ENERGETIC CORPORATIONS FACING PANDEMIC EFFECTS

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INTRODUCTION

The COVID-19 pandemic in early 2020 had a profound impact on global economy, and big energy corporations were no exception. Traditionally known for stability, energetic companies witnessed a unique confluence of demand shocks and supply gluts, creating a volatile market environment. This drop in demand, coupled with disruptions in the supply chain, has forced major energy corporations to reassess their strategies and adapt to a rapidly changing market:

1. Decreased Demand for Energy and Oil: The lockdowns and travel restrictions implemented to prevent virus spreading led to a sharp decline in economic activities all over the world. While businesses were closing and people were restricted from going out, demand for energy, as well as oil, collapsed.
2. Capital Expenditure Cuts: Because of decreasing demand for energy and oil, a lot of big energetic corporations undertook substantial cuts in capital expenditure. These cuts consisted of exploration and production projects, resulted in a reduced growth outlook. Investors' reaction to this was selling off shares, contributing to the declining stock prices.
3. Financial Strain and Debt Concerns: Declining revenues, linked with high levels of debts, were pressuring concerns about financial stability. Investors tended to react negatively to such uncertainties, subsequently impacting stock prices.

DATA

To analyze the effects of pandemic in the energetic market, it is necessary to consider some corporations from different countries. Although COVID-19 has hit the whole globe, the effect has been different for each country. Consequently, it can be interesting to observe the different "strength" of pandemic on TNCs.

Hence, in this part it will be briefly illustrated which are the corporations involved and where data about these TNCs are collected.

1.1 ENERGETIC CORPORATIONS

BRITISH PETROLEUM

British Petroleum, commonly known as BP, is a multinational oil and gas company headquartered in London, United Kingdom. Being one of the world's largest oil and gas companies, BP operates in over 70 countries and in all areas of oil and gas industry, including exploration, production, refining, distribution, and marketing. BP has set ambitious goals to reduce carbon emissions in its operations. The company aims to become net-zero by 2050 or sooner and is actively working on reducing emissions from its oil and gas production, refining, and other operations. BP is also exploring innovative technologies, such as carbon capture and storage, to further reduce its carbon footprint.

ROYAL DUTCH SHELL

Royal Dutch Shell, commonly known as Shell, is a multinational energy company headquartered in The Hague, Netherlands. As BP, it also operates in various segments of the energy industry, including exploration, production, refining, and marketing of oil and gas products as well as production of chemicals and renewable energy sources. In addition to that, Shell has embraced digital technology to improve operational efficiency and drive innovation. The company has implemented advanced data analytics and machine learning algorithms to optimize its processes, reduce costs, and enhance safety measures. This digital transformation has allowed Shell to adapt to changing market conditions and improve overall performance.

EXXONMOBIL

ExxonMobil, known as XOM is one of the largest publicly traded international oil and gas companies with the headquarter in Irving, Texas, United States. With operations in nearly 60 countries, ExxonMobil has also a diverse portfolio that spans exploration, production, refining, and the marketing of petroleum products. ExxonMobil is not just an oil and gas company. They also have a significant presence in the petrochemical industry, producing various chemicals used in everyday products like plastics, fertilizers, and synthetic fibers. ExxonMobil has made significant contributions to education and supports various STEM (Science, Technology, Engineering, and Mathematics) initiatives around the world, aiming to inspire and educate the next generation of scientists and engineers.

ENI

Eni, short for Ente Nazionale Idrocarburi, is an Italian multinational energy company headquartered in Rome, Italy. The company has a diverse portfolio, with activities in conventional and unconventional oil and gas resources, as well as in renewable energy sources such as solar, wind, and biofuels. Eni is committed to transitioning to a low-carbon future and reducing its environmental impact. Eni is known for its technological expertise and innovation in the energy industry. They have pioneered several breakthroughs, including the development of proprietary technologies for offshore drilling and extraction, as well as advancements in clean energy solutions. Eni has made significant strides in the field of circular economy. They have developed innovative processes to convert waste materials into valuable products, such as turning agricultural residues into biofuels or transforming industrial waste into raw materials for other industries.

1.2 DATASET

Data involved in this analysis are collected from *Yahoo Finance*, a part of the "*Yahoo!"* network mainly focused in business area. Indeed, *Yahoo Finance* offers the possibility for any user to observe simultaneous and historical values of firms and corporations on the stock market.

Before concentrating on stocks' value, the first step is related to the download of two useful tools: *Pandas* for manipulating actions and *Numpy* as mathematical library to create matrices and arrays. Beside these two necessary instruments, *Yahoo Finance* is imported, linking the website from which data is collected and the Python do-file on which the analysis is implemented. Moreover, given the fact that historical data are involved, date is imported from datetime, to express more easily date format.

In the following line of the code are expressed the tickers (i.e. how companies' shares are called in the stock market): SHEL, BP, E, XOM standing for Dutch Shell, BP corporation, ENI and Exxon respectively. After having listed the tickers, time dimension must be defined. As a result, in the 7th line start and end

dates are explicated: data imported from *Yahoo Finance* will cover a 5-year period from 2018/01/01 (American date format) to 2023/11/20.

Once that tickers and datetime are identified, it is possible to download data from the financial website. Lastly, to highlight just the value of stocks at the closing market, data collected at the end of each day (data.Close) are renamed as data (hence simplifying the lecture of the following code).

```
In [1]: #Shell #Eni #Exxon #BP
        import pandas as pd
        import numpy as np
        import yfinance as yf

In [4]: from datetime import date

In [5]: tickers = ['SHEL','BP','E','XOM']

In [7]: start, end = date(2018,1,1), date.today()

In [8]: data = yf.download(tickers, start, end)
        [**********100%%**********]  4 of 4 completed

In [10]: data = data.Close
```

FIGURE 1: CODE TO IMPORT THE DATASET

GRAPHS

HISTORICAL DATA

Once the data has been downloaded, it can be helpful to observe a general overview about oil companies' stocks value trend. Indeed, in the following graph, through the instruction "*.plot()*", historical data in the considered period are displayed.

```
In [11]: data.plot()
Out[11]: <Axes: xlabel='Date'>
```

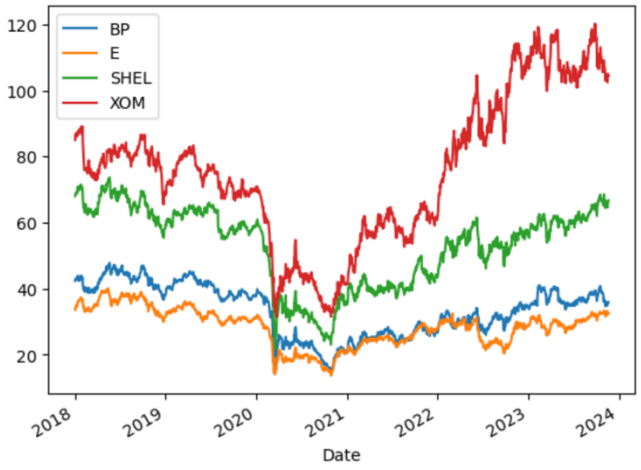

FIGURE 1: ENERGETIC CORPORATIONS IN THE STOCK MARKET

As it can be perceived, on the horizontal axis the considered period is reported also including a forecasted year (2024). On the vertical axis, the value of the stock is displayed. Graphically it can be stated that all four corporations have a quite similar trend. The only difference among them is the actual value of their

stocks. The orange line representing the ENI shares and the blue line illustrating BP have a lower value with respect to Shell (in green) and Exxon (in blue).

Globally observing their trends, it can be argued that they seem to comove. Indeed, by focusing on the first months of 2018, it can be noticed that a slight decrease hit all oil companies. Nevertheless, the most shocking decline appears in March/April 2020, when the pandemic began to spread across the whole globe. Sharpest plunge can be observed in Exxon share's price reducing to 40, and in Shell's one reaching a bottom point around 20. After a small period of recovery, once again, at the end of 2020 another downturn appears. Despite what happened before, the decrease is less evident but still significant. Improvements starting from 2021 illustrate the reprise of the whole economy. Indeed, considering the long run, from 2021 the trend involving these shares begin to grow, once again underlying the reaction of all sectors in response to a "ghost" period that stopped all productive activities. Last but not least, considering the starting point in 2018 and the most recent, it is possible to argue that apart from Exxon, the other energetic companies almost go approximately their initial value. Exxon instead, by overtaking its past values, reaches peaks of 110/120 per share.

VOLATILITY

However, what really matters in finance and stock market is the share's volatility. Indeed, the volatily is an important financial tool that measures the dispersion of each return from its average, indicating somehow how much risky is a stock. It is measured by the standard deviation:

$$\sigma = \sqrt{\frac{\sum(X_i - \bar{X})^2}{N}}$$

A higher standard deviation indicates higher volatility, suggesting that the stock's returns can vary widely from its average return. On the other hand, a lower standard deviation implies lower volatility and a more stable performance.

Considering the following graph, it is depicted the volatility of the stock's price movements of the oil companies over the considered period from 2018 to 2023.

```
In [13]: data.pct_change().plot(subplots=True);
```

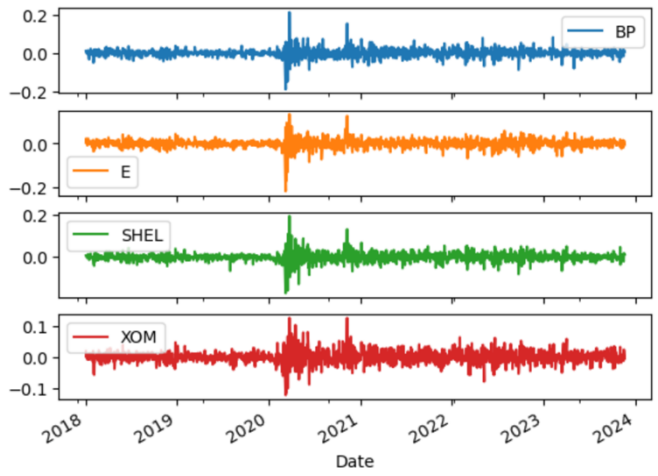

FIGURE 3: STANDAR DEVIATION OF THE STOCKS

As it can be noticed, differentiating from the previous graph, in this case each stock is taken individually. The main reason is to enable the reader to concentrate on single share's volatility, keeping a global view. Moreover, the scale is different for any share: BP ranges [-0.2, 0.2], Eni [-0.2, ≈0.05], Shell [≈-0.05, 0.2] and Exxon [-0.1, 0.1]. Thanks to this division, it is possible to state that lower volatility has persisted for each share until March/April 2020. Indeed, as it can be perceived, each oil company has faced an uncertain period, that financially has been interpreted has higher volatility, both negative and positive. Another peak can be observed at the end of 2021. From 2021 on, the volatility has become lower for each company, with still some deviations (more than in the period from 2018 to January 2020). Nevertheless, apart from those two higher deviations, oil companies' shares remain a "safe" investment, given the fact that their volatility do not spread widely, even in the darkest period of the last 5 years.

Now that volatility has been introduced, the further step is related to log returns, frequently employed in financial decisions while creating a portfolio.

LOG RETURNS

INTRODUCTION TO LOG RETURNS

In financial analysis, the choice between log returns and simple returns is a critical consideration that significantly influences the interpretation of investment performance. Simple returns, providing a straightforward percentage change based on price differences, are intuitive and widely used. On the other hand, log returns offer a logarithmic perspective, addressing the compounding effect and enabling additive calculations over multiple periods. This introduction explores the distinctive characteristics of both log and simple returns, shedding light on their implications for assessing financial market dynamics, risk, and the accurate representation of investment growth or decline over time. In general, a return is a change in price of an asset relative to its previous value defined by:

$$r_t = \frac{p_t - p_{t-1}}{p_{t-1}}.$$

However, the sum of returns over multiple periods does not give the overall return for those periods, unless the compositional effect is considered. Logarithmic returns are given by:

$$r_t = \ln\left(\frac{P_t}{P_{t-1}}\right)$$

The main difference is that logarithmic returns are additive over multiple periods. The sum of logarithmic returns over multiple periods provides the overall return for those periods.

Highlighting the distinction between simple returns and log returns is essential in understanding their unique characteristics in financial analysis. While simple returns offer an intuitive percentage change based on price differences, log returns provide a logarithmic perspective, enabling additive calculations over multiple periods. Unlike simple returns, log returns account for the compounding effect, making them particularly valuable in modeling and analyzing financial time series data.

LOG RETURN'S CODE

To calculate log returns, we have to insert the following codes:

- *`data['Price'].shift(1)`* which states the returns of prices from the previous period, creating a series of prices lagged by one period;
- *`data['Price'] / data['Price'].shift(1)`* that calculates the ratio between current and previous prices, representing the relative return between periods;
- *`np.log(...)`* that computes the natural logarithm of this ratio, obtaining the log returns.

The further step is the cumulative sum of log returns obtained by the command *`rets.cumsum()`* which calculates the cumulative sum of log returns up to that point in time.

To display graphically the log return, through *`.plot(subplots=True)`* the results are plotted.
The option *`subplots=True`* indicates creating a separate plot for each company.

In general, the resulting plot will show how log returns accumulate over time. If the plot is increasing, it indicates positive returns, while a decreasing trend indicates negative returns. The use of log returns is valuable when analyzing financial returns over multiple periods, as log returns handle the compounding effect more accurately.

GRAPH OF LOG RETURNS

```
In [14]: rets = np.log(data / data.shift(1))

In [15]: rets.cumsum().plot(subplots=True)

Out[15]: array([<Axes: xlabel='Date'>, <Axes: xlabel='Date'>,
                <Axes: xlabel='Date'>, <Axes: xlabel='Date'>], dtype=object)
```

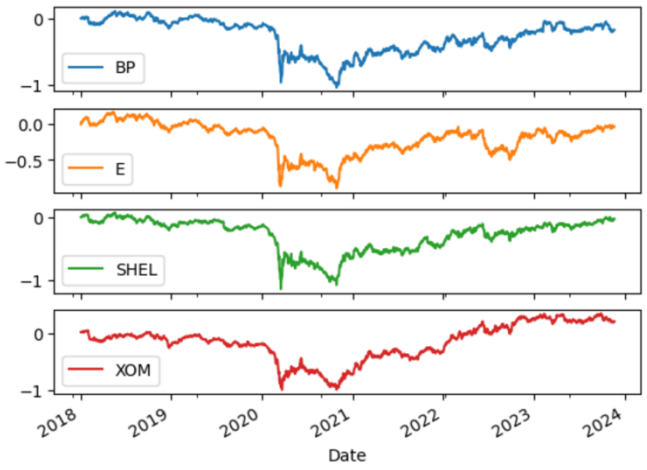

FIGURE 4: LOG RETURNS ON THE STOCK'S PRICE

From the graphs above, it appears that, in the last few years, the four energy companies have followed a similar trend path. On the horizontal axis are represented years, while on the vertical axis logarithmic changes. According to the stock exchange variations, three different phases can be distinguished:

1) The data indicates that, from 2018 to the beginning of the pandemic (February 2020), a stable economy described by a constant trend.

2) It is notable that, from the arrival of the pandemic to the end of the year, there were two shocks and a severe downturn in the economy.
3) The analysis suggests that, from 2022 to 2023 there was an economic recovery (characterized by a relatively small downturn in the middle of 2022 due to the energy crisis) and a growth forecast for 2024.

Focusing on Eni, it can be observed that: the log scale reaches 0,5 instead of 1 like for the other companies. Hence, the stock market plunge due to COVID-19 must be considered as less steep; in the same way, the downturn caused by the energy crisis, which appears stronger for Eni than others, is in truth at their same level.

CONCLUSION

To sum up, it has been illustrated through the stock's prices analysis that COVID 19 pandemic significantly impacted the whole economy and the energy corporations as well.
During the pandemic stock's prices fell down and the associated volatility rapidly increased. As a result, log returns have shown negative variations from 2020 to 2021.
Nevertheless, the energy companies taken into account demonstrate stability because of their soundness. Indeed, from 2021 both graphs about stock prices and log returns illustrate a growing trend towards their values before the pandemic. Positive forecasts are expected for following periods as a consequence of the economic recovery.