Vol.18 Iss.1 pp.1-6 International Journal of Scientific Research & Engineering Technology (IJSET)

Covid-19 and oil prices

Boumediene SOUIKI
Faculté d'economie Universite de Montpellier
Lab MRE en cotutelle
Faculté d'économie Université de Tlemcen
Lab POLDEVA
Email: souiki.boumediene@gmail.com

Françoise SEYTE
Faculté d'économie
Lab MRE Université de Montpellier
Email: francoise.seyte@umontpellier.fr

Mostefa BELMOKADDEM
Faculté d'économie
Lab POLDEVA Université de Tlemcen
Email:belmo_mus@yahoo.fr

***Abstract*—This paper aims to establish the different scenarios of the evolution of the oil prices in the context of a global pandemic due to the Covid-19. Our analyses are based on the findings of the CIDRAP group at the University of Minnesota, who have developed different scenarios of the evolution of the pandemic, under the hypothesis of the absence of a cure and/or a vaccine, and on the other hand, on a non-linear econometric approach that is likely to capture the irregularities observed in the oil prices trajectory.**

RÉSUMÉ

Cet article a pour objectif d'établir les différents scénarios de l'évolution du prix de pétrole dans un contexte d'une pandémie mondiale due au virus Covid-19. Pour mener ce travail, on se basera d'un côté, sur les travaux de l'équipe de CIDRAP de l'université de Minnesota qui a élaboré différents scénarios de l'évolution de la pandémie, sous l'hypothèse d'absence d'un remède et/ou d'un vaccin, et de l'autre coté, d'une approche économétrique non linéaire susceptible de capter les irrégularités observées sur la trajectoire du prix de pétrole.

Mots Clés— Prix du pétrole, Covid-19, Scénarios, Modèle NeTAR.

I. INTRODUCTION

At the dawn of the 21st century and particularly because of ecological constraints and imperatives, dependence on oil and its demand remains a major concern. This commodity we deal with everyday is still important in several sectors. In fact, it remains the principal source of energy for our transport. It is also used in the production of other energies. It is present almost everywhere in industry via plastic derivatives, and it is necessary for industrial chemistry, and even for construction (bitumen for roads and roofing tar ... and so on). The pricing of oil is a complex interaction between physical and financial fundamentals. Oil price trajectory analysis shows that its structure has experienced large variations over several periods and that high volatility is linked with significant structural transformations or major geopolitical shocks. Indeed, 2020 will be remembered as the year of the pandemic that brought the entire world to its knees and caused recession in the world' s economies. Indeed, on December 31, 2019, the Chinese authorities reported SARS-CoV-2 disease to the World Health Organization (WHO) for the first time. To deal with this situation, several countries decided to impose nationwide lockdown. By May 18, 2020, the virus had infected more than 47,10614 people and caused more than 315,000 deaths worldwide. Under these circumstances and following a trade conflict between Saudi Arabia and Russia and the advent of a global health crisis, the oil price has experienced an unprecedented collapse. The impact of this virus is well illustrated by the example of the WTI price in the United States, which experienced negative prices for the first time in its history. This unprecedented situation, as well as the fragility of the economic equilibrium of some rentier countries, realized the need to understand and control oil price fluctuations, trends and its impacts on the oil price trajectory. Many publications examine the issue of how price variations are identified in response to demand or supply shocks in the oil market.

These studies include Kilian and Park (2009), Balke et al. (2010), Baumeister and Peersman (2013) which found that oil supply shocks explain a smaller fraction of the variability in the real price of oil in recent periods, in contrast to demand shocks. Thus, depending on the type of source of the oil shocks, different explanations can be given for changes in the relationship between oil price fluctuation and economic activity. Nevertheless, the most recent empirical studies, such as Kilian (2014), and Baumeister and Hamilton (2019), argued that oil price increases as well as supply shocks in the oil market have much smaller effects on overall economic activity than in previous studies. The 2020 oil shock due to the health crisis is described as a demand shock. Indeed, this shock stemming from reduced consumption is due to the lockdown established by countries as well as a decline in economic activity in global markets. In this perspective, several studies aimed at measuring the impact of the pandemic on the price of oil and the economic activity of the countries. These include Kingsly and Henri (2020), Narayan (2020), as well as Albulescu (2020) which tried to estimate this impact using an ARDL modeling approach. This paper is based on the findings of the CIDRAP team at the University of Minnesota Moore et al. (2020) who developed different scenarios of the evolution of the pandemic under the hypothesis of the absence of a cure and/or a vaccine. Thus, for each scenario, an attempt will be made to develop the different repercussions that could be reflected in the price of oil.

Using an econometric approach over the time period from

ISSN: 2356-5608

January 1993 to May 2020 (several oil shocks are found, including the crisis of (2008) the excessive supply (2014) and the beginning of the pandemic (2020)), and depending on the suggested scenarios, the idea is to detect the thresholds causing structural changes in the trajectory of the oil price. Indeed, oil price dynamics can be apprehended through the use of econometric models likely to capture empirical irregularities, in particular their non-linearity. Thus, we use the threshold model framework and particularly the Nested Threshold AutoRegressive (NeTAR) model.

II. Global Context

An imbalance was observed in the physical oil market in 2020 due to the SARS-CoV-2 pandemic. By MARCH 30, 2020, more than 50 countries were forced to impose nationwide lockdown. As shown in the following graph, almost half of the world's population (more than 3.9 billion people) were advised to stay at home:

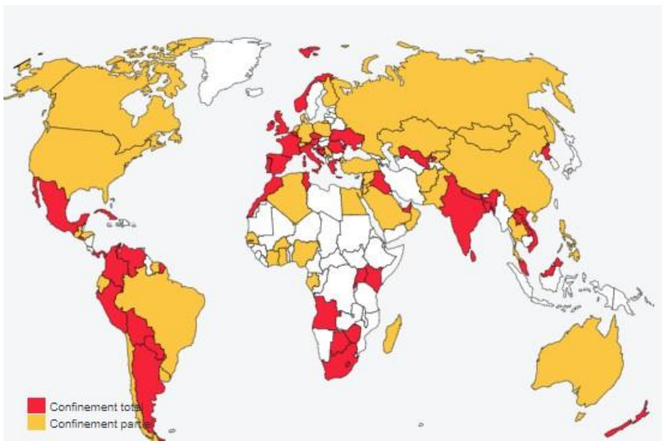

Fig. 1. Worldwide containment measures.Source : Le monde 30/03/2020

Late May 2020, several states around the world relaxed lockdown and started economic activities to recover.

These protective measures against the virus directly affected the supply and demand of oil market. As such, close attention is being paid to the reaction of oil prices to this situation.

*1) **Oil supply**:* Under the hypothesis of the absence of external factors such as: oil price, geopolitical conflicts, etc., oil production can be represented by the function : ***Production = Function (Reserves, Techniques and Extraction Capacity)***). In 2020 and given the historic decline in demand, the oil - exporting countries faced excessive supply situation that resulted in a trade conflict between these states causing a further fall in the prices. This situation began to affect the budgetary equilibrium of these countries and a supply reduction agreement came about in an attempt to support the price. With this in mind, the organization of petroleum exporting countries and its allies, including Russia (OPEC +), announced a drop in production of 10 million barrels per day, or 10% of world supply, from May 1, this reduction is both unprecedented and considerable. During the financial crisis of 2008, OPEC, without Russia at that time, decided to reduce its production by 2.2 million barrels per day. At the end of two months, OPEC + then intends to reduce the decrease in production to 8 million barrels per day (bpd) until December, then to 6 million bpd between January 2021 and April 2022. Except that this reduction requested from the producing countries is not yet unanimous. The withdrawal of ten million barrels would be mainly supported by Saudi Arabia and Russia, but at least twenty other countries should participate in the effort. However, some countries such as Mexico believe that the quotas imposed are too high and difficult to sustain financially even though it is a large cash windfall. OPEC+ compliance was 87% in May. OPEC +'s reductions of 9.7 million barrels per day have so far had a modest positive effect on oil prices, especially because the amount of crude oil stored in the world is still quite excessive. As a result, there is growing concern, including within the oil industry, that some of this lost demand will not be restored any time soon.

*2) **Oil demand**:* In the absence of external factors, the trajectory of oil demand faces two major constraints : - The supply of oil. - The energy mix. First, supply plays a significant important role in the global economic system. However, the management of this oil supply chain goes through a theoretical stage (study of the market, price, availability (supply) and especially the incurred cost) and then the application to achieve the two main objectives which are the maximization of profits and the minimization of risks. The complexity of this supply chain is due to the fact that oil consumption is affected by various external factors such as weather conditions, economic development, conflicts and political instability. Secondly, sometimes oil consumption also interacts with other substitute energy sources. we refer in this case to the energy mix, which also depends on the economic policies established by the countries. In spite of these attempts to forecast the trajectory of oil consumption, the proposed models were still insufficient. Indeed, consumption was generally treated as a distinct part when in reality factors such as: oil price, oil supply and oil stocks influence its movement (Benes et al. (2015)) and exogenous factors such as growth, extreme weather conditions, war and conflict, political instability and Dollar/Euro exchange rate. Most recently, Yu et al. (2019) proposed a model of oil consumption, based on large-scale data and using the "Google Trend". This model has two main steps, investigating relationships and improving prediction. The difficulty in such modeling is to select the most relevant variables to explain this trajectory of oil consumption knowing that many of these variables are very difficult to measure. With the fast development of information technology, a large amount of data is available and can be easily found online. In 2020, a new variable relating to sanitary risk has been added to all these factors. The coronavirus pandemic caused a 30% drop in global demand between January and April 2020 due to national lock downs. In other words, the shutdown of a large part of economic activities caused a drop of about 30 million barrels per day.

If we look closely at the oil consumption of the different

ISSN: 2356-5608

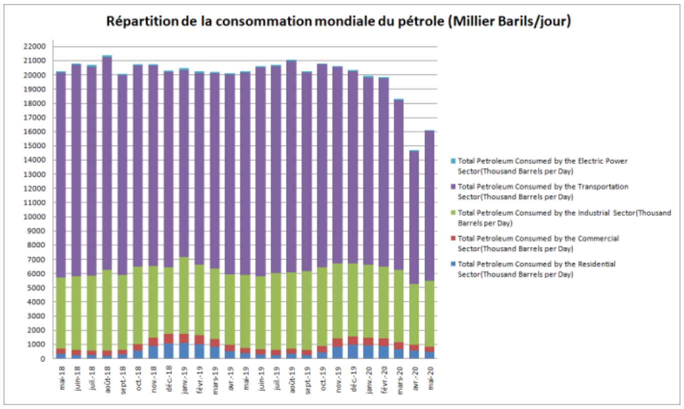

Fig. 2. Sectoral distribution of global oil consumption (MB/D)

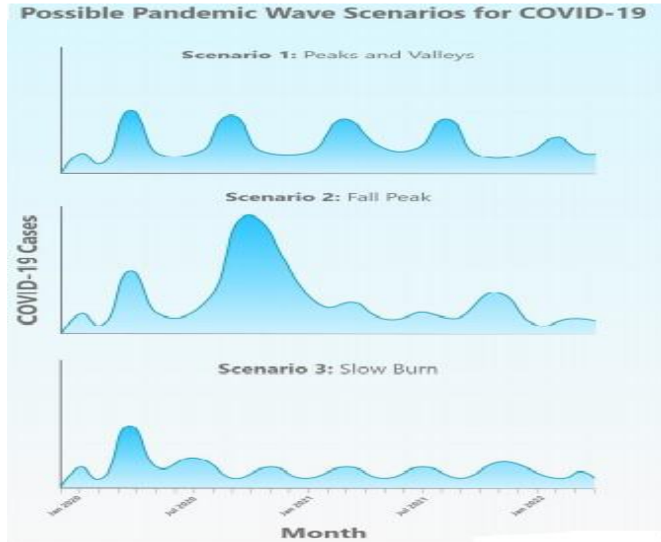

Fig. 3. Different scenarios of the evolution of the pandemic according to the CIDRAP team.

sectors (figure 2), we can clearly see that during covid-19 crisis oil consumption in the transport sector was most affected by these containment measures, followed by industrial sector. The other sectors did not suffer a lot. It is possible to imagine that, in the absence of containment measures, global demand will quickly resume its upward trajectory. Indeed, for the month of May 2020, the demand for oil is back on an upward curve following the easing of protective measures against the pandemic in several countries, but the market is still in oversupply with oil companies seeking to store oil everywhere.

III. Scenario Design

The oil market, like other markets, has not been spared. The outbreak of the pandemic was a multiplier factor of price drop considered as unprecedented. The effect on the oil markets of the lockdown due to this pandemic was reflected by : - A substantial decrease in consumption. - A production excess due to a decline in demand and a market share competition. -An increase in the number of speculators on the financial markets. As mentioned in the introduction, the elaboration of the different scenarios for the evolution of the Brent price will be based on the studies of CIDRAP and on the econometric approach of the NeTAR model.

A. Evolution of the pandemic

We will present the different scenarios of the evolution of the pandemic described by the CIDRAP team of the University of Minnesota and the variations of the oil market in terms of fundamentals. CIDRAP has tried to define the different scenarios of the evolution of the pandemic, based on the history of the epidemics and the different forms of the evolution of this epidemic. The following figure presents these various trajectories that have been set up.

Scenario 1: the first wave of COVID-19 in the spring of 2020 will be followed by a series of smaller repetitive waves that occur during the summer and then steadily over a period of 1 to 2 years, gradually decreasing in 2021. The occurrence of these waves may vary geographically and depends on the implemented mitigation measures. Depending on the peak wave heights, this scenario may require periodic reintegration and subsequent relaxation of mitigation measures over the next two years.

Scenario 2: The first wave of COVID-19 in the spring of 2020 is followed by a larger wave in fall or winter of 2020 and one or more subsequent smaller waves in 2021. This pattern will require the re-establishment of mitigation measures in the fall in an attempt to reduce the spread of infection and prevent health services from being overwhelmed. This scenario is similar to what was observed during the 1918-1919 pandemic. During that pandemic, a small wave began in March 1918 and stabilized during the summer. A much larger peak then occurred in the fall of 1918. A third peak occurred during the winter and spring of 1919; this wave subsided during the summer of 1919, signaling the end of the pandemic. The years 1957-1958 followed a similar pattern, with a spring wave followed by a much larger fall wave. Successive smaller and smaller waves continued to happen for several years.

Scenario 3: The first wave of COVID-19 in the spring of 2020 was followed by a ”slow burn” of transmissions and the appearance of cases, but without a clear wave pattern. Again, this may vary slightly geographically and may be influenced by the degree of mitigation implemented across regions. While this third pattern has not been observed in past pandemics it remains a possibility for COVID-19. This third scenario would probably not require the restoration of mitigation measures, although cases and deaths continue to be reported. Regardless of the pandemic scenario (assuming at least some level of ongoing mitigation measures), the authors estimate that another 18-24 months of significant COVID-19 activity should be expected, with periods of high circulation periodically appearing in various regions. As the pandemic

ISSN: 2356-5608

diminishes, it is likely that SARS-CoV-2 will continue to circulate in the human population and synchronize with a seasonal pattern of decreasing severity over time, as other less pathogenic coronaviruses, such as betacoronavirus OC43 and HKU1, and past pandemic flu viruses have done.

B. Nonlinear approach

Since the early 1970s, there has been an increasing interest in the analysis of economic phenomena characterized by structural ruptures. The literature provides several classes of models. The good fit of each type of model to the types of economic problems studied (date of rupture and knowledge of the mechanism that drives the regime change) leads to better results. In order to construct a model that reflects the variability patterns observed, the autoregressive model is developed first. A three-step process is carried out: specification (or identification) of the model; fitting (or estimation) of the model; verification (or applicability) of the model. These three steps are usually repeated until a suitable model is obtained and then it can be used. It is important to be aware of events that may affect the series and cause outliers. The following figure illustrates the range of Brent Oil future price changes.

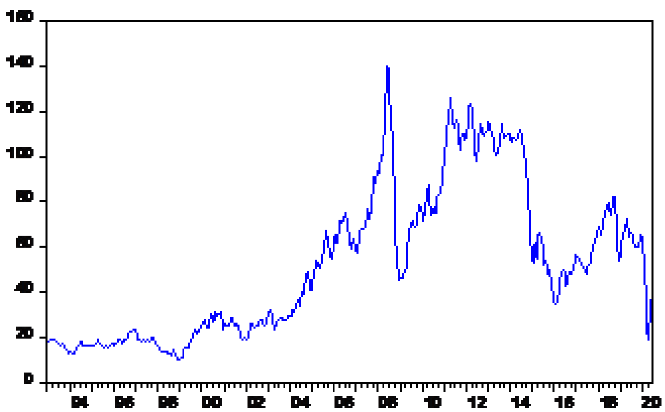

Fig. 4. Monthly evolution of the Brent oil price Futures ($).

Our sample starts from 1990, year of the Kuwait-Iraq conflict (1990) that drove up the price of oil despite the offsetting of the oil supply of these countries by the OPEC countries and Venezuela. The Asian financial crisis put an end to the upward trend in prices around 1997. In March 1999, after an agreement on reducing production between OPEC countries, Russia and others, prices resumed the upward trend. Since then and during the 2000s, the price of oil was highest in the history. The main reason for this growth was dynamics in Chinese economy, the emergence of newly industrialized countries and improved economic conditions in some regions of the world. Between 2008 and 2009; and after reaching the peak of the oil price, the financial crisis caused an unprecedented slump in the oil price. OPEC's reaction of reducing production has boosted the price to between 100 $ and 120 $ for the 2012-2014 period. Since 2014, oil production has increased significantly since the emergence of shale gas. This excessive production resulted in a sharp drop in prices. On the other hand, it was once again necessary for OPEC and some non-OPEC countries such as Russia and Mexico to announce a reduction in production to balance the market or perhaps obtain a slight overproduction. In 2018, we notice that demand and supply are rather balanced. This production may be reduced mainly for the following two reasons: A low price and a lack of investments. Indeed since the drop in oil prices at the end of 2014, there was a sharp decline in investment by oil companies in 2015, which continued in 2016 and 2017. On the consumption side, there has been a slowdown in demand, due mainly to lower growth rates . In 2020, the coronavirus pandemic caused a significant drop in demand, which in turn caused the price of oil to fall.

In order to capture these variations, and after defining the linear model, a monthly study will be conducted on the price of Brent Futures using abrupt transition threshold models.

In order to capture these variations, and after estimating the monthly Brent oil futures price using a linear autoregressive AR(2) model, we performed various statistical tests on this regression. The results of these tests revealed that: the linear model is poorly specified (RESET test), the presence of break dates in our data, the presence of auto-correlation, heteroskedasticity in the residuals and asymmetry. In order to improve the results of this regression and to better explain the formation of prices, we use the large family of regime-switching models, more specifically the threshold models. These non-linear models have the capacity to model several regimes of the price and its construction is based on the threshold value of the transition variable.

In case of a deterministic selection rule, there are two types of threshold models: the abrupt transition autoregressive (TAR) and smooth transition autoregressive (STAR) models. The variable transition (in the TAR model) or function (in the STAR model), noted S_t, is an exogenous variable that belongs or not to the set of exogenous variables Z_t of the model and whose value taken at each instant determines, with respect to a scale of thresholds s to be estimated, the regime operating at that instant.

The threshold model with an abrupt transition (TAR) is frequently used in the economic literature. According to this model, the regime is determined by a variable in relation to a threshold value. The existence of an empirical threshold seems plausible in various economic contexts. The NeTAR model is an extension of this model.

Of the two types of transition, we assume an aggressive change between regimes. Indeed, the oil prices have experienced large fluctuations in a short period of time. The threshold model is also regularly found in the economic studies. This basic model assumes that the regime is defined by a variable with respect to a threshold value. The existence of an empirical threshold seems plausible in various economic fields. The Threshold Auto Regressive model has been extended in several ways, including the SETAR model and the NeTAR model.

ISSN: 2356-5608

C. The Nested TAR model

Astatkie et al. (1997) proposed the NeTAR model which is an extension of the TAR model. This model has the characteristic of being determined not by one but by several origins that would cause the non-linearity of the model. These sources are represented by various threshold variables acting according to a given nesting scheme. The estimation of this NeTAR model is done through a sequence, in which the delay parameters are defined by a non-parametric smoothing and the estimation of the thresholds of the non-linear model. The construction of a NeTAR model in the presence of two non-linear sources relies on the selection of two threshold variables which can be a delayed endogenous variable y_{t-d} and a current or delayed variable X_t from the exogenous variables Z_t of the model. Suppose that y_{t-d} fluctuates first, we will have two ranges of values. For the first interval i ∈ [1,k$_1$], the variable x_{t-e1} (where $e_1 \geq 0$ to be defined) obtains its values in a split of k_{2i} intervals Uctum et al. (1998). The NeTAR model with K regimes can be written :

$$y_t = \begin{cases} \sum_{j=1} \beta_{1j} y_{t-j} + \sum_{i=1} \beta_{1j} Z_{t-i} + \varepsilon_{1t} & si x_{t-e1} < s_2 and y_{t-d} < s_1 \\ \sum_{j=1} \beta_{1j} y_{t-j} + \sum_{i=1} \beta_{1j} Z_{t-i} + \varepsilon_{2t} & si x_{t-e1} \geqslant s_2 and y_{t-d} < s_1 \\ \sum_{j=1} \beta_{1j} y_{t-j} + \sum_{i=1} \beta_{1j} Z_{t-i} + \varepsilon_{3t} & si x_{t-e2} < s_3 and y_{t-d} \geq s_1 \\ \sum_{j=1} \beta_{1j} y_{t-j} + \sum_{i=1} \beta_{1j} Z_{t-i} + \varepsilon_{4t} & si x_{t-e2} \geq s_3 and y_{t-d} \geq s_1 \end{cases}$$

D. Results and Interpretations

NeTAR model allows to have more than one transition variable. To explain the oil price variations, we first chose the monthly consumption of oil price as the regime change variable. This choice is based on economic theory as well as on the results of the various estimates in which the TAR model was found to be superior to the SETAR model. We then obtain our TAR model with two regimes. From there, regime 1 is the one where monthly consumption is below the optimal threshold (18307.16 MB/D), while regime 2 represents the values at or above this level. For each regime, the same estimation procedure will be applied again. We retain as threshold variable the third lag of the oil price return dlprice(-3) for the first regime (consumption¡18307.16 MB/D), in which we get two new equations. In parallel, when the consumption 18307.16 MB/D the transition variable will be dlprix(-4). The model is then written as :

$$\text{DLPRIX}_t = \begin{cases} \text{Si: } CONS_{TOT} < 18307.16 \text{ and } DLPRIX(-3) < 0.0556 \\ \underset{(0.1463)}{0.3151^{**}} \times DLPRIX(-1) - \underset{(0.1499)}{0.7703^{***}} \times DLPRIX(-2) + \underset{(0.0187)}{0.0121} \\ \text{Si: } CONS_{TOT} < 18307.16 \text{ and } DLPRIX(-3) \geq 0.0556 \\ \underset{(0.1499)}{1.6128^{***}} \times DLPRIX(-1) + \underset{(0.4432)}{1.0221^{**}} \times DLPRIX(-2) + \underset{(0.0187)}{0.0121} \\ \text{Si: } CONS_{TOT} \geq 18307.16 \text{ and } DLPRIX(-4) < -0.0417 \\ \underset{(0.1018)}{0.0851} \times DLPRIX(-1) + \underset{(0.1084)}{0.2478^{**}} \times DLPRIX(-2) + \underset{(0.0053)}{0.0031} \\ \text{Si: } CONS_{TOT} \geq 18307.16 \text{ and } DLPRIX(-4) \geqslant -0.0417 \\ \underset{(0.0734)}{0.1580^{**}} \times DLPRIX(-1) - \underset{(0.0709)}{0.1536^{**}} \times DLPRIX(-2) + \underset{(0.0053)}{0.0031} \end{cases}$$

This estimate indicates that when monthly consumption is less than 18307.16 MB/D (47/325 regime1 observations), the first two lagged returns are significant regardless of the third lagged return (greater or less than 5%). We may assume that the first regime represents a state of reduced or slowed demand and we can expect a decrease in the price unless there is a significant decrease in supply. When the monthly consumption is higher than 18307.16 MB/D (278/325 observations Regime2) the oil price returns depend on its second positive significant lag if dlprice(-4) is lower than -4% or on its first negative significant lag if it is higher.

Based on the scenarios developed by the CIDRAP team, we define the different scenarios of the evolution of the oil price: The first scenario assumes a sequence of smaller repetitive waves that do not necessarily require large-scale containment. From there, we can assume that the demand on the oil price will return to its upward trajectory and that it will exceed the 18307.16 MB/D threshold. The most appropriate model in this case is that of the second regime. It will just be necessary to determine whether the fourth lagged return is above or below -4%. In the second scenario, proposed by the CIDRAP team, the probability of containment is higher because of the larger waves. In this case, we will assume a recovery of demand but without exceeding the threshold of 18307.16 MB/D. The most appropriate model in this case is of the first regime. The only remaining question is whether the third delayed yield is greater or less than 5 percent. In the third scenario, a re-containment is not necessary, the oil price will be estimated by the model where the consumption is greater or equal to 18307.16 MB/D. From an econometric point of view, the results of the different tests show that the NeTAR modeling meets the model's assumptions better than linear modeling. Indeed, the residuals of the returns series no longer show autocorrelation, which means that this estimated NETAR model has well adjusted the series for any remaining dependencies. This model has significantly reduced the Jarque-Bera statistic but the residuals do not necessarily conform to the normal distribution and the ARCH test reveals that the homokedasticity hypothesis is well accepted in contrast to the AR(2) model.

IV. Conclusion

The market's sensitivity to the information made available to the public by market participants plays a key role in the formation of the oil price. A concrete example that often comes up is the volume of oil stocks in the United States, where the effect is immediate on the price of oil. In the current circumstances, in addition to the already known factors influencing the price of oil, such as: the role of OPEC+, geopolitical factors, the Dollar/Euro exchange rate or speculation, the number of new cases contaminated by the virus and the number of deaths affect not only the price of oil but all the shares of the stock exchanges in many ways. In this work, we have tried to elaborate the different scenarios of the evolution of the oil price (return) taking into account CIDRAP's work on the evolution of the pandemic and the results of the NeTAR model. Thus, the thresholds of this regression are considered as signals on the evolution of the price and cause structural changes in our data. Thus and in the case of the absence of a vaccine or a cure, the most likely scenario of the evolution of the pandemic is the second one. This scenario will require partial or total re-containment in several regions of the world.

ISSN: 2356-5608

Thereafter, the demand for oil becomes the most dominant factor in the formation of the price of oil. The spectacular drop in the price of oil in a short space of time has led us to assume a brutal structural change in our data. Thus, the NeTAR model revealed four regimes that could explain the different states of the formation of this price. Finally, we can assume that a re-containment will not have the same impact as for the period selected for this research. The use of threshold models with a smooth transition (STAR) would be more appropriate for future research.

References

Albulescu, C. (2020). Coronavirus and oil price crash. *Available at SSRN 3553452*.

Astatkie, T., Watts, D., and Watt, W. (1997). Nested threshold autoregressive (netar) models. *International Journal of Forecasting*, 13(1):105–116.

Balke, N. S., Brown, S., and Yu¨cel, M. (2010). Oil price shocks and us economic activity: an international perspective. *Available at SSRN 1647807*.

Baumeister, C. and Hamilton, J. D. (2019). Structural interpretation of vector autoregressions with incomplete identification: Revisiting the role of oil supply and demand shocks. *American Economic Review*, 109(5):1873–1910.

Baumeister, C. and Peersman, G. (2013). Time-varying effects of oil supply shocks on the us economy. *American Economic Journal: Macroeconomics*, 5(4):1–28.

Benes, J., Chauvet, M., Kamenik, O., Kumhof, M., Laxton, D., Mursula, S., and Selody, J. (2015). The future of oil: Geology versus technology. *International Journal of Forecasting*, 31(1):207–221.

Kilian, L. (2014). Oil price shocks: Causes and consequences.

Kilian, L. and Park, C. (2009). The impact of oil price shocks on the us stock market. *International Economic Review*, 50(4):1267–1287.

Kingsly, K. and Henri, K. (2020). Covid-19 and oil prices. *Available at SSRN 3555880*.

Moore, K. A., Lipsitch, M., Barry, J. M., and Osterholm, M. (2020). Covid-19: The cidrap viewpoint: Part 1: The future of the covid-19 pandemic: Lessons learned from pandemic influenza. *CIDRAP: University of Minnesota. April 30th*.

Narayan, P. K. (2020). Oil price news and covid-19—is there any connection? *Energy Research Letters*, 1(1):13176.

Uctum, R. et al. (1998). Econome´trie des mode`les a` changements de re´gimes. Technical report.

Yu, L., Zhao, Y., Tang, L., and Yang, Z. (2019). Online big data-driven oil consumption forecasting with google trends. *International Journal of Forecasting*, 35(1):213–223.

ISSN: 2356-5608