Influence of COVID-19 coronavirus pandemic on international oil markets

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Abstract
At the beginning of the COVID-19 coronavirus global pandemic, the oil market was crushed. In this period, the oil market was correlated with COVID-19 coronavirus world infection cases: more infected cases resulted in low oil prices, and the negative correlation between these two indices was very strong. Different factors determined the increase in both crude oil price and the number of oil futures contracts after April 20. Firstly, oil prices were driven by the coronavirus mortality rate, rather than by the absolute number of infection cases. The decisive driver for oil prices in the medium-term became pandemic development trends, instead of the actual epidemiological situation. This statement is proven by the statistical regression model of the interdependence between oil prices and COVID-19 coronavirus world mortality rate. Secondly, a gradual stable decrease in the coronavirus world mortality rate created an environment for the gradual restart of the world economy. Thirdly, the coronavirus mortality rate analysis provides investors with tangible guidelines to assess the medium-term sustainability of futures markets and, therefore, to elaborate investment strategies. Fourthly, after April 20, the oil market gradually achieved equilibrium, which is proven by a restored correlation between oil prices and the Euro-to-U.S. Dollar exchange rate. Three-month tendencies provide tangible guidelines for an optimistic forecast of the oil the market and maritime tanker business for the end of 2020 and all of 2021. So long as a new wave of COVID-19 does not dramatically increase mortality rates, the oil and maritime tanker trade market will regain the equilibrium it lost at the end of January.

Introduction

The world economy rapidly recovered after the 2009 global economic crisis, and starting from 2010, a rapid increase in the global GDP was obtained. In 2018, the world GDP was as high as US$ 85,909.816 billion, but world economic growth was unexpectedly hampered by the COVID-19 coronavirus pandemic. Within one month, the world economy was frozen, industries and budgetary incomes fell to critical levels, employment collapsed, investor activities distorted, and so on. The first months of the pandemic brought back memories of the Great Depression, when liberal economic doctrines failed, and governmental interventions became necessary (Jordà, Singh & Taylor, 2020). It is obvious that after the pandemic, many fundamental principles will change in the world, including social & economic development doctrines (Silagadze, Atanelishvili & Silagadze, 2019) and regional economic relations (Tvalchrelidze & Kervalishvili, 2019).

There are many publications in the global mass media but few analytical and scientific investigations that have discussed the influence of the coronavirus pandemic on either the economy or crude oil markets. Firstly, it was outlined that the COVID-19 coronavirus pandemic in February dramatically decreased world investments, including portfolio investments, and the negative effect of the pandemic was twice greater than that of the 2008–2009 world

economic crisis (OECD, 2020). Secondly, from the very beginning, the pandemic has had a huge negative impact on the manufacturing industry throughout the world, but mostly in Latin America (ECLAC, 2020), China (Malden & Stephens, 2020), and poor countries (WTO, 2020). Thirdly, some publications have provided contradictory information about the pandemic's influence on oil markets. For instance, in the first article (Albulescu, 2020), the author concludes that the pandemic's influence is minor, and oil price trends follow inherent regularities; however, in March 2020, there was little available statistical material, and econometric equations' coefficients were not correctly proven. In other publications (Aloui et al., 2020; Sharif, Aloui & Yarovaya, 2020, etc.), on the contrary, the pandemic impact was suggested to be huge. The COVID-19 coronavirus pandemic also touched the maritime sector and oil tanker shipment. Already in late January, the demand for tankers dramatically decreased, and this situation became even worse in February and March (Ship Technology, 2020). The published prospects for the end of the year and 2021 are also pessimistic (Liang, 2020). Hence, at the beginning of May, we processed all available worldwide statistics and concluded that by mid-summer, the situation would improve (Tvalchrelidze & Silagadze, 2020).

Now, the modern theory of commodity pricing was elaborated in the 1990s and represents the less-explored branch of economics. Firstly, commodity pricing does not follow the fundamental rule of economics – the interrelation of supply and demand (Deaton & Laroque, 1992, etc.). Secondly, there are many publications where the synergy between the pricing of different commodities was proven (for instance, Alquist & Coibion, 2014). In several publications (for instance, Tvalchrelidze, 2011; Tvalchrelidze & Silagadze, 2013; Tvalchrelidze, 2018, etc.) we have explored this topic and have demonstrated that the prices of all primary commodities depend on spot oil prices, which, in turn, are governed by the Euro-to-U.S. Dollar exchange rate. Thirdly, in recent years, a few publications have appeared (Browne & Cronin, 2007; Tvalchrelidze, 2011, etc.) that have proven that financially, commodities resemble financial instruments and money rather than goods. This approach allowed researchers to perform structural modelling of commodity prices in their forecasts (Lautier, 2009, etc.). We, however, prefer statistical modelling described below.

We now analyze the objective statistical information and identify oil market development trends within the framework of the COVID-19 coronavirus pandemic.

Statistical analysis and interpretation

Figure 1 displays weekly world oil prices from January 21 to July 27, 2020. Statistical data for this graph is cited according to Statista information (Statista, 2020). It can be observed that the average weighted world oil price decreased 4.73 times from January 21 to April 20. The most paradoxical fact is the negative price of WTI bland on April 20, meaning
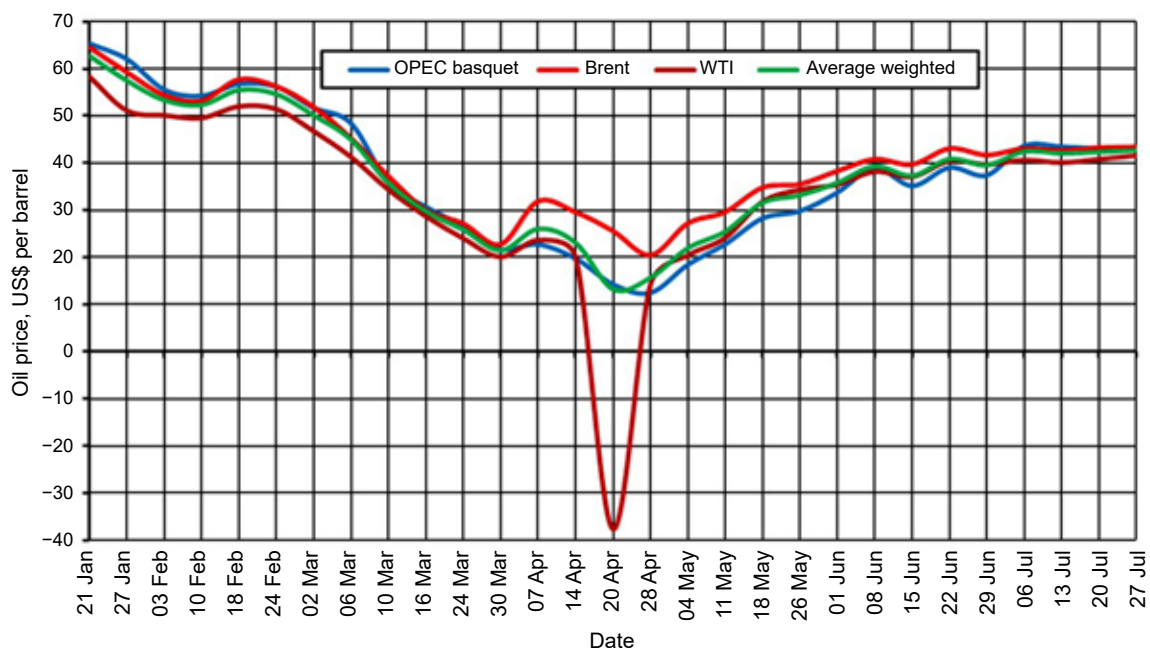

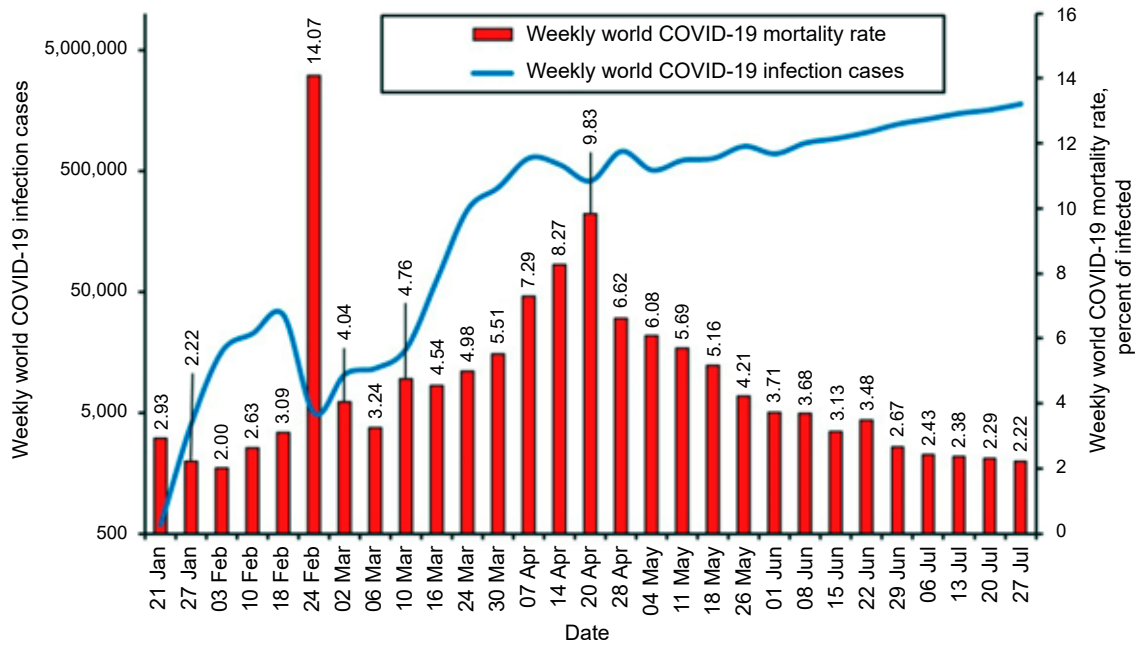**Figure 1. Oil Prices from January 21 – July 27, 2020**

Figure 2. Weekly COVID-19 Coronavirus Infection Cases and Mortality Rate

that oil merchants paid money to consumers to get rid of West Texas Intermediate oil stocks. However, after April 20, prices started to increase, and by July 27, they increased 2.84 times on average.

Figure 2 explores basic statistics on the COVID-19 coronavirus global pandemic. For calculations, official WHO data were used (Worldometer, 2020). Daily data were re-calculated every week. The mortality rate implies the percent of world weekly deaths with regard to the number of people infected weekly. It may be seen that the maximum mortality rate of

9.83 percent of infected people occurred on April 20; afterwards, the mortality rate started to gradually decrease.

The interrelation between world weekly COVID-19 coronavirus infection cases and average weighted weekly crude oil price is shown in Figure 3. It may be seen that, statistically, the pandemic may be divided into two periods: (i) January 21 – April 20, and (ii) after April 20.

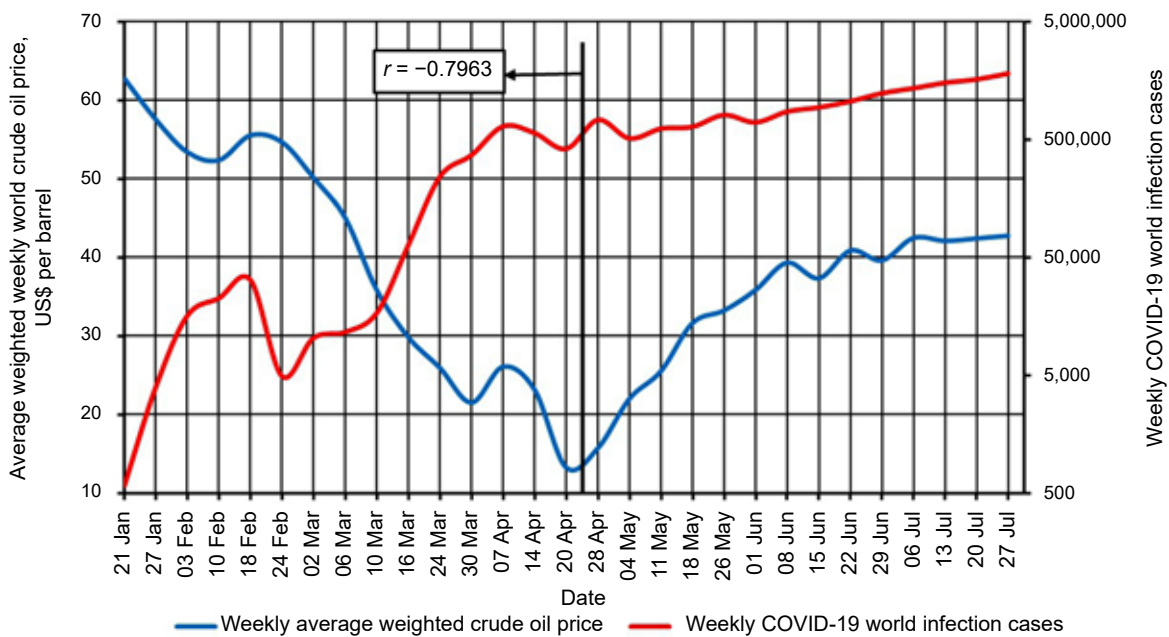Within the first period, a strong negative correlation between the mentioned two indices is observed

Figure 3. Interdependence between Average Weighted Weekly Crude Oil Price and COVID-19 Weekly World Infection Cases
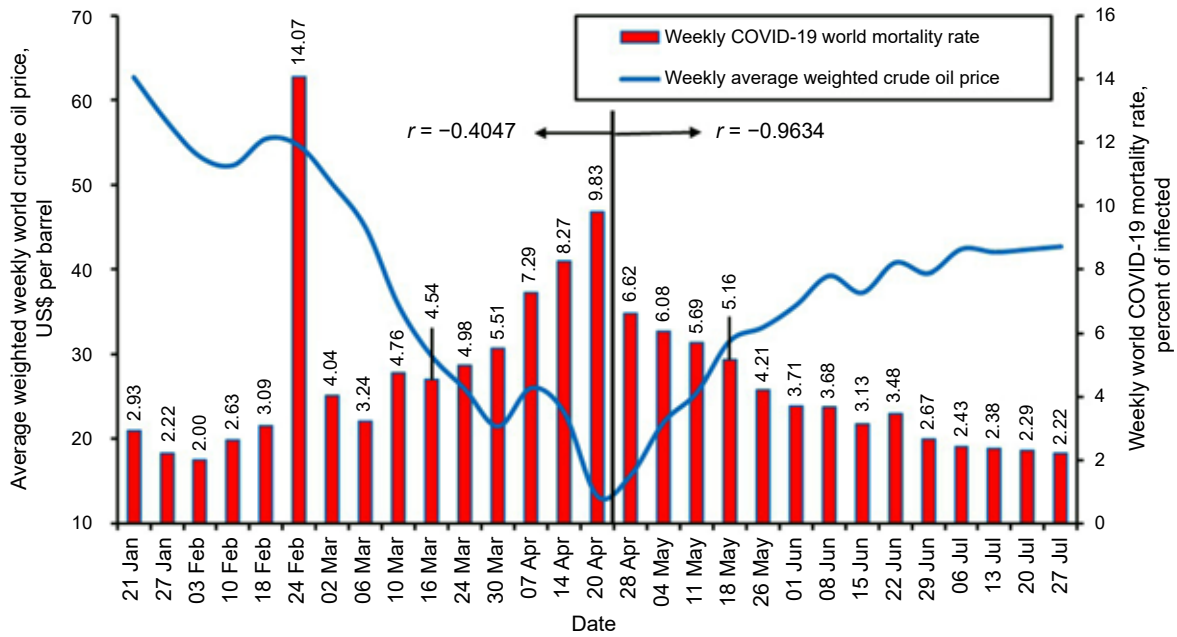
Figure 4. Interdependence between Average Weighted Weekly Crude Oil Price and COVID-19 Weekly World Mortality Rate

($r = -0.7963$), which allowed us to draw a corresponding regression statistical model (Tvalchrelidze & Silagadze, 2020). Hence, after April 20, this negative correlation was sharply disturbed, and oil prices started to increase, regardless of the number of global COVID-19 infections.

However, the most interesting regularity is expressed in Figure 4, where the weekly average weighted crude oil price is compared with COVID-19 weekly world mortality rate. It may be seen that before April 20, the negative correlation was weak, whereas later it became extremely strong ($r = -0.9631$).

The abovementioned indicates that within the first period, oil prices were driven by the absolute number of global COVID-19 coronavirus infection cases, whereas afterwards, when the mortality rate began to decrease gradually, and pandemic restrictions began to be lifted, the pandemic mortality rate became the main indicator, which determined the possible development of events.

The extremely high correlation coefficient between the COVID-19 coronavirus world weekly mortality rate and oil prices in late April – late July allowed us to perform statistical modelling of interdependence between these two indices according to the methodology elaborated in (Tvalchrelidze, 2011) and updated in (Tvalchrelidze & Silagadze, 2013). Modelling was based on the following simple regularities: Statistical interrelation between dependent y and variable x in two-dimensional space ($\bar{x}_i, \bar{y}_i$) may be determined by a regression equation:

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_p x_{ip} + \varepsilon_i \quad (1)$$

where ε_i = residual of equation (2):

$$\vec{x} = \begin{pmatrix} x_{11} & \ldots & x_{1p} \\ \ldots & \ldots & \ldots \\ x_{n1} & \ldots & x_{np} \end{pmatrix} \quad (2)$$

and coefficient β is determined by the least-squares method, meaning that deviation of squares of points in space ($\bar{x}_i, \bar{y}_i$) should be minimal. It is reached by an extremum:

$$F\left(\vec{\beta}_n\right) = \sum_{n=1}^{p}\left[\bar{y}_n - B\left(\bar{x}_n, \vec{\beta}_n\right)\right]^2 \quad (3)$$

In nonlinear cases, it is possible to compute the values of coefficients, standard errors, and residuals ε_i. To do so, we need to know mean values of $\bar{x}$ and $\bar{y}$, the standard deviation of x, the standard deviation of y, and the correlation between them. Such a computation was realized in the SPSS software using ANOVA (analysis of variance). The model is presented in Figure 5, and the basic parameters and constants of the quadratic regression equation, described in formulas (1)–(3), are provided in Tables 1 and 2. Figure 6 compares the real oil prices with those computed from the mortality rate based on the equation hereto.

It may be seen that the average statistical accuracy of the model is ±2%, which means that the relationship between global oil prices and the
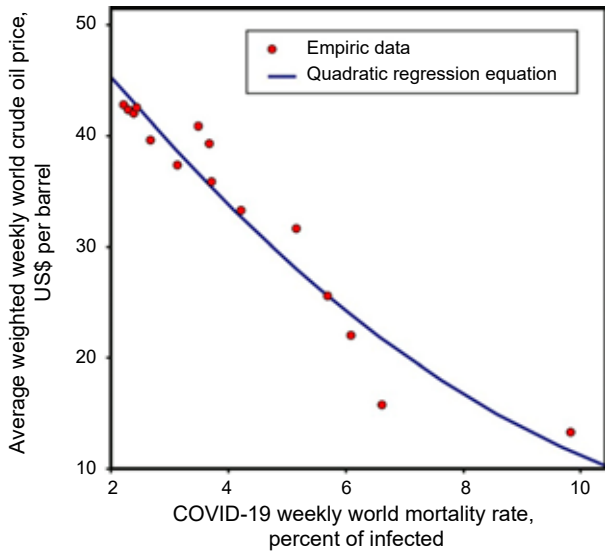
Figure 5. Quadratic Regression Model of Interdependence between Weekly Average Weighted Weekly Crude Oil Price and Weekly World COVID-19 Mortality Rate

Table 1. Basic parameters of the equation

Parameter	Sum of squares	dF	Mean square	F	ε
Regression	1,291.916	2	645.958	80.433	0
Residual	96.372	12	8.031		
Total	1,388.288	14			

Table 2. Coefficients of the equation

Parameter	B	S	β_i	t	ε
Variable*	−7.211	1.623	−1.548	−4.485	0.001
Variable^2	0.251	0.143	0.607	1.760	0.104
Constant β_0	58.876	3.931		14.978	0
Variable = Global weekly coronavirus infections					

COVID-19 coronavirus pandemic world mortality rate is extremely close.

Now, as was mentioned above, according to the theory of commodity pricing (Tvalchrelidze, 2011; Tvalchrelidze & Silagadze, 2013), oil prices are usually governed by the U.S. Dollar exchange rate: within the framework of weak Dollar oil prices, they are high and vice versa. Figure 7 demonstrates the interrelation between average weighted oil prices and the Euro-to-U.S. Dollar exchange rate (Exchange Rates UK, 2020) during the COVID-19 coronavirus global pandemic. It may be seen that from January 21 to April 20, no correlation between these two indices was observed (correlation coefficient $r = -0.0148$), while after April 20, there was a strong positive correlation ($r = 0.8099$).

The observed statistical regularities brought us to the following explanations:

1. The dramatic failure of crude oil prices from January 21 – April 20, 2020 was not determined by the diminished world demand for crude oil. The data from late April – May shows that the demand had not increased because coronavirus restrictions were still in place; nevertheless, prices began to increase due to diminishing mortality rates and the announcement of the gradual lifting of restrictions.

2. Today, oil prices are driven by the coronavirus mortality rate rather than by the absolute number of infections. In other words, the decisive factor for oil prices in the medium-term are pandemic development *tendencies* instead of the actual
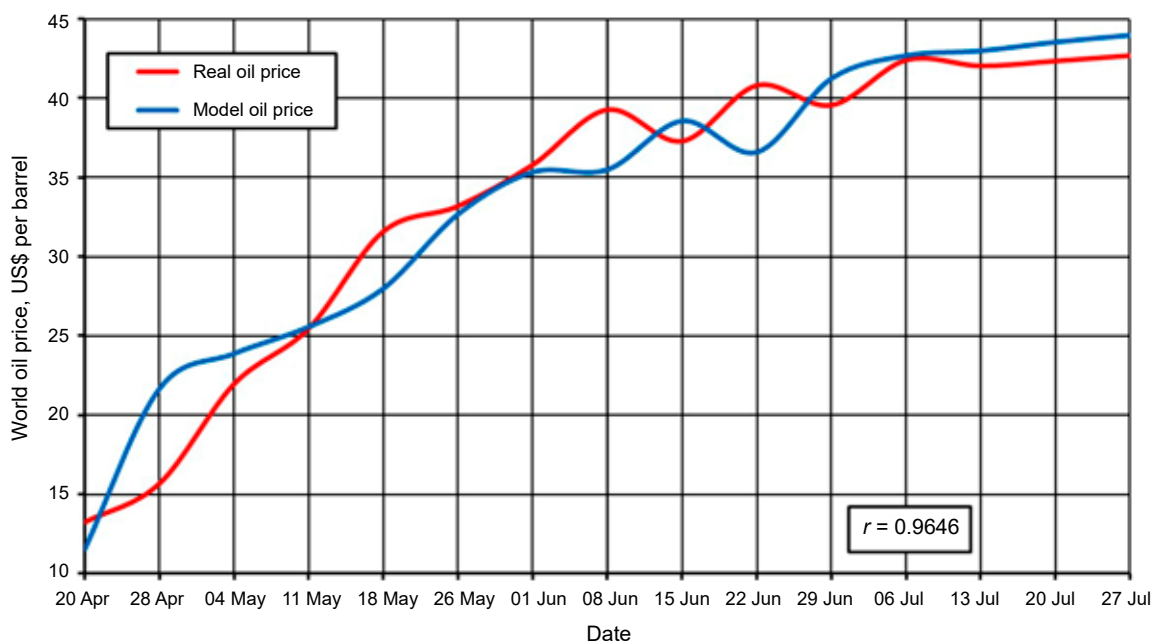

Figure 6. Comparison of Real and Model World Oil Prices from April 20 – July 27, 2020
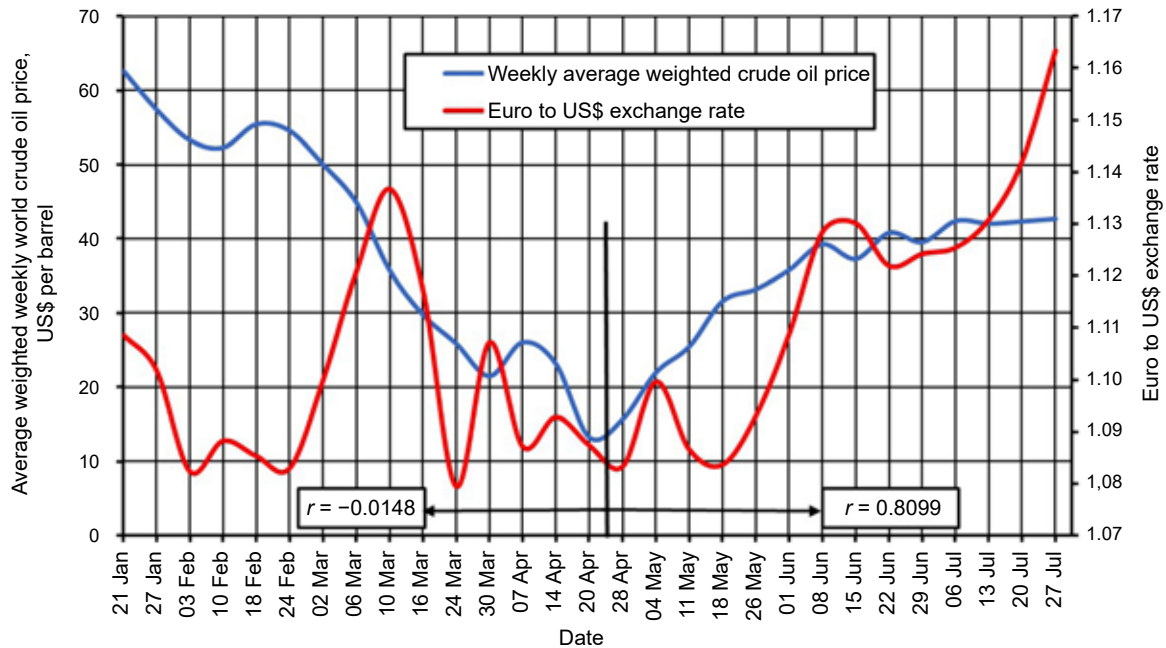
Figure 7. Interdependence between the Average Weighted Weekly World Crude Oil Price and the Euro-to-U.S. Dollar Exchange Rate

epidemiological situation. This statement is proven by the statistical regression model of the interdependence between oil prices and the COVID-19 coronavirus world mortality rate.

3. Coronavirus mortality rate analysis provides investors with tangible guidelines to assess the sustainability of futures markets in the medium-term and, therefore, to elaborate investment strategies.

4. After April 20, the oil markets gradually achieved equilibrium, which is proven by the restored correlation between oil prices and Euro-to-U.S. Dollar exchange rate. Today, the oil futures market is governed by its usual regularities.

Conclusions

At the beginning of the COVID-19 coronavirus global pandemic, the oil market crashed. Oil prices dramatically fell, and on April 20, negative prices on the West Texas Intermediate were fixed. Correspondingly, maritime tanker oil shipment faced difficult days, and prospects released at the end of winter and the beginning of spring were poor.

In this period, the oil market depended on COVID-19 coronavirus world infection cases: more infected cases decreased the fixed oil prices, and the negative correlation between these two indices was very strong. At the same time, the dramatic decrease in crude oil prices from January 21 – April 20 was determined by a negative investors'

forecast of the world oil market rather than by the diminished world demand on petroleum. This may be proven by the data from late April – May, when the demand had not increased because coronavirus sanctions were not lifted, but prices began to grow anyway.

Different factors determine the increase in both crude oil price and the number of oil futures contracts after April 20. Firstly, in this period, in contrast to the winter – early spring stage, oil prices were driven by the coronavirus mortality rate rather than by the absolute number of infections. In other words, the decisive driver for oil prices in medium-term became pandemic development tendencies instead of the actual epidemiological situation. This statement is proven by the regression statistical model, which showed an interdependence between oil prices and COVID-19 coronavirus global mortality rate. Secondly, a gradual stable decrease in the coronavirus world mortality rate created an environment for the liberalization of the pandemic sanctions and gradual renewal of the world economy. Thirdly, the coronavirus mortality rate analysis provides investors with tangible guidelines to assess the sustainability of futures markets in the medium-term and, therefore, to elaborate investment strategies. Fourthly, after April 20, the oil market gradually achieved equilibrium, which is proven by the restored correlation between oil prices and Euro-to-U.S. Dollar exchange rate. In addition to a diminishing coronavirus world mortality rate, the Federal Reserve decided

to weaken the U.S. Dollar to increase oil prices and stabilize the oil market.

Three-month trends, despite the negative expert assessments cited above, provide tangible guidelines for an optimistic forecast of the oil market and the maritime tanker business for the end of 2020 and all of 2021.

So long as a new wave of the COVID-19 coronavirus pandemic does not dramatically increase the mortality rate (and the actual epidemiologic situation gives no prerequisite for such an assumption), the oil and maritime tanker trade market will regain the equilibrium lost at the end of January.

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