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The Impact of Covid-19 on Prices of Oil, Gold, and Bitcoin: A Quantile-On-Quantile Analysis

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Abstract

This paper examines the impact of covid-19 ushered on the prices of gold, the virtual currency market specifically bitcoin, and the crude oil industry. Employing a non-linear causality approach, quantile-on-quantile, with daily data from January 2020 to June 2021 (1484 observations), we found evidence that the growth in the confirmed cases of Covid-19 affects the quantile of Bitcoin, Gold, and Oil. Also, we found an asymmetric (positive and negative) effect of confirmed cases on our variables throughout the quantiles. This study reveals that Bitcoin is the most variable influenced by confirmed cases' growth, followed by oil, and the less one was the Gold. Although the high risks of Bitcoin volatility at the initial era of the Covid-19 pandemic, compared to the price of gold and oil, it showed more stability. However, it recovered faster than other financial assets and achieved new historical peaks. The paper stresses the necessity of precaution when investing in financial markets to avoid any potential risk that arise from global risk such as Covid-19. This paper is significant for investors across the financial markets, as it shows the risks of fluctuations in the financial markets and the asymmetric reaction of financial market to the outbreak.

Keywords: *Covid-19, Bitcoin, Oil price, Gold price, Cryptocurrency*

1. Introduction

The emergence of crypto currency can be traced as far in the late 1990, with bitcoin being the first cryptocurrency to be created in 2009 as a result of the economic and financial crisis of 2008 that affected the globe as a whole. From the period of the advancement of the first crypto currency, the crypto currency market has seen exponential growth over the years, has it importance and significance in the digital financial market cannot be over emphasized.

However, from the inception of bitcoin, different forms of virtual currencies have surface over the years serving a similar but distinct function as the bitcoin which has amounted to the total number of crypto currencies to an estimated 8210 digital currencies as of January 2021 as published by coin market cap information. Coin market cap tabloid also indicate that the value of the digital currency industry is more than a thousand billion dollar.

Numerous factors responsible for such exponential growth has been as a result of the industrial digital revolution especially in the financial market such as artificial intelligence (AI) in the technology industry and in performing the

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transaction purpose of money i.e., the general acceptability of bitcoin in the payment for the day-to-day and the settlement of debt between and among parties.

The covid-19 pandemic insurgence grievously affects economies all over the world and debilitate the global financial marketing system including the digital currency market, with a sharp decline in the monthly value of bitcoin (about 36%). Covid-19 pandemic in its first wave triggered a sharp decline in crude oil value in the global oil market as it turns negative in April 2020 for the first time in history.

The highly contagious covid-19 saw an exponential spread from just a case in Wuhan China accumulated to a global catastrophe within three months, which support a sporadic and a cautious action by government around the world as almost all countries health preparedness and readiness was tested. Aside from the human toll, the virus ability to mutate to different variants has taken the world by surprise which has dampened growth which was forecast in both develop and developing economies as well as disruption in oil market. The prompt policy adjustment by OPEC and Non-OPEC countries in the declaration of cooperation for the first quarter of 2020 help non-OPEC countries start the new year in good footing.

Study published in the journal of communicable diseases, which used the Ebola virus in west Africa as a case study, reveals that outbreak may have a significantly greater impact than previously anticipated economically. It states that the destruction of covid-19 pandemic extends beyond individuals. in today's complex globe, economies and people are intertwin much further than respective boundaries. Covid-19 and other major outbreak are unstable as they are unanticipated, hazardous and invasive. While health system must take precedence, it is timely to scale up the health system to withstand future shocks in the health sector. in fact, in moment like these, regular discus, collaboration and trustworthy partnerships becomes even more valuable.

The WHO declared corona virus as global pandemic on the 11th March 2020 with it originated from Wuhan city in China. The corona virus is highly contagious just as the SARS or the Spanish flu, with it exponential rate of spreading led to economic meltdown across the globe. the wide spread of the decease has led to a global forceful lockdown and interborder restrictions which transcend to have a negative impact as in the different economics through trade between and among nations with which the world is yet to fully and effectively recovered from.

Covid-19 economic consequences, on the other hand has posed a dreadful threat and remain an unsolved theory to this day. Researchers have been arguing for years that viral epidemic outbreak constitute an increasing danger to human health and by extension the global market long before this crisis. Numerous eye-opening investigations have demonstrated countries unpreparedness to handle disaster which the current outbreak have confirmed. SARZ (2002-2003), the catastrophic Ebola virus in Africa (2014-2016), the Zika virus in Latin America which almost forced the 2016 Rio Olympic games to be postponed, the resurgence of the Ebola outbreak in the Democratic Republic of Congo are among several notable occurrences in the last six (6) decades. Catastrophic Flu and virus of this nature is expected to cost $630 billion (World Health Organization report) in lost earnings and debt and early death annually.

The effect of the virus has ushered significant strain on financial market where price volatility has been steadily increasing. Economic sanctions, such as travel bans and border closures, stay at home and work from home and the perennial closure of business facilities have all been widely implemented by countries to curb the spread of the virus which as cost severe economic meltdown. The preliminary data evaluating the effect of such strategies indicate that business environment have worsened substantially over time.

The technique implemented to tackle the corona virus are similar to those that have been used in the past during the period of global conflicts. As per the OECD, such policies are projected to reduced economic production by 20-25 percent.

The intent of this paper is to analyzed the impact of covid 19 pandemic on global oil market, global digital financial market with shocks meted on the crypto currency market with bitcoin as the main crypto currency under study and to evaluate how the global shocks of covid 19 pandemic affect the price, access and availability of gold.

Several studies done in this subject matter employ different approaches in producing similar conclusion. This study employs the quantile-on-quantile methodology in its analysis in dissecting the general influence of covid 19 pandemic on oil price, crypto currencies (bitcoin) and gold, using data from 22nd January 2020 till 30th June 2021 with total number of observations of 1484 including 371 for each series.

The analysis of this research has been segmented into different section to aid clarity and easy flow of comprehending it content. The next section of this research encompasses related literatures on the effect of covid 19 on crypto currencies, gold and oil prices. the following section entails data and the methodology employed in the estimation (quantile on quantile technique), the section that follows deals with the findings of the empirical result and the final section sum up findings and conclusion of the study.

2. Literature Review

In recent years, there has been an increase in the number of empirical research focused to a comprehensive examination of cryptocurrencies, gold and oil in the financial literature. As a result, Corbet *et al*. (2019) conduct a complete assessment of previous research in the subject, concluding that cryptocurrencies are legal portfolio assets that must face allegations of possible criminal use of an immature trade route. Beneki *et al.* (2019) summarizes one of most important findings from prior research on the occurrence of conditional volatility indirect effects in the bitcoin market.

Economic studies scientific proof on the contribution of digital currencies as an alternative investment, a speculative investment or a haven yields inconclusive contingent on the crypto currencies demand, the time period studied, and the net asset value (NAV) that evaluate crypto risk mitigation. Selmi *et al.* (2018) analyze bitcoin and gold role as buffer, safe haven a new or modified asset in various market situations which conclude the importance of crypto as a buffer zone amid socio-economic turmoil. According to Klein *et al.* (2018) bitcoin is speedily gaining grounds in becoming the new gold. Similarly, Guesmi *et al.* (2019) in his studies state investment techniques which incorporate gold, oil, equities and bitcoin have decreased incidence when compared when examine the first three. Canh *et al*. (2019) investigate the ability to lead crypto currencies with the biggest share value to mitigate shocks on oil and gold price, concluding the virtual currency market especially bitcoin, which shared a minimal relationship when compared to other macroeconomic variables, thereby limiting financial investors diversification capabilities.

Existing literatures supporting use of bitcoin as a safe haven and a diversifier has mixed result, however, it is not yet clear if they can be considered as a hedge or haven. Selmi *et al.* (2018) conducted a study which signify the importance of bitcoin and gold as safe haven during times of recession caused by some macroeconomic or political instability, Klein *et al.* (2019) support Selmi argument which symbolizes bit coin as the new gold.

This study shows a weak correlation between crypto and other economic factors, which limit the multifariousness influence. the study of Kurka (2019); Smales (2019) shows fragile nexus of cryptocurrency when compared with another traditional asset category. However, they argue that until the market consolidates, cryptocurrencies (such as Bitcoin) should be regarded as a safe haven.

For long term investors, gold and silver are not considered safe haven. Crypto currency returns, thereby implying diversification opportunities for investors. Since cryptocurrencies are considered a haven asset class, they also provide variety of benefit in times of extreme stress and uncertainty as it is important to analyzed their importance in these periods. The author experiments are multiple portfolios of bonds, stocks, and cryptocurrency for the pre-covid period. Although gold's properties prevented it from controlling risk during crisis, it was unable to prevent the volatility caused by covid 19 outbreak. This study shows that a new cryptocurrency, named Altcoin, serves as an effective diversifier despite its low return.

A study by Yousuf and Alie analyze variability transmission in bitcoin, dodge coin and altcoin in the pre covid era. they found that the dynamic correlation between various crypto currency pair is very high in the covid 19 period than the period after. This suggest that investor's ability to hedge is effective and efficient in this period.

Bouri conducted two separate studies in 2017. In the first study Bouri *et al*. (2017a) found that the cryptocurrency does have significant capability to hedge against uncertainty in the short term especially in extreme market conditions, thereby corroborating that uncertainty negatively affect the returns on bitcoin. Bouri et al. (2017b) in the second study recognized bitcoin ability in serving as a diversifying instrument during economic meltdown. except for gold, Kurka (2019) find a limited link that exist between bitcoin and other conventional type of assets. Smale (2019), on the other hand, claim that there is no link between crypto currency returns and those of other equities and that cryptocurrency should be regarded as a sanctuary until the bitcoin has stabilized. Das *et al.* (2020) suggest that other assets (gold, commodities, and the dollar) are regarded as better assets than bitcoin for ensuring petroleum risks and that the insuring capacity of different assets are dependent on the characteristics of oil potential consequences and currency fluctuations

Previous done by AL-Khazali *et al.* (2018) evaluate the effect of positive against negative macroeconomic news in major economies on the nexus between bitcoin and gold profit fluctuation between the period July 19 2010 – February 7, 2017. they discovered disproportionate affects as well as indication that gold differs from BTC. Gold profits and fluctuation, in particular, reacted consistently to stock markets shocks in a way that was compatible with its historic function as a safe space, but BTC values and price fluctuations did not.

The study conducted by Bouri *et al.* (2018) examine the nexus that exist between commodity prices and the prices of bitcoin employing both NARDL and Quantile ARDL method between the period July 17 2010, to February 2 2017. the result of this study pinpoint two significant decision. First, researchers discover that there is continuous proof of strong cohesive link between demand side crude oil shocks (risk shocks) and virtual currencies across the analyzed time. Furthermore, the finding reveals that demand and risk shocks have a greater impact on the bitcoin market. This finding is coherently in alignment with earlier studies by depicting strong nexus among financial markets during period of uncertainty in the global financial market (Adekoya, 2021).

The Second significant point of this research shows virtual currency industry response to shocks produce by the oil industry is rather consistent across virtual currencies upset kind, while tether stand as a distinct coin. Tether coin response negatively with demand shocks to oil prices during the period of analysis and era of the corona virus.

Das *et al.* (2020) conclude that bitcoin is not as advantageous as other assets to hedge oil related risks. Charfeddine *et al.* (2020) affirm that crypto currencies can be used to mitigate risk associated with different asset classes, such as crude oil. A paper by Jareno *et al*. (2020) explore the connectivity binding gold and bitcoin. He went further by stating that bitcoin has the potential of acting as safe haven during economic meltdown. in 2020, Shahzad *et al.* (2020) wrote extensively, claiming that bitcoin and gold possess a distinct feature that makes them safer and more stable investment. His study pinpoints the importance of coper as it serves best in providing diversifying opportunities.

Liu *et al*. (2020), Impact of covid-19 pandemic on crude oil and stock market in the US using time varying parameter vector auto regressive (TVP-Var) model. Their result indicates that there is a negative connection between crude oil returns and stock returns. It is further state that the covid-19 pandemic can cause a significant positive influence on the crude oil market and stock market. It was concluded that the spread of covid-19 pandemic may not damage economic performance as per the data sample reviewed

Ghazani and Khosravni (2020) and Okarie and Lin (2020) wrote extensively on the importance of crude oil as of the pivotal commodity across the globe as it is one of the important assets in the tradeoffs involving various financial instruments in various financial market as it is significant in most economies. Yin (2021) in his paper highlight that both internal and external disequilibrium in the oil industry is regarded as a crucial shock in destabilizing the crypto currency market as the price of oil shocks might auger similar risk level as compared to other macroeconomic uncertainties during the post 2000 era after the rejuvenation and calibration of the oil market.

Sharif *et al*. (2020) stated that in the findings of their study that even though the oil market may tend to recover from the shocks through policies and reforms by major oil producing and exporting countries through rigorous dialogue, the underlying impact of a sharp escalation in the geopolitical risk during the pandemic will opt to be policy makers point of concern in both the long and the short term. Both external and internal shocks on oil prices due to the advent of the covid 19 pandemic have a degrading effect on the oil market, similar effect can be experience in both the crypto currency market as well as the global price of gold.

Seraj *et al.* (2020) through a quantile-on-quantile approach evaluate the causality between the oil prices and exchange rate in five major oil exporting countries namely Russia, US, Saudi Arabia, Canada and the United Arab Emirate using monthly data from April 1996 to January 2020. the finding of their study reveals a causal relationship of prices of oil and oil product to exchange rate across quantile in all countries.

Using wavelet coherence analysis, Karamti and Belhassine (2021) investigate the existence of market volatilities among dread associated to the presence the virus in US stock market (Baker *et al.*, 2020) infectious diseases market velocity index) international market during the first and second wave of the pandemic in the US in terms of the crypto currency market. The finding of Karamati and Belhassine (2021) demonstrate a positive significant relation between US virus fear and bitcoin within the first tide of the pandemic, but the fear index clearly leads the bitcoin market at the start of the second wave, highlighting the crypto currency's role as a safe haven when fear rises.

3. Data

We use daily data of the price of Bitcoin[1], Gold[2], Oil[3] and the change in the world confirmed cases of covid-19[4]. the daily data cover the period from the first announcement of confirmed cases in the world of covid-19 on the 22nd of Jan 2020 till the 30th of June 2021. The confirmed covid-19 cases were obtained from (Our world in data) while the price of other variables was obtained from investing. the total number of observations is 1484, including 371 for each series. the descriptive statistics of data presented in Table 1.

Table 1: Descriptive Statistics

	N	Mean	SD	Median	Min	Max	Range	Skew	Kurtosis
Brent	371	49.86	13.7	46.06	19.33	76.18	56.85	0.01	-0.87
Bitcoin	371	23169.09	17768.08	11761.6	4858.4	63533.8	58675.4	0.86	-0.81
Gold	371	1813.37	114.5	1817.9	1494.6	2103.2	608.6	-0.23	-0.27
Covid-19	371	60675194	59309561	36922190	557	182202370	182201813	0.64	-1.01

Among our price variables, it is clear that Bitcoin is right-skewed with the highest standard deviation with the value of 17768, followed by Gold with a standard deviation value of 1817, and its negative skewed. The standard deviation of the oil is the lowest, with a value of 13. Regarding the Covid-19, we can notice that the median is 36922190, and the daily confirmed cases ranged between 557 to 182202370.

Usually, the researcher uses log-returns rather than simple returns, it has an excellent property, it can be interpreted as continuous price also it has time additive (Brooks, 2019); we convert our price into continuous using the following equation $r_t = 100\% \times ln\left(\frac{p_t}{p_{t-1}}\right)$. The series log-returns are plotted in Figures 1-3.

Figure 1 shows bitcoin returns; we can notice that during the first two months is highly volatile. Bitcoin is a cryptocurrency, and one popular feature of the crypto market is the high volatility. However, the coincide the high volatility of Bitcoin, which reaches 40% of return with Brent oil (Figure 2) in the same period of announcement of the pandemic, may be an indicator of existing such relationship between these variables. Figure 3 shows the high volatility of Gold throughout the whole period.

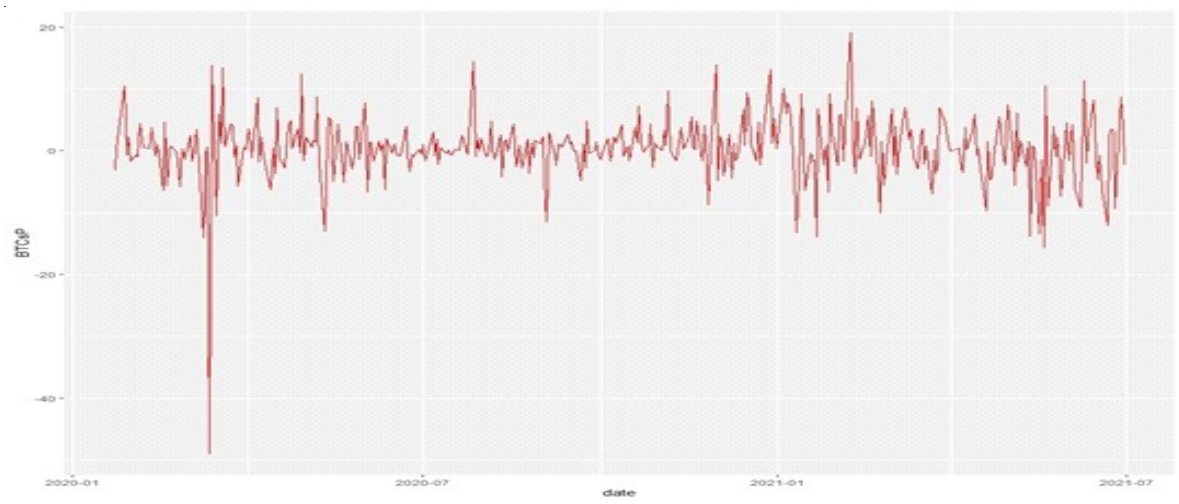

Figure 1: Brent Oil Returns

[1] https://finance.yahoo.com/quote/BTC-USD/history/

[2] https://tradingeconomics.com/commodity/gold

[3] https://tradingeconomics.com/commodity/crude-oil

[4] https://covid19.who.int/

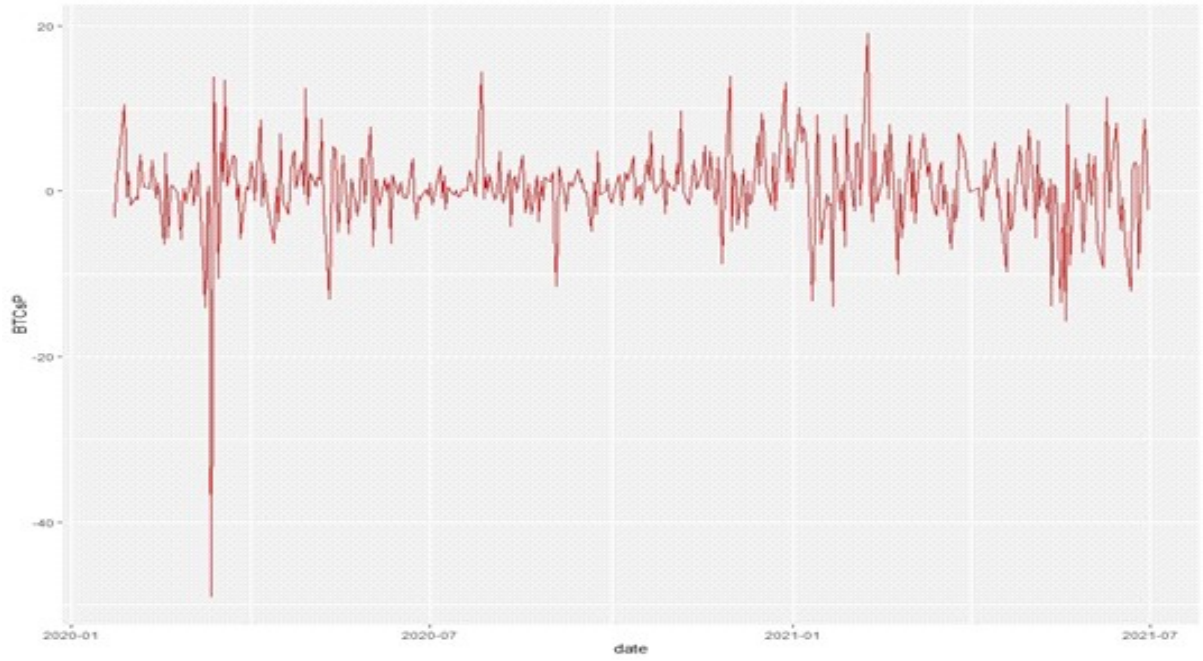

Figure 2: Bitcoin Returns

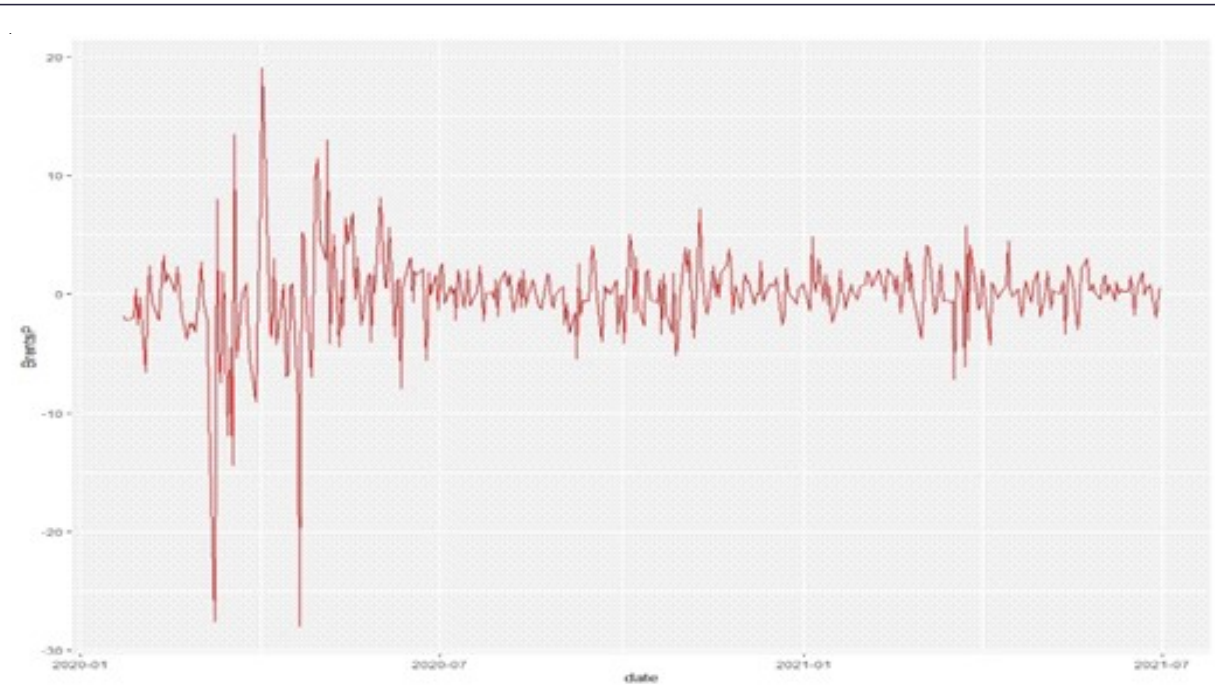

Figure 3: Gold Returns

3. Methodology

We use the quantile-on-quantile model in this paper to analyze the effect of covid-19 shocks on the Bitcoin, oil price, and gold price. The main advantage of Quantile regression methodology is that the method allows for understanding relationships between variables outside of the main data, making it useful in understanding outcomes that are non-linear relationships with predictor variables.

The initial regression model can be shown as follows:

$$X_t = \beta^{\theta}(covid_t) + \mu_t^{\theta} \quad ...(1)$$

where X represents the Bitcoin, oil price, and gold price at time t, $covid_t$ shows the covid-19 shocks at time t, θ denotes θ^{th} quantile and μ_t^{θ} presents the quantile residue. β^{θ} is an unknown factor which lacks the prior information. in terms of an unknown factor, β^{θ}, a first-order Taylor expansion is employed;

$$\beta^{\theta}(covid_t) \approx \beta^{\theta}(covid^{\tau}) + \beta^{\theta}(covid^{\tau})(covid^{\tau} + covid_t) \quad ...(2)$$

where $\beta^{\theta}(covid^{\tau})$ denotes the partial derivative of $\beta^{\theta}(covid_t)$ with respect to covid-19 shocks. Equation (2) can be rewritten that;

$$\beta^{\theta}(covid_t) \approx \beta_0(\theta, \tau) + \beta_1(\theta, \tau)(covid^{\tau} + covid^{\tau}) \quad ...(3)$$

We can obtain the new equation by replacing the equation (3) into equation (1);

$$X_t = \beta_0(\theta, \tau) + \beta_1(\theta, \tau)(covid^{\tau} + covid^{\tau}) + \mu_t^{\theta} \quad ...(4)$$

in the end, the linear regression's estimates b_0 and b_1 can be used to replace β_0 and β_1. We can estimate the minimization problem now;

$$min_{b_0,b_1} \sum_i^n \rho_{\theta}\left[X_t - b_0 - b_1\left(\hat{covid}_t - \hat{covid}^{\tau}\right)K\left(\frac{F_n\left(\hat{covid}_t - \tau\right)}{h}\right)\right] \quad ...(5)$$

where $\rho_{\theta}(u)$ is the quantile loss function that can be written as $\rho_{\theta}(u) = u(\theta - I(u < 0))$, i present the usual indicator function, and K shows the kernel function. We use the Gaussian kernel to weigh the observations in the neighborhood of $covid^{\tau}$. Also, the weights have the inverse linkage with the distanced observations of the distribution function of

$$covid_t\left(F_n\hat{covid}_t\right) = \frac{1}{n}\sum_{k=1}^n I\left(\hat{covid}_k - \hat{covid}_t\right) \quad ...(6)$$

and the distribution function can be obtained which associates with the quantile Oil^{τ} indexed by τ. (See Jiang *et al.*, 2020).

4. Empirical Results

We use Quantile on Quantile methodology to examine the relationship between oil, gold, and bitcoin with confirmed cases of Covid-19. Figures of 4-6 show the Covid-19 supply shocks on oil, gold, and bitcoin, the estimated slope coefficient $\beta_1(\theta, \tau)$ presented on the Z-axis, it shows degree the τ^{th} quantile of Covid-19 supply shocks (x-axis) on the quantile of Bitcoin, Gold, and oil, in each variable (y-axis).

We notice exciting findings from Figures 4-6, we can notice that the quantile of Covid-19 supplies negative and positive shocks to each of Bitcoin, Oil, and Gold, these shocks seem to be close to each other. The adverse shocks locate

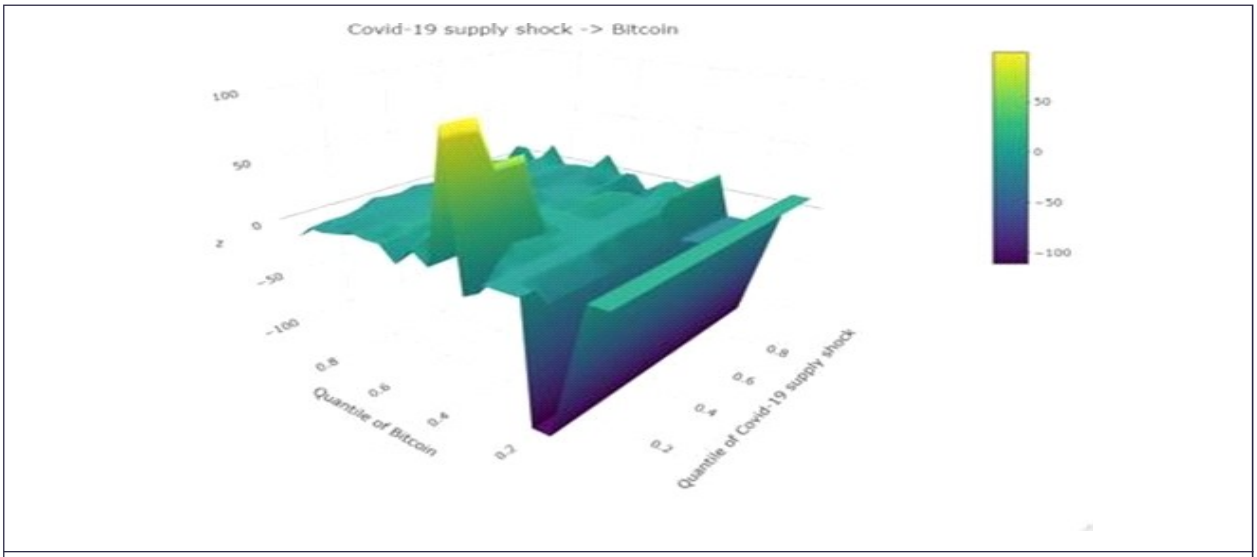

Figure 4: Covid-19 Shock on Bitcoin

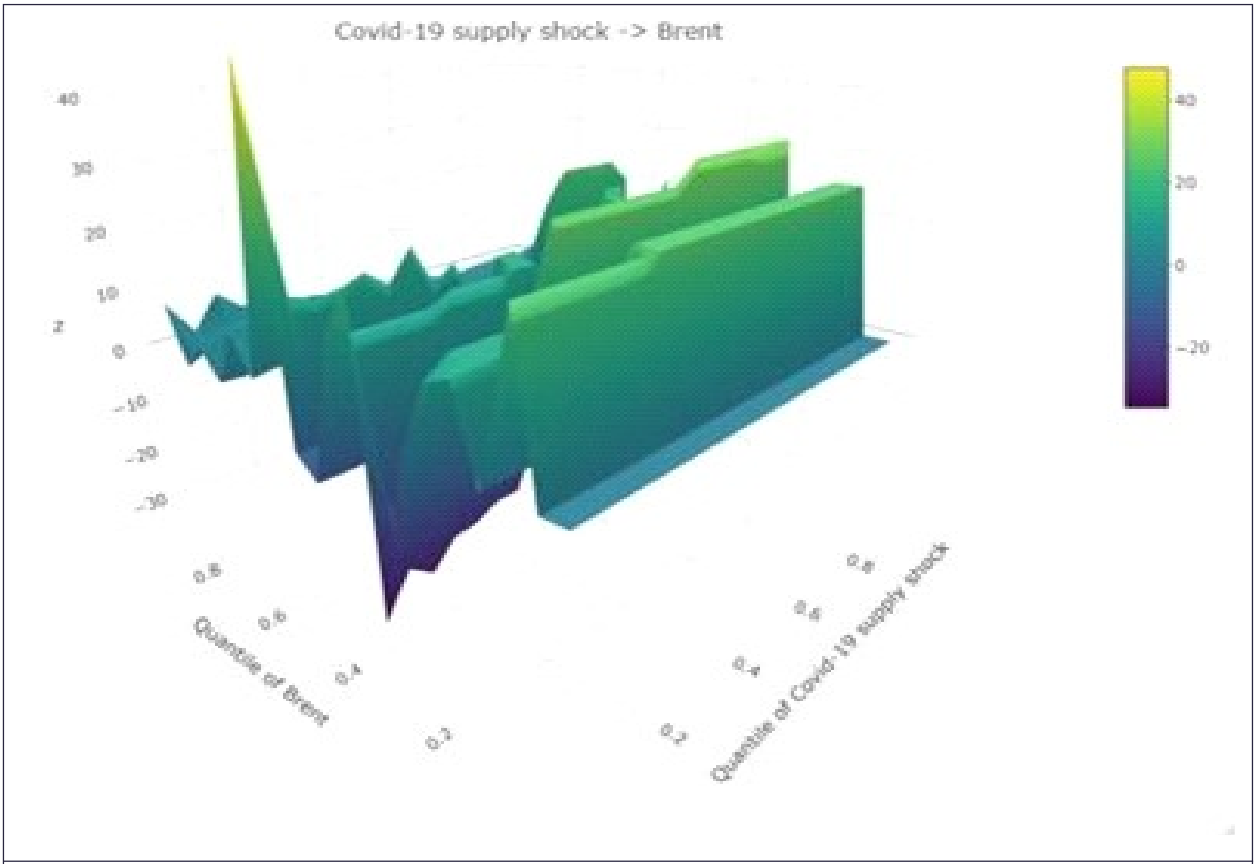

Figure 5: covid-19 Shock on Oil

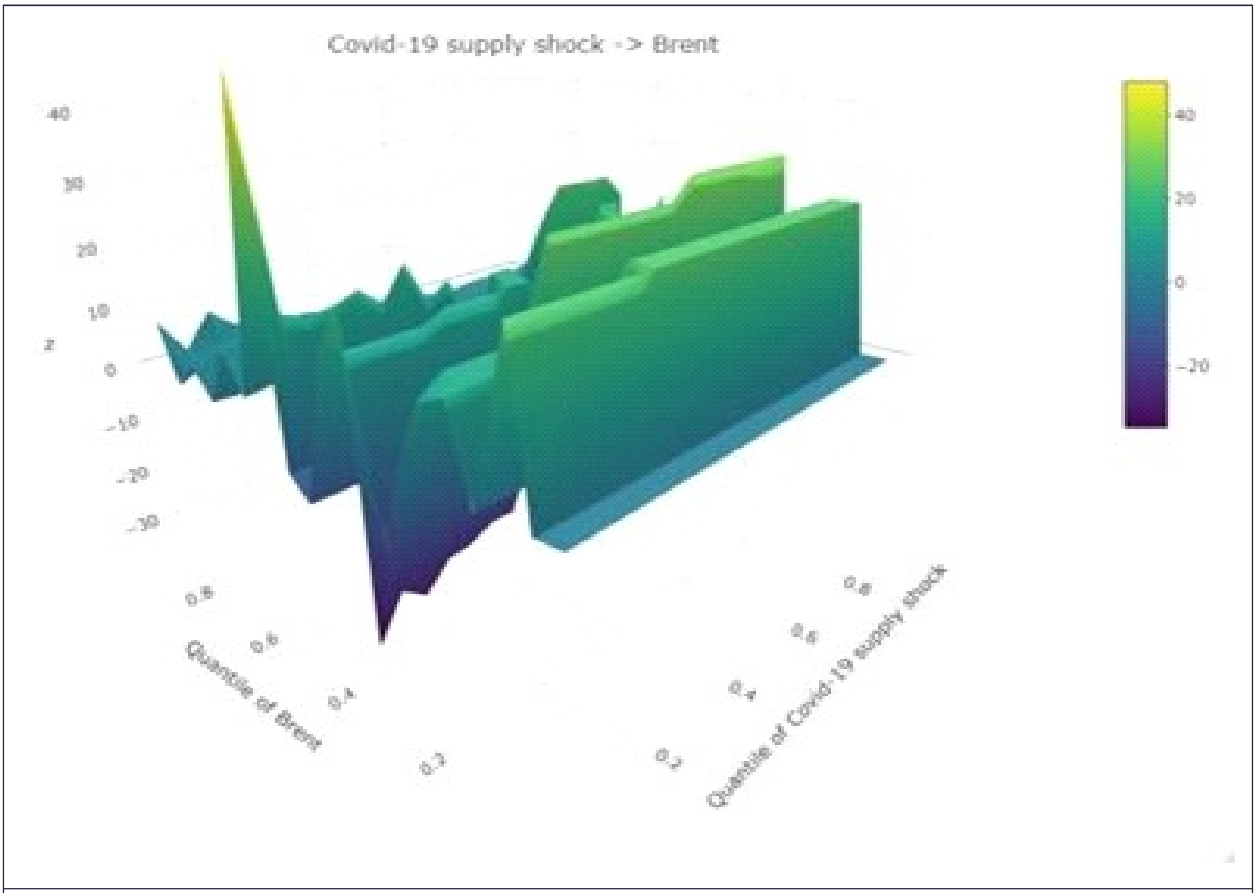

Figure 5: covid-19 Shock on Oil

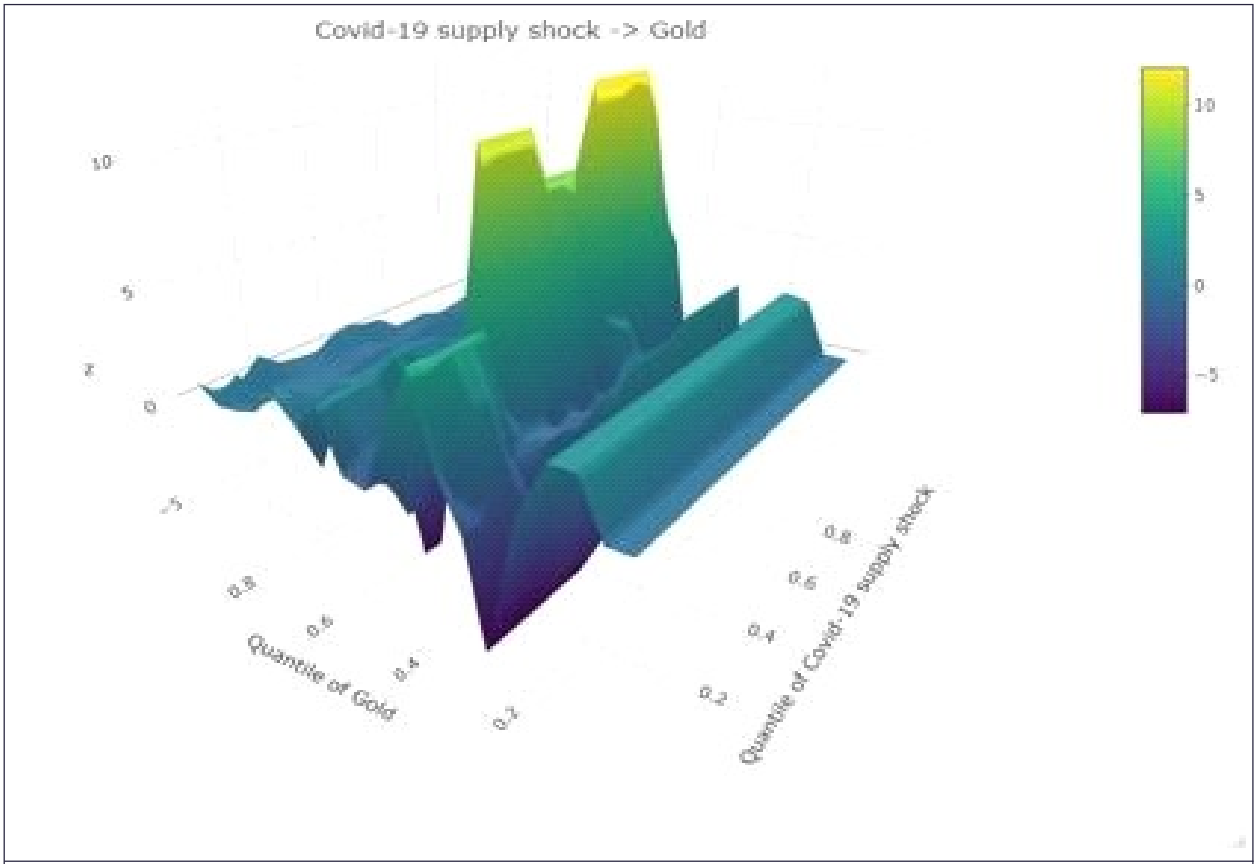

Figure 6: Covid-19 Shock on Gold

between the quantiles (0,2-0.4) of the variables. the positive shocks supplied by Covid-19 locates around the quantile 0.6 of the variables. This is a strong indicator for effect the growth of confirmed cases of Covid-19 on Bitcoin, Oil, and Gold.

In general, we can see that the Confirmed cases of Covid-19 supply a combination of negative and positive shocks to our variables, and this appears clearly in the estimated value of the slope coefficient (*Z*-axis), which have a combination of negative and positive value and thus, we say that the covid-19 have an asymmetric effect on Bitcoin, Oil, and Gold.

On a case-by-case basis, we can get more details. Figure 4 shows how the growth of confirmed cases of Covid-19 supply shocks to Bitcoins throughout the quantiles. At the lower quantile (0.2, 0.2), there is a strong negative shock to Bitcoin, and its effects reach -100 on slop coefficient, another strong but positive shock from Covid-19 to Bitcoin between the quantile (0.6, 0.8) the value of the slope coefficient is around 50. For Gold, we can notice a negative shock supplied by covid-19 to Gold between the quantile (0.2, 0.4), the effects of this shock reach around-5, followed by two positive shocks between the quantile (0.4, 0.6) and (0.6, 0.8) with slop coefficient value around 1 and 10 respectively. For oil, there is series of asymmetric shocks supplied by covid-19. These positive and negative shocks start from the quantile (0.4, 0.8). The most severe shock reaches around -30, while the positive one reaches around 40.

It is clear the significant volatility of Bitcoin compared to oil and gold during the first period of the Covid pandemic, but Bitcoin recovered faster than other variables during the pandemic, and this is consistent with the study of both Bouri *et al.* (2017a), and Yousaf and Ali (2020), and despite the high volatility of Bitcoin, which increases the risk of investing in it, but uh, it has proven its ability to recover quickly and dramatically, as the positive shocks show this on the quantile (0.6, 0.8), which reached to around 50. Global crises such as the Corona crisis occur suddenly, which raises the risks that investors may be exposed to through the financial markets. therefore, investors should diversify by investing in different markets to reduce such risks.

5. Conclusion

This study examines the impact of covid-19 ushered on the prices of gold, virtual currency market specifically bitcoin and the crude oil industry. Employing a nonlinear causality approach, quantile-on-quantile, with daily data from 2018 to 2020 (1484 observations), we found evidence that first, growth in the confirmed cases of Covid 19 affects the quantile of Bitcoin, Gold, and Oil, Second, we found an asymmetric (positive and negative) effect of confirmed cases on our

variables throughout the quantiles. Which agrees with the results of Mensi *et al.* (2020), who found that the oil and gold reacted asymmetrically to the corona pandemic. Finally, we found that Bitcoin is more volatile this study reveal that Bitcoin is the most variable influenced by confirmed cases' growth, followed by oil, and the less one was the Gold.

Although the high risks of bitcoin volatility at the initial era of the covid-19 pandemic, compared to gold and oil, it showed more stability. However, it recovered faster than other financial assets and achieved new historical peaks. The result agrees with Conlon and McGee. (2020) that bitcoin is more volatile than other financial assets but it's still a good choice to hedge against risks since it recovered faster than other financial assets. This result aligns with Bouri *et al.* (2017a) and Yousaf and Ali (2020) as they show cryptocurrency weak ability to hedge against uncertainty in the short term and under severe market conditions.

This paper stress the necessity of precaution when investing in financial market to avoid any potential risk that arise from global such as covid-19. This paper is significant for investors across the financial markets, as it shows the risk of fluctuations in the financial market and the asymmetric reaction of the financial market to the outbreak.

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