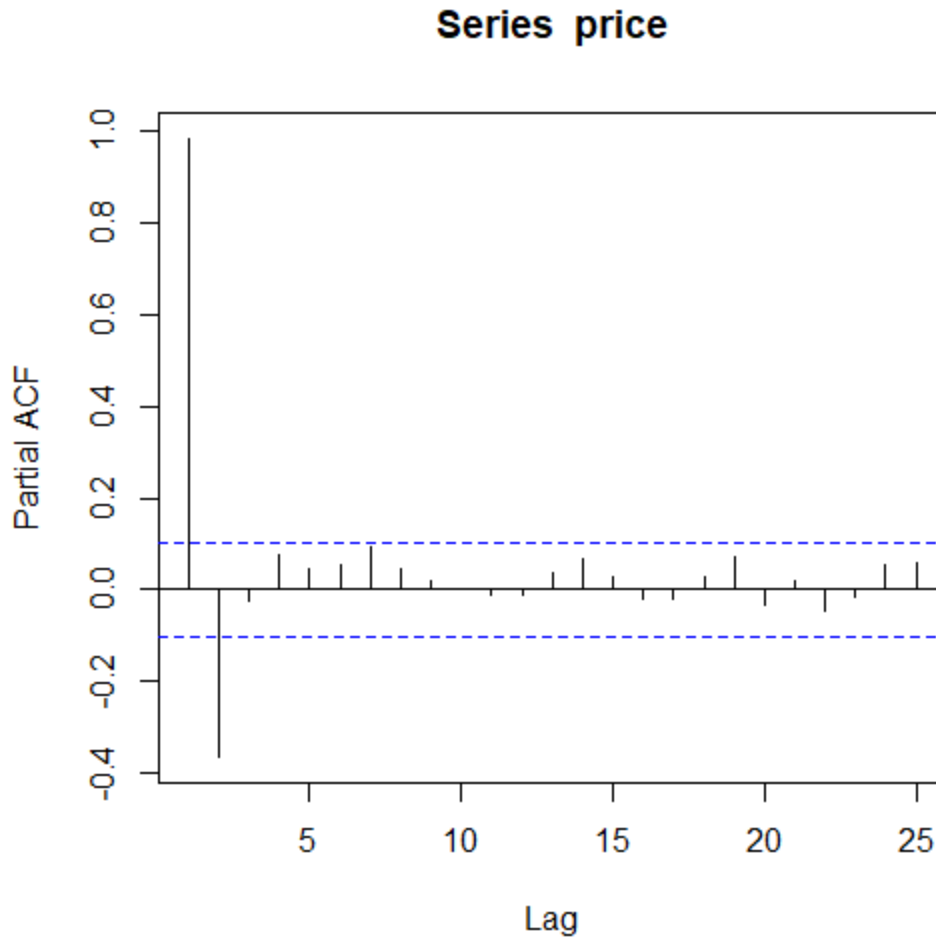
Graph 7.3 ACF of WTI prices



Source: Author's elaboration on EIA data

Graph 7.3 shows the typical behavior of a Random Walk (RW) process: the autocorrelation slowly decreases as lags increase. A RW is a random process, that describes a path that consists of a succession of random steps. The concept of autocorrelation is important to determine the nature of our model; Autocorrelation is the correlation between a variable lagged one or more periods and itself (J.Jaya Selvi , R.Kaviya Shree , J.Krishnan, 2018), it means that in the case of WTI prices, observation at time n has explanatory power in observation at time $n+1$, and the first lag of AC are almost corresponding to 1 which is the level of 100% correlation.

Graph 7.4 PACF of WTI prices

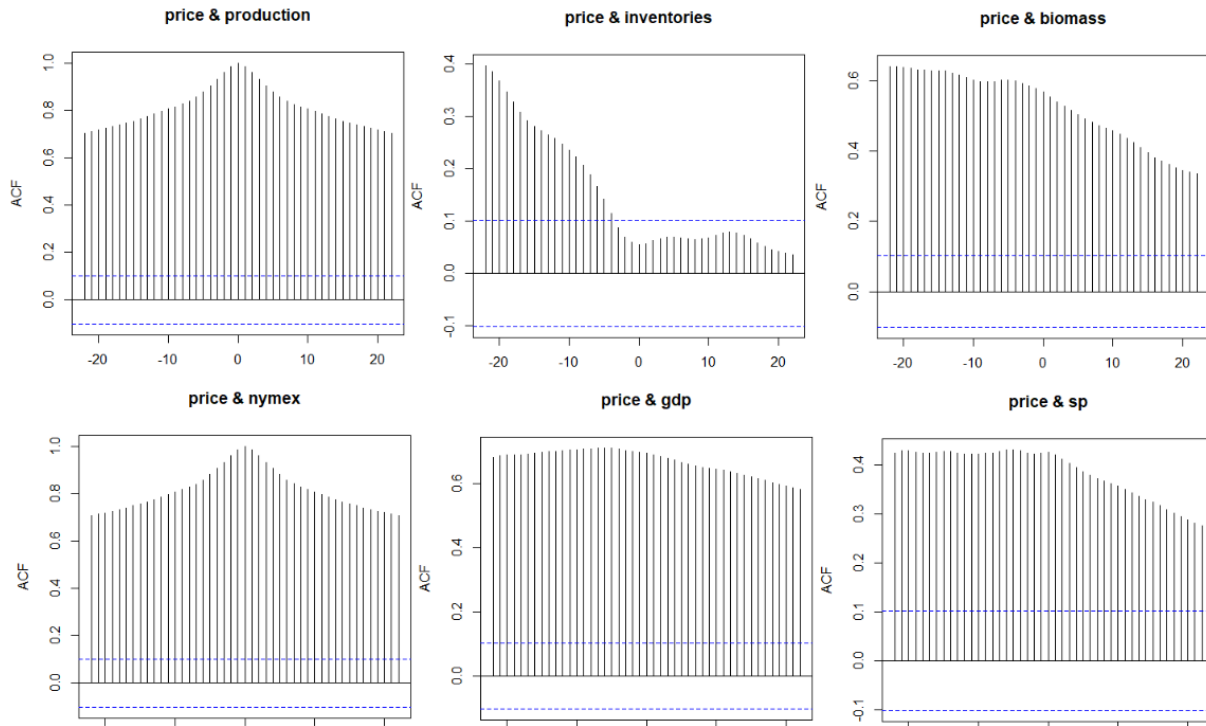


Source: Author's elaboration on EIA data

The PACF has two lags that exceed the blue threshold corresponding to the significance level under which lags are not relevant. Second lag can be considered important in the definition of the model but since it is not that far from the blue bounds it can be due to errors.

As last step before getting deep in the explanation of the model, to understand if the external factors identified before to be production of crude oil, oil stocks and so on have explanatory power on the prices, the cross correlation function on R is used for that purpose:

Graph 7.5 Cross-correlation of WTI price with other factors



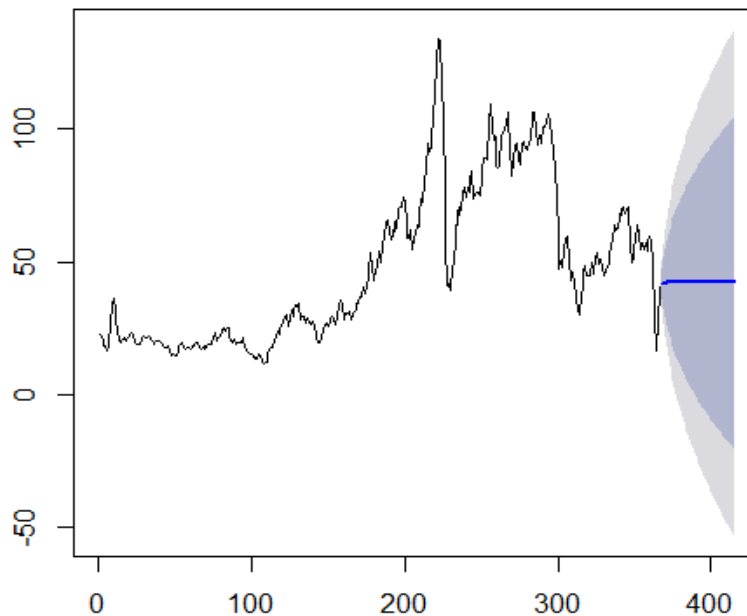
Source: Author's elaboration on EIA data

The graph explains the level of cross correlation between WTI price and all other factors; there is a high correlation for all the elements, even if for inventories is not significant after 20 lags. The most important result is the high correlation with production of biomass energy: this mean that renewable energy affects oil price movements.

Considering the information collected the parameters applied to the ARIMA are $p=1$, $d=1$ and $q=0$, then we get An ARIMA (1,1,0). Applying this result to the specific R function we get that the coefficient of regression is equal to 0.3797 with standard deviation of 0.0482 and the error term of the model represents the “uncertainty”. Using the “forecast” package provided by the software R, the model can predict the trend of WTI price selecting $h=48$ (numbers of observations to be predicted):

Graph 7.6 Forecast of WTI price

Forecasts from ARIMA(1,1,0)



Source: Author's elaboration on EIA data

The dark gray area represents the range of the possible fluctuations since the last observation, following the rules of a random walk. Of course, the model is very generic in the forecast and it reflects accurately the reality since the high volatility to which oil prices are subject. When implementing the model using Arima() function of R, there is an input to load called "xreg". It requires to input a vector or a matrix of external regressors that influence with a certain degree of correlation. In WTI case so far analyzed, the matrix previously loaded with 367x6 dimension was used for this purpose in order to look for a more accurate representation of reality.

The problem with this models is that it is impossible to considers all the possible outcomes since there is a high level of uncertainty as for example during the pandemic. Moreover, the regressors for crude oil forecast models too many and continuously changing: for example the case of an agreement not signed or an accident in an oil extraction site. This uncertainty makes it difficult to rely on econometrics models for price prediction

8. CONCLUSIONS

The final aim of this work is to answer the question: how the crude oil market will evolve in the next future. Starting from the result of the model, as afore mentioned, the high volatility is well represented. Too many uncertainty factors that can influence prices, productions, futures and so on. So far, determinants of the industry have been analyzed in detail but there are some other elements that can change forever the structure of the crude oil market. The most imminent event that can affect the evolution of prices is the US elections on 3 November 2020.

A possible win by Biden would compromise US oil companies, in fact the energy policy proposed by Biden is considered hostile or at least not clear by oil sector players, and a win by democratic party would lead to a turnaround towards energy transaction (Atlantic Council, 2020). Biden in his "Equitable Clean Energy Future" plan promises \$ 2 trillion of investments to reach the goal of "net zero carbon emissions" by 2050 (but already by 2035 for power plants). It is an ambitious plan since according to EIA data of 2019, wind and sun provide 9,2% of the energy consumed by the United States, while fossil fuels are 62,7%. Blatantly against Trump's trend to bolster fossil fuels - with the cancellation of pollution and emissions rules and the appointment of climate skeptics to positions of power - would be reversed. Renewable energy would find an acceleration. A new agreement with OPEC could be necessary. Moreover, less restrictive sanctions on Iran could trigger different scenarios in the crude oil market; Moreover, a deal with Iran would result in soaring Persian oil production, flooding the already oversupplied market (Financial Times, 2020).

Other factors that will influence is the progressive growth of renewable energy illustrated in chapter six. EU seems to be the leader international entity fostering the energy transaction process. This of course, will impact dropping the crude oil price and the conversion seems to be unstoppable due to the reduction in costs of renewables and due to their eco-friendly nature. There is a more sensibilization on the environmental theme by governments that respect to a decade ago, they see a possible economic advantage in investing in green energy and not only an etic issue. The green wave of responsible investment convinced big funds to sell 14 trillion dollars of fossil fuel-related stocks in less than a decade, renewables are rapidly gaining market share (BloombergNEF, 2020).

The OPEC forecast a positive progression in demand of crude oil in the next decades: the peak oil demand prediction by OPEC is 109.3 million barrels per day in 2040, from the 90.7 mbd estimated for 2020, which is weighed down by the effect of the pandemic, which is still holding back air transport and which for months has paralyzed road traffic and industrial activities in many countries (Il Sole 24 Ore, 2020). OPEC talks about a "peak" after which the prices will hopelessly decline, and this declaration is itself a warning.

JP Morgan is globally institute with the greatest exposure in the world to fossil fuels, and it decided to review its loan portfolio with the aim of aligning it with climate objectives over time. In February 2020, the institute had pledged not to grant new credit to companies that extract or use coal and had offered 200 billion dollars in funding for "green" activities (JP Morgan Chase, 2020) and the financial institution reiterated its commitment to creating a more sustainable future for its employees and the customers and communities that it serves.

According to Financial Times in 2020 many financial institutions have already made their contribution to the battle against climate change. Blackrock, global number one in asset management, has compiled a blacklist of around 250 companies guilty of neglecting the climate risk and has already punished 53 by voting against management in shareholders' meetings.

The main theme is if the global oil demand has reached its historical maximum. According to British Petroleum company, crude oil demand will face a declining demand, that's why it has announced a € 1 billion investment in two wind farms, acquiring 50% of the Norwegian company Equinor which builds these offshore wind farms in the United States. BP wants to multiply its wind capacity by twenty by 2030, rising from 2.5 to 50 gigawatts (The Guardian, 2020).

The devastating fires during September 2020 in California were considered by US government as another warning signal: on the technological front, the Californian emergency itself is pushing towards new solutions for the conservation of solar and wind energy in high-capacity battery networks, an answer to the problem of the cyclical nature of renewable sources (Wall Street Journal, 2020).

Among the scenarios created by the lockdowns, smart working enforced by companies for their workers is to be considered since in many countries is about to become permanent, perhaps in partial and alternating forms, but such as to reduce the consumption of fuels for commuting.

Many countries have interests in exploiting renewables: among them the most interested is China, whose long-term aim is to conquer world leadership in renewables. 70% of the solar panels are already made in China. Even in lithium for electric car batteries, as well as in other minerals and rare earths (Bloomberg, 2020).

In conclusion, the push towards renewables has started years ago and now is stronger than ever. A possible scenario for oil companies involves the hypothesis of converting the production as BP and other multinationals are doing since the whole world seems to go in the same directions. There is no certain date or time indication for renewables to overwhelm crude oil in the sectors where the latter is used, but according to international agreements and single country goals the time span is measured in decades. Crude oil price, for example the WTI benchmark used in this work will be subject to further fluctuation for unpredictable events and this situation is going to make life difficult for oil exporters in terms of cost of productions compared to reducing costs of renewables thanks to improving technology.

REFERENCES

WHO (2020), “Considerations in adjusting public health and social measures in the context of COVID-19”, available at <https://www.who.int/publications/i/item/considerations-in-adjusting-public-health-and-social-measures-in-the-context-of-covid-19-interim-guidance>, accessed April 16, 2020

World Bank (2020), “Global Economic Prospect”, available at <https://www.worldbank.org/en/publication/global-economic-prospects>, accessed June 2020

UNCTAD (2019), “Commodity-dependent countries urged to diversify exports”, available at <https://unctad.org/en/pages/newsdetails.aspx?OriginalVersionID=2058>, accessed April 16, 2019

World Bank (2020a), “April 2020 Commodity Market Outlook”, available at <https://www.worldbank.org/en/research/commodity-markets>, accessed April 2020

OECD (2020), “COVID-19 and the food and agriculture sector: Issues and policy responses”, available at <https://www.oecd.org/coronavirus/policy-responses/covid-19-and-the-food-and-agriculture-sector-issues-and-policy-responses-a23f764b/>, accessed April 29, 2020

USTR (2019), Section 301 Investigation Fact Sheet, available at <https://ustr.gov/about-us/policy-offices/press-office/fact-sheets/2018/june/section-301-investigation-fact-sheet>, accessed April 2020

USTR (2020), “Economic and trade agreement between the united states of America and the people’s republic of China”, available at <https://ustr.gov/countries-regions/china-mongolia-taiwan/peoples-republic-china/phase-one-trade-agreement/textaccessed>, accessed January 15, 2020

J.Holt, Journal of Business Inquiry (2009) , “A Summary of the Primary Causes of the Housing Bubble and the Resulting Credit Crisis: A Non-Technical Paper”, available at <http://www.uvu.edu/woodbury/jbi/articles>, accessed August 1, 2020

G.Paulin , BLS (2018) , “Housing and expenditures: before, during, and after the bubble”, available at <https://www.bls.gov/opub/btn/volume-7/housing-and-expenditures-before-during-and-after-the-bubble.htm> , accessed June 2020

S&P Global (2006) ,”Dow Jones US Selected Home Construction Index”, available at <https://www.spglobal.com/spdji/en/indices/equity/dow-jones-us-select-home-construction-index/#overview>, accessed September 2020

K.Kraus , New York Times (2008) “Commodity Prices Tumble”, available at <https://www.nytimes.com/2008/10/14/business/economy/14commodities.html>, accessed October 13, 2008

RJ. Caballero, E.Farhi, P.ouricnhas , Massachusetts Institute of Technology, Harvard University, University of California Berkley (2008) “Financial Crash, Commodity Prices, and Global Imbalances” available at <https://economics.mit.edu/files/12605>, accessed August 2020

Investopedia (2008), “The 2008 Financial Crisis and Its Effects on Gas and Oil”, available at <https://www.investopedia.com/ask/answers/052715/how-did-financial-crisis-affect-oil-and-gassector.asp>, accessed February 18, 2020

US Department of Commerce (2008) ,“ Guide for the Use of the International System of Units (SI)”, available at <http://physics.nist.gov/cuu/pdf/sp811.pdf> , accessed August 2020

Free Economic Data (2020), “World Pandemic Uncertainty Index”, available at <https://fred.stlouisfed.org/series/WUPI> accessed August 2020

Economic Policy Uncertainty (2020), “Economic Policy Uncertainty Index” available at <https://www.policyuncertainty.com/> accessed August 2020

M.Strauss-Khan, Atlantic Council (2020), “Can we compare the COVID-19 and 2008 crises?”, available at <https://www.atlanticcouncil.org/blogs/new-atlanticist/can-we-compare-the-covid-19-and-2008-crises/> accessed May 5, 2020

Borsaitaliana (2016), “Le radici dell’helicopter money”, available at <https://www.borsaitaliana.it/notizie/sotto-la-lente/helicopter-261.htm>, accessed May 26, 2019

IMF (2017), “Special Drawing Right (SDR) allocation”, available at <https://www.imf.org/external/np/exr/faq/sdrallocfaqs.htm>, accessed 28 July 2019

J.Kennon, The Balance (2020), “What is a commodity?”, available at <https://www.thebalance.com/what-are-commodities-356089>, accessed June 24, 2020

Australian Government Geoscience Australia (2013), “Australia’s mineral resource assessment 2013”, available at <https://www.ga.gov.au/data-pubs/data-and-publications-search/publications/australian-minerals-resource-assessment>, assessed September 2020

Department of mineral resources & energy (2020) ,“Overview”, available at http://www.energy.gov.za/files/coal_frame.html, accessed September 2020

EIA (2020), “Natural Gas Market Centers: A 2008 Update”, available at <https://www.eia.gov/maps/>, accessed April 2020

Institute of Energy Economics, Japan (IEEJ) (2017) by Hiroshi Hashimoto, “Japan’s pursuit of its own LNG hub”, available at <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKewjbraf9woHsAhUI9aQKHRanAeEQFjABegQIARAB&url=https%3A%2F%2Feneken.ieej.or.jp%2Fdata%2F7352.pdf&usq=AOvVaw0N1xqIQATAR9hBPOX2KMjUp>, accessed May 2017

The Times-Picayune (2019), “EnLink to buy Chevron pipelines in Louisiana, Texas for \$235 million”, available at https://www.nola.com/news/business/article_7f580d79-fe0a-51cf-8912-280f7b8b10bc.html, accessed July 19, 2019

Passalacqua (2020), “Arabica vs Robusta”, available at <https://www.passalacqua.com/arabica-vs-robusta> September 2020

CNBC (2018), “China bought 500,000 tons of U.S. soybeans. But that’s just a drop in the U.S. export bucket”, available at <https://www.cnn.com/2018/12/12/chinas-soybean-purchase-just-a-drop-in-the-us-export-bucket.html> accessed December 12, 2019

USGS (2019), “Copper Data Sheet” available at https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjEs52Y0IHsAhWIsKQKHbgFCjIQFjACegQIAxAB&url=https%3A%2F%2Fpubs.usgs.gov%2Fperiodicals%2Fmcs2020%2Fmcs2020-copper.pdf&usg=AOvVaw0QxzeAgU6aGdQ36_BooxE accessed September 2020

H.Sanderson, Financial Times (2015) by , “China breaks 6-year silence on gold reserves”, available at <https://www.ft.com/content/2c67f078-2c6d-11e5-8613-e7aedbb7bdb7> accessed July 17, 2015

S&P Global (2020), “Platts Dated Brent vs other Brents “,available at https://www.spglobal.com/platts/plattscontent/assets/files/en/our-methodology/methodology-specifications/pdb_faq.pdf accessed April 2020

CME Group (2020), “ Crude Oil Future Contracts Specs” , available at https://www.cmegroup.com/trading/energy/crude-oil/light-sweet-crude_contractSpecs_futures.html accessed September 2020

EIA (2014) , “Benchmark play an important role in pricing crude oil”, available at <https://www.eia.gov/todayinenergy/detail.php?id=18571> accessed October 28, 2014

Estonian Academy Publishers (2015), “About technical terms of oil shale and shale oil”, available at http://www.kirj.ee/public/oilshale_pdf/2015/issue_4/Oil_Shale-2015-4-291-292.pdf, accessed April 4, 2015

EIA (2020), “ Drilling Productivity Report”, available at https://www.eia.gov/petroleum/drilling/pdf/dpr-full.pdf_p.1 accessed September, 2020

EIA (2019), “How much shale (tight) oil is produced in the United States?”, available at <https://www.eia.gov/tools/faqs/faq.php?id=847&t=6> accessed September 2020

N.Cunningham, Oilprice.com (2020), “\$30 Oil Isn’t Good Enough For U.S. Shale”, available at <https://oilprice.com/Energy/Oil-Prices/30-Oil-Isnt-Good-Enough-For-US-Shale.html> accessed May 25, 2020

Rystad Energy (2020), “US bankruptcies and how to avoid them: The costs and benefits of saving E&Ps via royalty exemptions” available at <https://www.rystadenergy.com/newsevents/news/press-releases/us-bankruptcies-and-how-to-avoid-them-the-costs-and-benefits-of-saving-eps-via-royalty-exemptions/>, accessed May 20, 2020

S&P Global (2020), “S&P Global Platts Launches New Benchmark for US Crude: Platts American GulfCoast Select”, available at <http://press.spglobal.com/2020-06-25-S-P-Global-Platts-Launches-New-Benchmark-for-US-Crude-Platts-American-GulfCoast-Select>, accessed 25 June, 2020

OPEC (2012), “OPEC Statute” available at https://www.opec.org/opec_web/static_files_project/media/downloads/publications/OPEC_Statute.pdf, accessed September 2020

OPEC (2020), “OPEC Monthly Oil Market Report”, available at [https://www.opec.org/opec_web/static_files_project/media/downloads/publications/OPEC MOR_July_2020.pdf](https://www.opec.org/opec_web/static_files_project/media/downloads/publications/OPEC_MOR_July_2020.pdf), accessed July 14, 2020

Huffington Post (2012), “NOPEC (‘No Oil Producing and Exporting Cartels Act’): A Presidential Issue and a Test of Political Integrity”, available at https://www.huffpost.com/entry/nopec-no-oil-producing-an_b_1869803?guccounter=1&guce_referrer=aHR0cHM6Ly9lbi53aWtpcGVkaWEub3JnL3dpa2kvTm9fT2lsX1Byb2RlY2luZl9hbmRfRXhwb3J0aW5nX0NhcncRlbHNfQWN0&guce_referrer_sig=AQAAAIruYCOHGpxeMv-qEPsT9nomB5aekvxY0evIGCZDEFJmzKD7Uehg0xS4k5K965ve-dwbSSh2Ea6GLkK_buy9WQfLJ6S6vTRczGVyMryPL9MVR6w7wPx7rClc-xyKjNOqwPUVBICr3Wq46kjampKXZHLwiEvwWLFx9H7XWDEFakI4 accessed November 9, 2019

R.Perper and B.Bostock, Business Insider (2020) , “Oil is down 21% after its biggest drop in decades following Saudi price cuts that sparked a race to the bottom with Russia”, available at <https://www.businessinsider.com/oil-price-crash-market-drop-global-price-war-futures-coronavirus-2020-3?IR=T> accessed September 2020

L.Elliot, The Guardian (2014) “Stakes are high as US plays the oil card against Iran and Russia”, available at <https://www.theguardian.com/business/economics-blog/2014/nov/09/us-iran-russia-oil-prices-shale> accessed September 2020

ETEnergyWorld (2019), “OPEC and allies deepen oil cut to 2.1 million barrels per day starting 2020”, available at <https://energy.economictimes.indiatimes.com/news/oil-and-gas/opec-and-allies-deepen-oil-cut-to-2-1-million-barrels-per-day-starting-2020/72422663> accessed August 8, 2020

CNBC (2020) by Sam Meredith, “Oil drops as OPEC agrees on massive oil supply cut to offset virus impact; awaits Russia’s approval”, available at <https://www.cnbc.com/2020/03/05/opec-meets-to-decide-whether-to-cut-output-as-coronavirus-hits-demand.html>, accessed March 5, 2020

RadioFreeEurope (2020), “Ruble Tumbles, U.S. Shares Plunge After OPEC-Russia Deal Collapse”, available at <https://www.rferl.org/a/ruble-oil-prices-tumble-after-opec-deal-collapses-amid-coronavirus-fears/30476938.html>, accessed March 9, 2020

BBC (2020), “Markets start to bounce back after steep losses”, available at <https://www.bbc.com/news/business-51811972>, accessed March 10, 2020

J.Ambrose , The Guardian (2020), “Saudi Arabia steps up oil price war with big production increase”, available at <https://www.theguardian.com/world/2020/mar/11/saudi-arabia-oil-price-war-production-increase-aramco>, accessed March 11, 2020

S.Watkins, Oilprice.com (2020) , “The Sad Truth About the OPEC+ Production Cut”, available at <https://oilprice.com/Energy/Crude-Oil/The-Sad-Truth-About-The-OPEC-Production-Cut.html>, accessed April 13, 2020

David Sheppard and Anjali Raval, Financial Times (2020), “Oil prices hit lowest level in 17 years as demand plunges “, available at <https://www.ft.com/content/d63d0618-6928-11ea-800d-da70cff6e4d3> accessed March 18, 2020

RT (2020), “Russia says there is no oil price war with Saudi Arabia”, available at <https://www.rt.com/business/482916-putin-opec-falling-oil/>, accessed March 12, 2020

Reuters (2020) by Rania El Gamal, Olesya Astakhova, Alex Lawler, “Saudi, Russia agree oil cuts extension, raise pressure for compliance “, available at <https://www.reuters.com/article/us-oil-opec/saudi-russia-agree-oil-cuts-extension-raise-pressure-for-compliance-idUSKBN23A10U>, accessed June 3, 2020

HIS Markit (2020), “Sanctions against Iran: the long-term effects on international crude oil trades”, available at <https://ihsmarkit.com/research-analysis/sanctions-against-iran-the-longterm-effects-on-crude-oil-trades.html>, accessed March 30, 2020

OPEC (2019), “Annual Statistical Bulletin”, available at https://www.opec.org/opec_web/en/publications/202.htm, accessed March 2020

Congressional research Service (2020), “Oil Market Effects from U.S. Economic Sanctions: Iran, Russia, Venezuela”, available at https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwi0_cuTiYnsAhUHkxQKHanTDVIOFjAAegQIBRAB&url=https%3A%2F%2Ffas.org%2Fsgp%2Fcrs%2Frow%2FR46213.pdf&usg=AOvVaw1qgTvJNSXTrMoLR3xpaYJ0 , accessed February 5, 2020

BP (2019), “BP Statistical Review of World Energy”, available at <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwigjYXmj4rsAhXwAmMBHU30BmQQFjABegQIBhAB&url=https%3A%2F%2Fwww.bp.com%2Fcontent%2Fdam%2Fbp%2Fbusiness-sites%2Fen%2Fglobal%2Fcorporate%2Fpdfs%2Fenergy-economics%2Fstatistical-review%2Fbp-stats-review-2019-full-report.pdf&usg=AOvVaw2-4FHh1TLr436eLRPP9jn7> , accessed September 2020

BBC (2019), “Syria war: Who benefits from its oil production?”, available at <https://www.bbc.com/news/50464561>, accessed September 21, 2020

S.Gross and Tracy Alloway,, Bloomberg (2020) “Five Things You Need to Know to Start Your Day”, available at <https://www.bloomberg.com/news/newsletters/2020-08-20/five-things-you-need-to-know-to-start-your-day-ke3eu91f>, accessed August 20, 2020

Sheela Tobben , Bloomberg (2020), “China Readies for Record-Breaking U.S. Oil Haul in September”, available at <https://www.bloomberg.com/news/articles/2020-08-20/china-gears-up-for-record-breaking-u-s-crude-haul-in-september?srnd=premium-asia&sref=gktCD7qq>, accessed August 20, 2020

Yahoo Finance (2020), “China Readies for Record-Breaking U.S. Oil Haul in September” <https://uk.finance.yahoo.com/news/china-gears-record-breaking-u-203320318.html> accessed 2020

EIA (2020), “Renewable energy explained”, available at <https://www.eia.gov/energyexplained/renewable-sources/>, accessed April 2020

EIA (2020), “Biomass explained”, available at <https://www.eia.gov/energyexplained/biomass/>, accessed April 2020

IRENA (2020), “ Renewable energy and jobs Annual review 2020” , available at https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Sep/IRENA_RE_Jobs_2020.pdf accessed September 2020

IRENA (2019)” Renewable capacity statistics 2019”, available at <https://irena.org/publications/2019/Mar/Renewable-Capacity-Statistics-2019> accessed September 2020

Deloitte (2020), “2020 renewable energy industry outlook”, available at <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/energy-resources/us-2020-renewable-energy-midyear-outlook.pdf>, accessed September 2020

EUROSTAT (2020),” Energy Statistics”, available at https://ec.europa.eu/eurostat/databrowser/view/nrg_bal_s/default/table?lang=en, accessed June 15, 2020

IRENA (2020), “ Renewable power generation costs in 2019” , available at [https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jun/IRENA Power Generation Costs 2019.pdf](https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jun/IRENA_Power_Generation_Costs_2019.pdf), accessed September 2020

Bloomberg (2020), “Solar, Wind, and Batteries Are All Grown Up”, available at <https://www.bloomberg.com/news/articles/2020-08-20/solar-wind-and-battery-cleantech-are-now-mainstream-investments?srnd=green-energy-science>, accessed August 2020

European Commission (2013), “European commission guidance for the design of renewables support schemes”, available at https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiOvtHH9pPsAhUlxIUKHbXDA3oQFjAAegQIARAC&url=https%3A%2F%2Fec.europa.eu%2Fenergy%2Fsites%2Fener%2Ffiles%2Fdocuments%2Fcom_2013_public_intervention_swd04_en.pdf&usg=AOvVaw1b4DbBkGGv7LQmnnIVoxb6, accessed July 2020

EUR-lex (2009), “Directive 2009/28/ec of the european parliament and of the council”, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0028&from=EN>, accessed July 2020

EU (2019), “The European Green Deal”, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019DC0640&from=EN>, accessed December 11, 2019

EU (2020), “2030 climate & energy framework” https://ec.europa.eu/clima/policies/strategies/2030_en accessed September, 2020

CEPS (2020),”The European Green Deal after Corona”, available at <https://www.ceps.eu/ceps-publications/the-european-green-deal-after-corona/>, accessed March 31, 2020

Bloomberg (2020) by Will Mathis, “A Stake in One of the World’s Biggest Offshore Wind Farms Is Going Up for Sale”, available at <https://www.bloomberg.com/news/articles/2020-08-21/vattenfall-to-sell-stake-in-giant-dutch-offshore-wind-farm> accessed September 2020

The Marsican Bear (2017), “Revolution Wind Farm il più grande progetto al mondo che comprende parco eolico offshore e sistema di accumulo elettrico “, available at <https://www.themarsicanbear.com/2017/10/09/1305/>, accessed October 9, 2020

R.Coase (1960), “The problem of social cost”, available at <https://www.law.uchicago.edu/files/file/coase-problem.pdf> accessed September 2020

Rome University “Tor Vergata” (2011), available at <http://www.scienze.uniroma2.it/wp-content/uploads/2010/11/Esternalit%C3%A0.pdf> , accessed September 2020

Bureau of Economic Analysis (2020), “GDP Price Deflator”, available at <https://www.bea.gov/data/prices-inflation/gdp-price-deflator#:~:text=The%20gross%20domestic%20product%20implicit,Prices%20of%20imports%20are%20excluded> accessed October, 2020

Halleh Bostanchi, California state university 2017, “ WTI oil price prediction modelling and forecasting” available at http://dspace.calstate.edu/bitstream/handle/10211.3/199548/BostanchiHalleh_Project2017.pdf?sequence=4 accessed August 2020

A. Focacci (2017), University of Bologna, “Trusting in econometric tools? a multibreakpoint analysis of crude oil prices”, available at https://siecon3-607788.c.cdn77.org/sites/siecon.org/files/media_wysiwyg/focacci-5_0.pdf accessed October 2020

M.Taboga,(2017). “Linear regression models” available at <https://www.statlect.com/fundamentals-of-statistics/linear-regression> accessed October 2020

J.Jaya Selvi , R.Kaviya Shree , J.Krishnan (2018), “Forecasting Crude Oil Price Using ARIMA Models”, available at http://www.ijarse.com/images/fullpdf/1522053404_NIMT185ijarse.pdf accessed October 2020

Derek Brower, Financial Times (2020), “Oil market has not priced in prospect of a Biden victory” available at <https://www.ft.com/content/0d6d0fbf-93b5-4f01-a6c8-f2d8ca95dc4a> accessed October 2020

D.Godwyn and A.Clabough Council (2020), “Election 2020: What’s at Stake for Energy?” available at <https://www.atlanticcouncil.org/wp-content/uploads/2020/01/Election-2020-final-web-version.pdf> accessed October 2020

J.Ambrose, The Guardian (2020), “BP takes \$1.1bn stake in offshore wind farms as it agrees Equinor deal” available at <https://www.theguardian.com/business/2020/sep/10/bp-takes-11bn-stake-in-offshore-wind-farms-as-it-agrees-equinor-deal> accessed October 2020

Wall Street Journal (2020), “L'onda verde travolge il petrolio in Borsa: i titoli delle major bruciano 700 mld dal 2019”, available at <https://www.wsj.com/articles/californias-wildfire-power-eclipse-11599864717> accessed October 2020

EIA (2019), “What is U.S. electricity generation by energy source?” available at <https://www.eia.gov/tools/faqs/faq.php?id=427&t=3> accessed October 2020

D.Brower, Financial Times (2020), “Biden gambles on placing climate change at heart of US energy policy” available at <https://www.ft.com/content/2ac477e7-34a4-4c0e-b9f4-018cef47d67d> accessed October 2020

BloombergNEF (2020), “Global trends in renewable energy investment 2020”, available at https://www.fs-unep-centre.org/wp-content/uploads/2020/06/GTR_2020.pdf accessed October 2020

JP Morgan Chase (2020) ,“ JPMorgan Chase Issues \$1 Billion Inaugural Green Bonds”, available at <https://www.jpmorganchase.com/ir/news/2020/inaugural-green-bonds-091620> accessed October 2020

A. Mooney, Financial Times (2020),” BlackRock punishes 53 companies over climate inaction “available at <https://www.ft.com/content/8809032d-47a1-47c3-ae88-ef3c182134c0> accessed October 2020

Yahoo Finance (2020), “The transition to renewables has been underway for some time, but is preparing to accelerate rapidly also for purely economic reasons. Three 30-year scenarios for oil & gas”, available at <https://it.finance.yahoo.com/notizie/schroders-petrolio-verso-un-declino-093020222.html?guccounter=1> accessed October 2020

Bloomberg, (2020) “ The Solar-Powered Future Is Being Assembled in China”, available at <https://www.bloomberg.com/features/2020-china-solar-giant-longi/> accessed October 2020

